MANUAL

FOR

VICTORIAN

NAVAL FORCES.

1887.

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2006

MANUAL

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NAVAL FORCES.

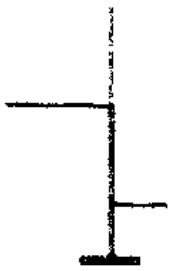
Melbourne:
BY AUTHORITY: ROBT. S. BRAIN, GOVERNMENT PRINTER.

1887.

B. 506.

James Hewit
Oven St Maryville

SEMAPHORE SIGNS.



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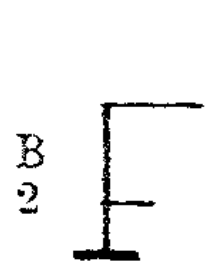

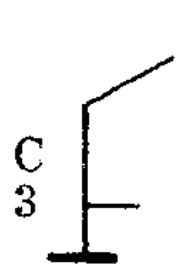

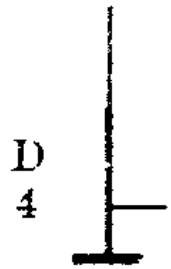

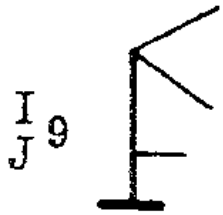

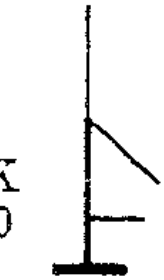

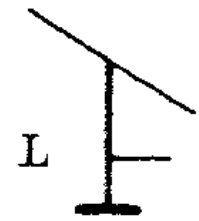

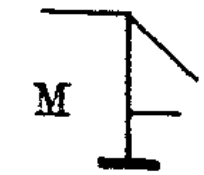

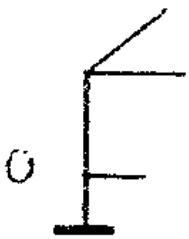

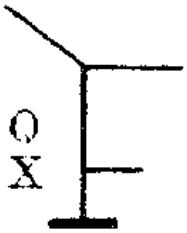

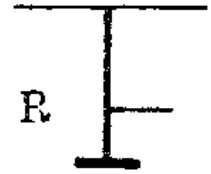

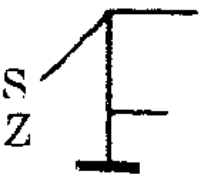

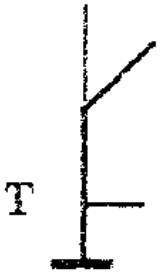

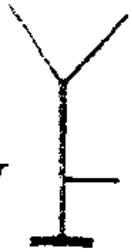

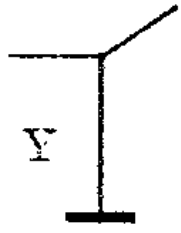

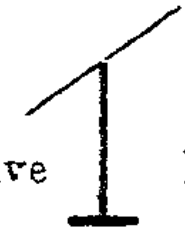

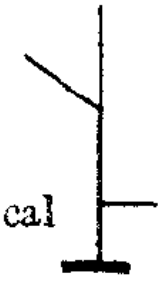

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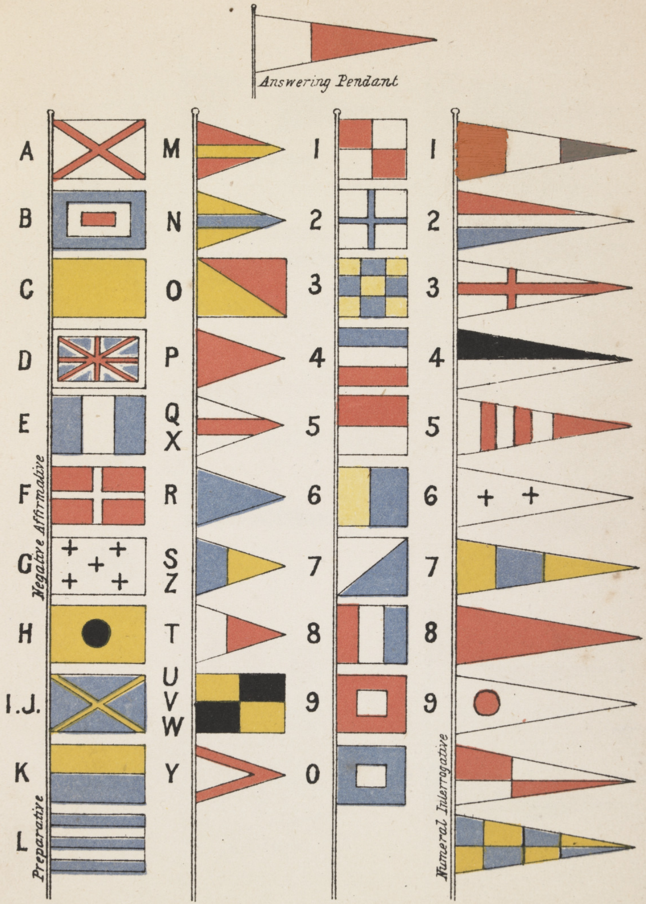
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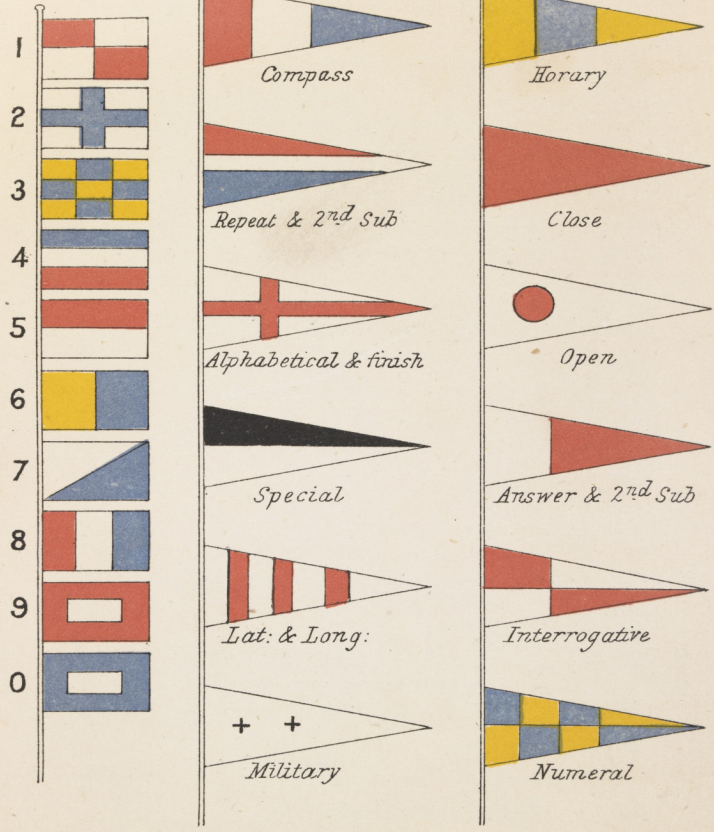
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CONTENTS.

PART III.

MAGAZINES, PROJECTILES, AMMUNITION, ETC.

PART IV.

NAVIGATION.

INTRODUCTION.

QUARTERS.

In arranging quarters, it is necessary to consider the supply of powder, so as, if possible to have guns at the same quarters supplied from the same magazines.

In turret ships, each turret forms a quarter by itself.

When a separate crew is to be stationed to each gun, the guns will be numbered odd on the Starboard side and even on the Port side, commencing from forward in each battery or on each deck. When they are to be worked with half-crews, they will be numbered from forward aft on each side of the deck, the odd numbered guns on the Starboard side and the even numbered guns on the Port side being known as the left guns, and the others as the right guns. Guns mounted independently, as, for instance, bow and stern guns, will be given names depending on their position.

Guns in turrets will be known as the right or left gun of each turret.

ACTION.

On the call for action, every one repairs at once to his allotted station.

The gunner in charge of magazines will obtain the keys of them, and see that the lights are lighted, everything in working order, and the powder passed up.

Charge and Projectile.

In armoured ships, guns, as a rule, are to be loaded with charge and Palliser shell, and in unarmoured ships with full charge and common shell.

Small-arm and Machine-gun Ammunition.

The supplies of small-arm and machine-gun ammunition will be by men specially stationed. Ammunition should be served out at once to small-arm men; and, after the arms are provided, to the rest of the quarters.

Machine-gun ammunition should be passed up at once, and hoppers and drums to be filled by the men stationed.

Riggers.

Riggers provide tackles, and collision-mats and gear; after which they would fall in at some station allotted them.

Helm.

Helmsmen, signalmen, &c., provide their arms, and repair to their stations.

Fire Brigade.

Fire brigade connect hoses to and rig all pumps required. The carpenter is responsible that the pump suctions are turned on to the sea-cocks; the engineer officer that the Kingston valves are open, that all sluice valves and water-tight doors not ordered to be left open are closed, and that the steam fire-engine is ready for use and hoses connected. The stokers of fire brigade should connect hoses and branch pipes at the fire-main deliveries in each compartment.

Miscellaneous.

Arrangements should be made for fitting time fuzes. Men stationed to strike down wounded, and provide whips, &c. The officers of quarters report when their guns are loaded and run out.

PROVIDE ARMS.

The order will then be given by bugle call to provide arms and stores. Every man having a rifle should provide it, placing it in some ready rack. Waist-belts, pouches, and pistols to be worn.

Tubs of water, for damping sponges, should be brought to the guns.

REMARKS FOR INSTRUCTORS.

The Instructor of the Drill should bear in mind that in every change of Nos. each man has different duties from those he has previously engaged in; and, in order that they may be well executed, it is essential that each man should comprehend the object and motive of the various duties which he is called upon to perform.

When a mistake is made by any No. at the gun, the Instructor is immediately to give the word "Still," in order that every man may have his attention drawn to the error committed. The gun's crew remains perfectly steady whilst the Instructor points out the error, and corrects it. He then gives the order "Carry on," when the work is resumed from the point at which the order "Still" was given.

Great patience, and the utmost precision, are necessary on the part of the Instructor. On no account whatever is he to allow the gun's crew to pretend to load, or pretend to lay the gun.

The directions given by the Instructor to the men under instruction must be clear, firm, and concise.

The men should fully comprehend one part of the drill before they proceed to another. They should not be kept too long at one part of the exercise.

Rifling spirally increasing from 1/100 Calibres at breech to 1/40 at muzzle —

PART I.

10-INCH M.L.R. GUN.

TURRET GUN.

DESCRIPTION OF GUN.

Calibre, 10 inches.
Weight of gun, 18 tons.
Preponderance, 8 cwt.
Length, extreme, 15 feet.
Length of bore, 12ft. 1in.
Length of rifling, 118 inches.

Number of grooves, 7.
Width, 1·5 inch.
~~Number of calibres in which one turn is completed, from 100 to 40.~~

PRELIMINARY DRILL.

The turret's crews will consist of 34 men, viz., 15 men and 1 powderman to each gun, and a captain and 2nd captain of turret.

The crews fall in two deep, a gun's crew on each side of the deck, the Nos. as far as 8 in the front rank, the others in the rear; the powderman on the left of the gun's crew, captain and 2nd captain in front, facing inboard.

CLOSE UP.

Captain of turret on centre platform; 2nd captain in charge outside.

Inside turret.—1, in rear, in charge of gun; 2, in rear, in line with the breech; 3, close to the port; 4, in rear of 3; 5, in rear of 4, and so on to 7.

Outside.—8 to 13, on running out and in winch handles; 14 and 15, training winch.

NUMBER. The gun's crew will call their numbers in succession.

FALL OUT. The turret's crews place themselves as before detailed.

CAST LOOSE. Captain of turret, ships centre sight and sets firing gear; 1 takes off rear coupling-chains, bring-to firing gear, ships side sights, and sees gun uncoupled by clutch-lever; 2, takes off rear securing-chains, and assists to bring-to firing gear and attend rear pawls; 3 and 4, out tompion, unbar and open the port, take off front coupling-chains; 5 and 6, take off front securing-chains; 7, off turret securing-chains; 7 of right gun, the after one; 5, 6, and 7, then trice up projectile; 3 and 4, step on the loading platform, 3 outside; 4, takes the worm; 3 and 4, search the gun; 1, examines the vent; 2nd captain of turret and remaining Nos. uncover turret and clear away outside; 8, unship cowls; 9, 10, 11, and 12, lower skylights and place armour covers (9 and 10, the foremost ones); 13 and 14, let down stanchions; 15, takes off port covers.

Shell-room party.—Receive skylights and secure armour covers.

NOTE.—2nd captain of turret superintends and reports when clear outside. Captain of turret trains for loading if required.

1 serves the vent; 2 attends the elevating gear and attaches the tubes; 5 receives the cartridge case from the powderman through the entry port and passes it to 3 and 4, who enter the cartridge; 5, 6, and 7 haul the projectile in front of the muzzle; 3 steps down off loading platform

LOAD. and guides it clear; 3 and 4 enter and unsling it; 5 pass slings to 6 and 7, who overhaul the tackle and hook on another projectile inside the turret; 9, 11, and 13 trice up projectile outside; if a wad is used, 7 passes it to 3, who enters it; 4 takes the rammer, assisted by 3 force all home together; 3 and 4 spring the rammer; 4 returns it, and steps off loading platform; 1 then pricks the cartridge; if time fuze is used, 2 will fit it. When the projectile is triced up, 7 will attach a gas-check.

RUN OUT. 3 attends the compressor; 4, 5, and 6 trice up the lifting-lever; 4 attends it; when the gun is out, 4 eases down the lifting-lever; 3 sets taut the compressor, and the Nos. close up; 1, of last gun out, couples with clutch-lever for drill purposes only. If necessary to give the order "Winches," "Run out," the same Nos. occupy the same position as in running in.

DEFLECTION. —— YARDS. The captain of turret adjusts his sight.

BEARING. OBJECT. When the object is named, the captain of turret trains the turret and aligns his sight; 2nd captain attends turret pointer; 2, under the direction of 1, attends the elevating gear, and keeps the gun laid for elevation, as shown on standard. When the sights are aligned, captain of turret orders "Well." No. 2 set taut elevating clamp.

READY. 2 steps up on the side of the carriage. places the tube in the vent, and steps clear; 1 attaches the tube-lanyard to the firing gear, sees all clear, and reports "Ready"; captain of turret repeats it, and removes the safety-pins.

FIRE.	At the order "Fire," captain of turret fires by pulling the lever handle, then trains the turret for loading.
MISS FIRE.	2 clears the vent if necessary, hooks another tube to the lanyard; the firing gear is re-set; 1 reports "Ready."
RUN IN.	Captain of turret re-sets the firing bar; 3 attends the compressor, easing it off as soon as the running-in chains are taut from the winches; 2 and 7 trice up nipping-lever; 7 attends it; 4, 5, and 6 trice up lifting-lever; 4 attends it; 8 to 13 man running-in winches; when the gun is in, 1 orders "Well"; 4 eases down the lifting-lever; 3 sets taut the compressor, and reports "Compressor taut"; 7 then eases down nipping-lever; 8, 10, and 12, unships winch handles; 1, 2, and 7 bring-to firing gear, and the Nos. close up.
SPONGE.	1 serves the vent; 3 and 4 step on the loading platform; 3 takes the sponge, assisted by 4 forces it hard home to the bottom of the bore, keeping it there while a round turn is given; they then withdraw it; 3 returns it, and the Nos. close up.
OUT TUBE.	Captain of turret puts in the safety-pin; 1 unhooks the tube-lanyard from the firing gear; 2 takes the tube out of the vent, and the Nos. close up.
	Before elevating or performing any operation during which the firing of the gun would injure the crew or fittings, captain of turret orders "Out tube," and proceed as above.
CEASE FIRING (*from the "Ready"*).	Captain of turret puts in safety-pins and orders out tube. The sights are put down, the deflection-scale set at zero, and the Nos. close up.

UNLOAD. The gun is to be placed in the loading position and emptied, 6 serving the worm and extractor as required, the elevating and loading Nos. assisting. When the gun is empty the Nos. close up.

SECURE. The turret and guns are placed in the securing position; the securing-chains, &c., are secured, and everything replaced by the Nos. who cleared them away. When finished, 1 orders "Fall out."

SHIFTING STEPS. If the gun is out, 1 orders "Run in," and, when placed, "Well"; names the step; and orders "Raise" or "Lower" the gun, and attends the valve; 2 attends the elevating gear, inside jamming-clamp, and rear key; 3 outside jamming-clamp and keys; 4 inside front key; 5 and 6 ship pump-levers and man them, 5 in front. In raising, 3 and 4 assist 5 and 6 on pump-levers; 2 will report to 1, when keys are in or out, "Raise" or "Lower"; the outside keys are not to be placed till after the inside keys are reported in by 2; 1 will ascertain when the saddle is in line with slot of carriage, and give the order "Well"; 3 place outside keys; 1 will then ease the gun down on the keys, and order "Return stores"; 2 and 3 set taut jamming-clamp, and the previous orders will be carried out.

All orders given by the No. 1, and reports from the gun's crew, are to be in all cases preceded by the words "Right" or "Left" Gun.

At the order "Change rounds," 1 takes the highest No., the remainder the next lowest No.; if with captain of turret, he will take the highest No.

DIMINISHED CREW.

When casualties occur at the gun, No. 1 is to inform the officer of the turret, who will detail Nos. to fill the vacancies. In case of the captain of the turret being removed, the officer of the turret will select a No. to fill the vacancy.

PRACTICE.

CLEARING FOR ACTION.

ACTION. The guns are cast loose, and everything on deck removed clear of the fire; the bugle will then sound the "Advance;" the guns will be loaded with full charge and chilled projectile, and run out. Nos. close up, and wait further orders. Should it be desired to load with any other projectile to that above-named, the "Still" must be sounded, and orders given.

EXERCISE ACTION. As above, without powder being provided, the gun being always loaded with dummy charge and projectile.

SIMULTANEOUS FIRING.

In this firing, the guns in each turret are fired simultaneously, the turrets working independently.

If desired, the guns of a turret may be fired independently. In this case, the cartridge of the gun that is being loaded is not to be exposed while the other gun is at the "Ready."

SIMULTANEOUS FIRING. A caution.

DISTANCE.
BEARING.
OBJECT.
ELEVATE.

The captain of the turret adjusts his sight and trains, the gun is laid for the object as in Preliminary Drill, No. 1 giving the necessary orders.

Electric Firing

Ready } 2 places Elec-
tric tube in
the vent 1 con
nect Slot & Bolt
& reports Right or
left Gun Ready.

Cease Firing } 1 disconnect
Slot & Bolt
2 Takes out
tube

× Electric Firing

COMMENCE.	The captain of the turret fires at his own discretion, and trains for loading; No. 1, if necessary, orders "Run in;" when the gun is in it is laid for loading, sponged, and loaded without orders; 1 then orders "Run out," and proceeds with the firing.
CEASE FIRING.	As detailed in Preliminary Drill. If the gun is in, it is to be loaded and run out.

A directing dial, worked from the conning tower and marked in degrees, before or abaft either beam, is placed so as always to be seen by the captain of turret, who will at once train on bearing indicated; 2nd captain sees bearing correctly on by turret pointer.

When the order for any firing is given, preceded by the words "Prepare for," the guns are to be laid, but not brought to the "Ready," the order "Ready" being given in this case by the officer in charge for the first round.

DIRECTOR FIRING.

In this firing the turrets are fired either together or separately from the conning tower by means of electricity, having been previously laid by the director.

DIRECTOR FIRING.	The captain of the turret adjusts the sight for 800 yards.
——(*name the bearing*). HORIZONTAL. or (—— DEGREES ELEVATION) or (DEPRESSION.)	The turret is trained under the direction of the 2nd captain of turret. On receiving the elevation from the director, the gun is laid and brought to the "Ready," as in ~~Preliminary Drill.~~ X When the guns are fired, the captain of the turret trains for loading, 1 disconnects the slot and bolt; the gun is run in, loaded, and run out as in Simultaneous Firing, and is then laid as before.
CEASE FIRING.	As in Simultaneous Firing. The slot and bolt are always to be disconnected before the tube is taken out.

10-INCH R.B.L. GUN.

Description of Gun.

Calibre, 10 inches.
Weight, 25 tons.
Preponderance, *nil.*
Length of bore, 25 feet.
Length of rifling, 20 ft. 5·5 in.
Length, total, 26 ft. 8 in.
Length over all, 27 ft. 10 in.
Number of grooves, 42.

Rifling spirally increasing from 1 turn in 100 calibres at breech to 1 turn in 40 at 14·5 inches from the muzzle; remainder, uniform, 1 in 40.

Permanent angle of deflection, 1° 10′ to the left, to compensate for twist of rifling.

The gun is mounted on an automatic carriage and slide, with recoil press.

The elevating gear is on the friction-cone principle, and attached to the right bracket of carriage.

The carriage is double-plated wrought-iron, with recoil-press cylinders attached.

The slide is extra single-plated, with front and rear buffers attached.

The piston rods are connected to front and rear transom of slide, which is permanently fixed to the deck.

PRELIMINARY DRILL.

The gun's crew will consist of 10 men, and 2 P.M., and will fall in as follows:—

P.M. 9. 7. 5. 3. 1. 2. 4. 6. 8. 10.

Close Up. { 1 in rear of the gun, facing the port; 2 on the right, in line with the sights; 3 on the left, in line with the fore part of carriage; 4 on the right, in line with the fore part of carriage; 5 in rear of 3; 6 in rear of 4; and so on as far as 10. Powderman at magazine hatch.

Note Nos 1. 2. Prepare
Electric Circuit Gear
No 1. Prepare Branch
wires
2. Provide Needle
Holder

NUMBER. The gun's crew call their Nos. in succession.

FALL OUT. As before detailed.

CAST LOOSE. 1 and 2 ship sights, and prepare firing gear; 1 then superintends; 2 provides pouch and primers; 3, 4, 5, and 6 unbar and open the port, and clear away front securing-chains and band; 3 out tompion; 4 sees valve adjusted for firing position, and, when all is clear, 3 and 4 remove front shores; 5 and 6 out bolts and screw in plugs; 5 takes down sponge and rammer; 6 ships handle of elevating gear; 7, 8, 9, and 10 clear away rear securing-chains and band; 7 and 8 out bolts and screw in plugs; 9 and 10 clear away shell whip, and sling projectile. All the unemployed Nos. trice up projectile. Powderman rigs and places magazine screen.

NOTE.—Should the gun remain stationary after the shores are removed, 1 will order "Tackles run out;" 5, 6, 9, and 10 hook on side tackles; 5 and 6 bring-to; 7 and 8 ship winch handles; all Nos. man the winches, and run the gun out, then all Nos. on their respective sides return side tackles; 7 and 8 return winch handles.

LOAD. 1 inside the tower; 2, 3, and 4 open the breech, using the lever if necessary; 2 sees the bore clear, takes out needle holder, and places primer; 3 places loading-tray, and, assisted by 2, lays the gun for loading; 7, 8, 9, and 10 haul projectile in line with the breech; 3 and 4 enter and unsling it; 5 serves the rammer to 3; 3, 4, 7, and 8 ram home; 3 and 4 receive the cartridge from the P.M., and enter it; 4 tears off shalloon; 3 and 4 ram home, and withdraw the rammer; 5 returns it; 3 returns loading-tray, and 3 attends platform catch; 2, 3,

and 4 close the breech; 2 replaces needle-holder; 9 and 10 prepare shell, whip and sling projectile; 7, 8, 9, and 10 trice up projectile. The powderman provides another cartridge.

NOTE.—If using fuzes, 2 provides and fits them. If using time fuses, 3 provides thimble and pellet, and screws them in just before the shell is entered. In closing the breech, care must be taken to see the breech-block close home before locking, as the threads of the screw are liable to be cut and damaged.

DEFLECTION. DISTANCE, or ELEVATION. — 3 and 4 adjust the sights.

OBJECT. — 1, inside the tower, gets the direction on.

ELEVATE. — 6, assisted by 2, attends elevating gear and lays the gun under the direction of 1; at the order "Well" from 1, 6 and 2 step clear.

NOTE.—Orders for elevating are "Raise," "Lower," "Quick," or "Slow," and, when laid, "Well."

READY. — 2 connects the firing gear, and all Nos. get under cover.

FIRE. — 1 fires, and, if necessary, orders "Run out;" 2 disconnects the firing gear; and, when the gun is out, the gun's crew close up.

MISS-FIRE. — 1 waits a considerable pause, and then orders "Half-cock;" 2 disconnects the firing gear, takes out needle-holder, and re-primes the gun; 1 then orders "Ready."

SPONGE. — 2, 3, and 4 open the breech; 3 places loading-tray; 5 serves the sponge to 3; 3 and 4 carefully sponge the gun; 6 wipes the cup.

Classified by 2
by the Sub for
Loading

CEASE FIRING. { 1 orders "Half-cock"; 2 disconnects firing gear; 3 and 4 down sights; Nos. close up.

NOTE.—Should the order "Ports closed" be given, 1 orders "Run in;" 4 adjusts the valve; 5, 6, 9, and 10 hook on side tackles; 5 and 6 bring-to; 7 and 8 ship winch handles; all Nos. run the gun in; when the gun is in, 1 orders "Well;" 3 and 4 in front shores; 3, 4, 5, and 6 close the port; 7, 8, 9, and 10 return tackles and winch handles, and the Nos. close up.

UNLOAD. { 2 removes the needle-holder; 1, 2, and 3 open the breech; 3 places the loading-tray and removes the cartridge; powderman returns it; 4 and 5 outside, and receive the long rammer from 6, and force back the projectile; 2 and 3 sling it; 7, 8, 9, and 10 return it; 3 returns loading-tray, and attends platform-catch; 1, 2, and 3 close the breech; 2 replaces needle-holder; 6 returns long rammer; and the Nos. close up.

NOTE.—If the gun is loaded with a fuzed shell, it is to be fired away.

SECURE. { 1 sees the gun placed in the securing position, and everything is secured and replaced by the Nos. that cleared it away, and, when everything is finished, 1 orders "Fall out," then "Stand at ease."

DIMINISHED CREW.

Number of men ...	8, 9, or 10	6 or 7	5
Loading-tray ...	3	3	3
Sponge and rammer	5	5	5
Long rammer ...	6	6	2
Wipe the cup ...	6	6	2
Work projectile ...	7, 8, 9, and 10	3, 4, 6, and 7	2, 3, 4, and 5
Ram home ...	3, 4, 7, and 8	3, 4, 6, and 7	2, 3, 4, and 5
Winches ...	All Nos.		

PRACTICE.

INTRODUCTORY REMARKS.

The following drill is for the bow gun of the *Victoria*, and comprises the different modes of firing, together with other matters connected with the general working of the gun.

It should be impressed upon the men that laying the gun cannot be too carefully performed, and requires extreme care and attention on the part of No. 1, as well as the intelligent co-operation of the gun's crew in carrying out his orders. Loading, on the contrary, cannot be executed with too much rapidity, provided the safety of the crew or gun be not compromised. In clearing for action, the gun will be loaded with full charge and chilled shell, unless ordered to the contrary.

CLEARING FOR ACTION.

ACTION.	The gun will be cast loose, run out, and loaded with full charge and chilled shell, and the gun's crew will close up, unless ordered to the contrary.
FOR EXERCISE ACTION.	The same as for action, but no powder or fuzes are provided.

INDEPENDENT FIRING.

In this firing, 1 must seize the most favourable opportunity for delivering his fire. To be effective, it is requisite he should experience no difficulty in laying the gun by sight as soon as it is out.

INDEPENDENT FIRING.	A caution to indicate the description of firing about to be practised.
DEFLECTION, YARDS, or ELEVATION (*If necessary, name the direction*). OBJECT.	1 gets the direction on, then orders "Elevate;" lays the gun, then orders "Ready."

Electric Firing

Ready } 2 Connects branch wires to clip, then connect Slot & Bolt 1 pulls cock pistol or firing key

Note 1 is not to pull cock till Slot & Bolt are connected.

Fire } 1 Fires hooks up brands wires 2 disconnect Slot & Bolt & then wires from clip.

Note A spare needle holder will always be kept ready fitted (wire & glue) to replace Primer fired. No 2 Probably & putting it

COMMENCE.	1 fires at his own discretion; and when the gun is out it is laid for loading, sponged, and loaded without orders; 1 then proceeds with the firing.
CEASE FIRING.	As in Preliminary Drill.

NOTE.—If electric gear is to be used, it will be named before the caution for independent firing, thus "Electric Independent Firing."

The gun's crew will be taught the stowage of spare parts and stores, and how to fit them; also the removal of the wounded.

Cease Firing	1 half cocks pistol & gives the order Half Cock 2 disconnect Lead & Bolt & then [illegible] from clips

1. 2. Replace [illegible]

D

8-INCH R.B.L. GUN.

Description of Gun.

Calibre, 8 inches.
Weight, 12 tons.
Preponderance, *nil.*
Length of bore, 17 ft. 4 in.
Length of Rifling, 13 ft. 10 in.
Total, 18 ft. 6 in.
Over all, 19 ft. 3 in.
Number of grooves, 33.

Rifling spirally increasing from 1 in 100 calibres at the breech to 1 in 40 at 10·8 inches from the muzzle; remainder uniform twist, 1 in 40.

Permanent angle of deflection, 1° 30′ to the left, to compensate for twist of rifling.

The gun is mounted on a naval carriage and slide. The elevating gear is on the friction-cone principle, and attached to the left bracket of the carriage.

The carriage is double-plated wrought iron, and on permanent rollers, with Elswick compressor.

The slide is of the Service pattern, and is capable of traversing 25° on each bow.

PRELIMINARY DRILL.

In preliminary drill, the principal duties to be performed by each of the gun's crew, in B.L. gun exercise, are fully detailed. Too much attention cannot be paid to the thorough instruction of the men in these duties, upon which the accuracy and rapidity of the fire mainly depends.

Nos 1. 2. Prepare Electric firing gear

1 Prepare branch wires

2 Provide needle holder

The following drill is for 8-inch B.L. guns. The gun's crew will consist of 8 men and 2 P.M., and will fall in as follows:—

7. 5. 3. 1. 2. 4. 6. 8. P.M.

Close Up. 1 in rear, facing the port; 2 on the right, in line with the sights; 3 on the left in line with fore part of carriage; 4 on the right, in line with fore part of carriage; 5 in the rear of 3; 6 in the rear of 4; and so on.

Number. The gun's crew call their Nos. in succession.

Change Rounds. At the order "Change rounds," 3 becomes 4, and the remainder move round one place to the left.

Fall Out. The gun's crew place themselves in rear of the gun, as before detailed.

Cast Loose. 1 and 2 ship sights and prepare firing gear; 2 provides pouch and primers; 3, 4, 5, and 6 unbar, open the port, and clear away front securing-chains and band; 3 out tompion; 3 and 4 remove front shore; 2, 7, and 8 clear away rear securing-chains and band; 7 and 8 ship winch handles for training; 7 clears away shell whip; 8 takes down sponge and rammer; 7 and 8 trice up a projectile. When the gun is cast loose the Nos. close up.

Run Out. 6 attends compressor and eases the gun out; should the gun remain stationary on the compressor being eased up, 1 orders "Tackles run out"; 3, 4, 5, and 6 hook on side tackles; 2 and 5 bring-to, and attend falls; 7 and 8 shift winch handles; 3, 4, 7, and 8 run out. When the gun is out the same Nos. return tackles, and the gun's crew close up.

Note.—When the gun is out, No. 1 directs the proper adjustment of the compressor.

LOAD. 1 and 2 open the breech, using the lever if necessary; 1 sees the bore clear, and superintends loading; 2 takes out needle-holder, and places primer; 3 places loading-tray; 5 lays the gun for loading; Nos. on the left of gun haul projectile in line with the breech; 7 attends the fall; 3 and 4 enter and unsling it; 8 serves the rammer to 4; 3, 4, 7, and 8 ram home; 3 and 4 take the cartridge case from powderman, and hold it in line with the bore; 8 reverses the rammer, and presses home the cartridge, 4 tearing off the shalloon, withdraws the rammer; 8 returns it; 3 returns loading-tray; 1 and 2 close the breech; 2 replaces needle-holder; 7 and 8 trice up another projectile; and gun's crew close up.

NOTE.—When using time fuzes, 3 will screw in the thimble and pellet just before the shell is entered.

In closing the breech, care must be taken to see the breech-block close home before locking, as the threads of the screw are liable to be cut and damaged.

DEFLECTION, DISTANCE, or ELEVATION. OBJECT. 1 and 2 adjust the sights; 3, 4, 7, and 8 man the winches, and train under the direction of 1, who places himself at the extent of his lanyard.

NOTE.—This method of laying the gun for direction is used when the object is visible through the port, and no doubt can exist as to its position. The orders for training are "Right" (or "Left"), "Quick," or "Slow," according to the direction in which the muzzle of the gun is to be trained. When the direction is on, 1 orders "Stop."

When deflection is required, both tangent sights are adjusted, 2 attending the right one, and it is named before the distance, and its use continued, although the distance may alter until otherwise ordered.

1 is responsible that both sights are adjusted according to the charge and projectile the gun is loaded with.

If no distance should be named, 1 estimates the distance of the object, and adjusts the sight accordingly.

ELEVATE. — 5 attends elevating gear, and lays the gun under the direction of 1, who gives the order "Raise" (or "Lower"); when laid, 1 orders "Well"; 5 sets taut the break.

READY. — 2 connects the firing gear.

NOTE.—The gun may be elevated and trained at the same time.

FIRE. — 1 fires by pulling the lanyard smartly with a jerk; 2 disconnects the firing gear; 1 orders "Run out"; 6 attends compressor; and, when the gun is out, 5 lays the gun for loading, and the crew close up.

MISS-FIRE. — 1 waits a considerable pause, and then orders "Half-cock;" 2 disconnects firing gear, takes out the needle-holder, replaces a primer; 1 then orders "Ready."

SPONGE. — 1 and 2 open the breech, using the lever if necessary; 3 places the loading tray; 6 wipes the cup; 8 serves the sponge; 3 and 4 carefully sponge the gun; 8 then provides the rammer. The sponge should be well damped when firing.

LOAD. — As before detailed.

CEASE FIRING. — If at the "Ready," 1 orders "Half-cock"; 2 disconnects firing gear; 1 and 2 down sights; gun's crew close up.

NOTE.—If while loading, or after the gun is fired, the order "Cease Firing" should be given the loading will be completed, and the gun's crew close up. Should it be necessary for the gun's crew to leave their gun, for "boarders," to man a pump, &c., the gun will be left in the "Cease firing" position.

CLOSE THE PORT. — Should the order "Close the port" be given, 1 orders "Run in" (as for "Run out"); when the gun is in, 3 and 4 close the port; and gun's crew close up.

NOTE.—The port may be closed to protect the crew from machine-gun fire, or to keep the sea out.

UNLOAD. 2 removes the needle-holder; 1 and 2 open the breech; 3 places the loading-tray, and withdraws the cartridge, and powderman returns it; 4 and 6 outside, and receive long rammer from 8, and force back projectile; 2 and 3 sling projectile; 7 and 8 return it; 5 attends elevating gear; 3 returns loading-tray; 8 returns long rammer; 1 and 2 close the breech; 2 replaces needle-holder; gun's crew close up.

NOTE.—If the gun is loaded with filled shell and fuzed, it should be fired if the range is clear.

The order "Unload" may be given, to alter the charge and projectile or for securing.

SECURE. 1 sees the gun trained to the securing position; 1 then orders "Run in;" when the gun is in, 1 orders "Well;" 1 and 2 return the sights and firing gear, 2 the pouch and primers; 3 in tompion; 3, 4, 5, and 6 put on front securing-chains and band; 3 and 4 close and bar in the port, and place front shore; 2, 7, and 8 on rear securing-chains and band; 7 and 8 return projectile and winch handles; 7 make up shell whip; 8 returns sponge and rammer. When everything is finished, 1 orders "Fall out."

PRACTICE.

This part comprises the different modes of firing, together with other matters connected with working the guns.

No definite rules can be laid down with respect to the application of the various modes of firing. This must be left to the discretion of the Commanding Officer.

When one gun's crew is worked by itself, the drill should be carried out as if it formed part of a division of guns.

It should be impressed upon the men that laying the gun cannot be too carefully performed, and requires extreme care and attention on the part of No. 1, as well as the intelligent co-operation of the gun's crew in carrying out his orders.

Loading, on the contrary, cannot be executed with too much rapidity, provided neither the safety of the crew or gun be compromised. After the gun's crew have been well trained in using words of command, they should be carefully instructed in working the guns without them, and the employment of signals should be the usual practice. They should also be instructed in working the guns with diminished crews.

If it is desired to keep the ports open, the order "Ports open" is to be given, and this order is to remain in force until the order "Ports closed." In the "Cease firing" position, with the port open, the gun is to be close out. The projectiles are to be provided and triced up as soon as the gun is out, or in the "Cease firing" position.

On the gun being run out for the first time, or on any change of circumstances that may render it necessary, No. 1 should direct the proper adjustment of the compressor, so that the recoil will not throw any undue strain on the carriage. The amount of compression required will depend on the charge, motion of the ship, &c., when firing. It is important to remember that when the compressor bars and plates are wet, the recoil will be increased owing to the diminution of the friction.

Clearing for Action.

Action.	The guns are to be cast loose, run out, and loaded, and the crew close up.
For Exercise. Action.	As above, without powder being provided. The guns are to be loaded with projectile and dummy cartridge.

Note.—In unarmoured ships, the guns are to be loaded with reduced charge and common shell; in armour-clad ships or ships with armour-piercing guns, full charge and Palliser shell.

Independent Firing.

In this firing, the Nos. 1 should seize the most favourable opportunity of delivering their fire. To be effective, it is requisite that they should experience no difficulty in laying the guns by sight as soon as they are out.

This firing should be used when the object is visible from the gun-deck.

Independent Firing.	A caution, to indicate what description of firing is about to be practised.
Close Alongside; or Deflection, Distance (*name the direction if necessary*). Object.	The sights are to be adjusted, and the gun is trained for the object. 1 then orders "Elevate;" lays the gun, and gives the word "Ready."
Commence.	1 fires at his own discretion, and orders "Run out." When the gun is out, it is laid for loading, sponged, and loaded without orders. 1 then proceeds with the firing.
Cease Firing.	As detailed in Preliminary Drill. If the gun is in, it is to be run out and loaded.

Note.—When the ship has motion, the gun should be fired a little before the sights come on with the object.

Electric Firing.

In this firing, the guns are laid as in Independent Firing, but fired with electric gear. at the order "Ready," 2 connects the electric wires.

Note.—"Object" alters train at the "Ready." "Elevation" or "Distance" alters "Half-cock"—relay, and come to the "Ready."

Fire or Commence) (Fires & hooks up branch wires, 2 discon nect slot & Bole & then wires from Clip

Note One spare needle Holder will always be kept ready (wire the) to replace Premier fired No 2. Providing & fitting it.

Cease Firing) (half cock pistol or firing key) then Give order Half cock 2 dis connect slot & Bolt & then wires from clips 1; 2. Replace wires 1; Full cock pistol or firing key) 1; 2 to full cock till slot & Bolt [illegible] [illegible]

CEASE FIRING. As in Independent Firing. When the order for any firing is preceded by the words "Prepare for," the guns are to be laid, but not brought to the "Ready;" the order "Ready" being given in this case by the officers of the quarters for the first round.

CLOSING THE PORTS.

The ports may be closed in any description of firing, for the following reasons :—

I. To protect the gun's crew from machine-gun fire.
II. To prevent water coming in.
III. To shut in the lights as much as possible at night time.

CLOSE PORTS. The order for any firing may be given from the position of "Close ports"; 1 giving the order "Run out." 3 and 4 will then open the port, and when the gun is out proceed in the usual manner.

SUPPLY OF SPARE STORES, AND METHOD OF REPLACING DISABLED GUN GEAR.

No precise rules can be laid down for this exercise, as much must be left to the individual judgment and intelligence of the officers of the quarters and the Nos. 1.

Whenever anything is broken, carried away, or rendered useless, it is at once to be replaced by the Nos. whose duty it is to attend it.

1 orders one or more of the highest Nos. to fall out and provide the spare stores required, and assisted by an armourer would replace it.

SPARE GEAR.

The guns' crews are all to be acquainted with the stowage of spare stores for their guns, such as rammers, sponges, tackles, shell whips, hand-spikes, running-in ropes, and are

frequently to be exercised in replacing gear at the gun supposed to be broken or rendered useless, and working the guns with extempore and make-shift arrangements, in disconnecting the training gear and using tackles for training, or using handspikes for elevating and controlling the gun if an accident occurs to the compressor.

The gun should not be kept out of action for a longer time than can be avoided.

If the ship has much motion, the slide may be secured with chocks, and the direction of the object brought on by the helm.

EXERCISE BY SIGNALS.

After the guns' crews have been well trained in the different firings, they should be made thoroughly conversant with the following system of signals; which should be used instead of the words of command for which they stand during exercise at quarters, unless smoke, darkness, or some such absolute necessity renders the word of command necessary.

This method possesses the great advantage of enforcing silence, and compels the gun's crew to fix their attention on No. 1.

SIGNALS.

ORDERS. RIGHT (OR LEFT.)	If at the breech of the gun, 1 extends his left (or right) arm to the rear in a line with the shoulder, the palm of the hand turned in the direction towards which the slide is required to be moved. If at the extent of the lanyard, the left arm is to be extended to the front, above the right, the palm of the hand as before detailed.
RIGHT (OR LEFT), QUICK.	As for right (or left), but moved quickly in the required direction.
ELEVATE (RAISE OR LOWER.)	The arm extended to the front, the palm of the hand up or down, according as the breech is to be raised or lowered.

REST.	The upper arm extended in a line with the shoulder, and the fore arm raised perpendicularly, palm of the hand to the front.
WELL (OR STOP).	In training or elevating, drop the hand; in running in or out, 1 raises his right arm perpendicularly, palm of the hand to the front.
READY.	1 slacks the lanyard.
HALF-COCK.	1 shakes the lanyard.

The gun is run out or in without orders. When the executive order for the firing is given, the guns' crews at once get into the training position without orders.

If the port is closed, it is to be opened without orders, when the executive order for the firing is given.

When the gun is elevated and trained at the same time, words of command are to be given for elevating.

When using electric gear, words of command are used for "Ready" and "Half-cock."

DIMINISHED CREW.

When casualties occur, 1 directs the highest Nos. to fill the vacancies, except in the case of 1 or 2 being removed, when the vacancy should be filled by the lowest original No.

Example.

I. With a full gun's crew, fall out 1; 2 takes 1, and directs 3 to take 2, and the highest No. at the gun to take 3.

II. With a full gun's crew, fall out 1 and 2; 3 takes 1 and then directs 4 to take 2, the highest No. to take 3, and the next highest to take 4.

In all cases of exercise with diminished crews, whatever additional work they may have to perform, the Nos. will continue their duties as if with a full gun's crew unless otherwise specified.

The following table shows the changes in the duties of the several Nos. of the gun's crew, and the additional work to be performed by them (when working the guns with diminished crews):—

Duty. 8-inch Gun.	8 Men.	6 or 7 Men.	5 Men.	4 Men.
Compressor ...	6	6	4	4
Rammer ...	8	1	1	1
Ram Home ...	3, 4, 7, 8	1, 3, 4, 7	1, 3, 4	1, 3, 4
Projectile ...	7, 8	5, 7	3, 5	3, 4
Winches ...	3, 4, 7, 8	3, 4, 5, 6	2, 3, 4, 5	2, 3, 4
Loading-tray ...	3	3	3	3
Wipe cup ...	6	6	2	2
To elevate ...	5	5	5	3

6-INCH R.B.L. GUN.

DESCRIPTION OF GUN.

Calibre, 6 inches.
Weight, 4 tons.
Preponderance, *nil.*
Length of bore, 13 feet.
Length of rifling, 10ft. 4·45 in.
Length, total, 13 ft. 10·4 in.
Length over all, 14 ft. 7 in.
Number of grooves, 28.

Rifling, spiral, increasing from 0 at breach to 1 in 40 at 5·45 inches from the muzzle. Remainder 1 in 40 calibres.

The gun is mounted on the naval hydraulic automatic "centre-pivot carriage and slide."

PRELIMINARY DRILL.

Albert.

The gun's crew will consist of 6 men and 1 P.M., and will fall in as follows :—

P.M. 5. 3. 1. 2. 4. 6.

CLOSE UP. 1 in rear of the gun, facing the port; 2 on the right, in line with the sight; 3 on the left, inside the shield; 4 on the right, inside the shield; 5 in rear of 3; 6 in rear of 4.

NUMBER. The gun's crew call their Nos. in succession.

FALL OUT. As before detailed.

CAST LOOSE. 1 and 2 ship sights and prepare firing gear; 2 provides pouch and primers, and connects training gear, takes up rear flap; 3 out tompion, and provides loading-tray; 4 provides sponge and rammer; 5 and 6 clear away securing-chains and shell whips; 5 provides projectile.

NOTE.—After the gun is cast loose, 1 trains the gun, to allow 2 to unscrew rear bolt and put in plug.

LOAD. 1 and 2 open the breech, using the lever if necessary; 1 sees the bore clear, and superintends the loading; 6 wipes the cup; 2 takes out needle-holder, places a primer, and lays the gun for loading; 3 places loading-tray, and receives projectile from 5 and enters it; 4 takes the rammer, and, assisted by 3, rams home; 3 takes cartridge-case from P.M., holds it in line with the bore; 4 reverses the rammer and presses home the cartridge, tearing off the shalloon; 3 returns the loading-tray; 4 returns the rammer; 1 and 2 close the breech; 2 replaces needle-holder; 5 provides another projectile; gun's crew close up.

NOTE.—Care should be taken by No. 1 to see the firing-hammer close home, as, in opening the breech, it is liable to strike against the carriage.

DEFLECTION, DISTANCE, OR ELEVATION. OBJECT. 1 and 2 adjust the sights; 3 and 4 man the winches and train under the direction of 1, who retires to the extent of his lanyard.

See Notes to 8-inch Preliminary Drill.

ELEVATE. 2 attends elevating gear, and lays the gun under the direction of 1, who gives the order "Raise" (or "Lower"); when laid, 1 orders "Well."

READY. 2 connects the firing gear.

NOTE.—The gun may be trained and elevated at the same time.

FIRE. 1 fires by pulling the lanyard smartly with a jerk; 2 disconnects the firing gear when the gun is out; 2 lays the gun for loading, and the crew close up.

MISS-FIRE. 1 waits a considerable pause, and then orders "Half-cock;" 2 disconnects the firing gear, takes out the needle-holder, replaces a primer; 1 then orders "Ready."

SPONGE. 1 and 2 open the breech; 3 places the loading-tray; 4 provides, and, assisted by 3, carefully sponges the gun; 6 wipes the cup; 4 then provides the rammer.

LOAD. As before detailed.

NOTE.—The sponge should be well damped when firing.

CEASE FIRING. If at the "Ready," 1 orders "Half-cock;" 2 disconnects the firing gear; 1 and 2 down sights; gun's crew close up.

See Note to 8-inch Preliminary Drill.

UNLOAD. 2 removes the needle-holder; 1 and 2 open the breech; 3 places the loading-tray and withdraws the cartridge; powderman returns it; 4 receives long rammer from 6 and forces back projectile; 3 receives it; 5 returns it; 3 returns loading-tray; 4 the rammer; 1 and 2 close the breech; 2 replaces the needle-holder; and the gun's crew close up.

NOTE.—The gun must be trained for unloading.

SECURE. 1 sees the gun trained to the securing position; 2 screws in the bolt, and puts down rear flap; 1 and 2 return sights and firing gear; 2 the pouch and primers; 3 in tompion, and returns loading-tray; 4 returns sponge and rammer; 5 and 6, on securing-chains, return shell whips and projectiles. When all is finished, 1 orders "Fall out."

PRACTICE.

The notes to Practice for 8-inch Gun also apply to 6-inch and other guns.

ACTION. The gun is to be cast loose, loaded, and the gun's crew close up.

FOR EXERCISE. ACTION. As above, without powder being provided. The gun is to be loaded with projectile and dummy cartridge.

INDEPENDENT FIRING. A caution, to indicate the description of firing about to be practised.

CLOSE ALONGSIDE; or DEFLECTION, DISTANCE. (*name the distance, if necessary.*) OBJECT.	The sights are adjusted, the gun trained for the object; 1 then orders "Elevate," lays the gun, and gives the word "Ready."
COMMENCE.	1 fires at his own discretion; and, when the gun is out, it is laid for loading, sponged and loaded without orders; 1 then proceeds with the firing.
CEASE FIRING.	As detailed in Preliminary Drill. If the gun is fired, it is to be loaded.

NOTE.—When the ship has motion, the gun should be fired a little before the sights come on with the object.

ELECTRIC FIRING.	In this firing, the guns are laid as in Independent Firing, but fired with electric gear. At the order "Ready," 2 connects the electric wires.
CEASE FIRING.	As in Independent Firing.

NOTE.—When the order for any firing is preceded by the words "Prepare for," the guns are laid, but not brought to the "Ready"; the order "Ready" being given in this case by the officer of the quarters for the first round.

SPARE STORES.	As for 8-inch gun.
SIGNALS.	As for 8-inch gun.

DIMINISHED CREW.

As for 8-inch gun. (See Table of Duties.)

Duty at 6-inch Gun.	6 Men.	5 Men.	4 Men.	3 Men.
Sponge and rammer ...	4	4	4	1
Ram home	3, 4	3, 4	3, 4	1, 3
Projectile	5	5	3	3
Loading-tray ...	3	3	3	3
Wipe cup	6	2	2	2
Elevate	2	2	2	2

Calibre	Inches
Weight Nominal	4 tons
Preponderance	45 lb.
Length of bore	12 ft 9.9 in
" Rifling	10 " 2.07
" Chamber	2 " 6.16
" Total	13 " 10.4
No of Grooves	28.

Rifling spirally increasing from 0 at the Breech to 1 in 40 at Calibre 5.45 from muzzle to [illegible] — 1 in 40

6-INCH R.B.L. ARMSTRONG GUN,

AND VAVASSEUR CENTRAL-PIVOT MOUNTING.

The gun's crew will consist of 6 men and 1 P.M., and will fall in as follows:—

P.M. 5. 3. 1. 2. 4. 6.

Close Up. 1 in rear of the gun, facing the port; 2 on the right, in line with the sight; 3 on the left, in line with fore part of carriage; 4 on the right, in line with fore part of carriage; 5 in rear of 3; 6 in rear of 4.

Number. The gun's crew will call their Nos. in succession.

Fall Out. As before detailed.

Cast Loose. 1 and 2 ship sights, and provide firing gear; 2 provides pouch and primers; 3 and 4 clear away securing chains; 3 out tompion, and provides loading-tray; 4 provides sponge and rammer; 5 and 6 provide and ship training winch handles and ship pickets; 5 provides projectiles.

Note.—All Nos. assist to clear away any fittings that interfere with the working of the gun. Gun's crew close up.

Load. 1 and 2 open the breech, using the lever if necessary; 1 sees the bore clear, and superintends the loading; 2 takes out needle-holder, and places a primer; 3 places loading-tray, receives projectile from 5, and enters it; 4 takes the rammer, and, assisted by 3, rams home; 3 takes cartridge from P.M., and enters it (if full charge, tear off the shalloon); 4 presses it home; 3 returns

loading-tray; 4 returns rammer; 1 and 2 close the breech; 2 replaces needle-holder; 5 provides another projectile; gun's crew close up.

DEFLECTION, DISTANCE, or ELEVATION. OBJECT. — 1 and 2 adjust the sights (2 the right). 3, 4, and 6 man the winches, and train under the direction of 1, who retires to the extent of his tube-lanyard.

NOTE.—The training winches will be kept manned until after the gun has been fired.

ELEVATE. — 5 attends elevating gear, and lays the gun under the direction of 1.

NOTE.—5 will attend the elevating gear until after the gun has been fired, and will then lay the gun to the loading mark.

READY. — 2 connects firing gear.

FIRE. — 1 fires; 2 disconnects firing gear, and attends by-pass valve, and when the gun is out 5 lays it to the loading mark; Nos. close up.

NOTE.—The gun may be trained, elevated, and fired simultaneously.

MISS-FIRE. — 1 waits a considerable pause, and orders "Half-cock"; 2 disconnects firing gear; takes out needle-holder, and places a fresh primer; 1 orders "Ready."

NOTE.—If the ship is pitching and rolling heavily, 1 will direct 2 to shut the by-pass valve; the gun will then remain in after recoil; 2 will then attend the valve, and ease the gun out to the firing position.

SPONGE. — 1 and 2 open the breech; 3 places loading tray; 6 wipes the cup; 4 provides sponge, and, assisted by 3, sponges the gun.

LOAD. — As before detailed.

X: If Fuzes are used
2 Provide & fit them
3 Provides a Screw on
~~thimble~~ & remove
Safety Pin.

^ Should ~~the~~ order
"Quick" be given all
members except 1 man
the couches

Note Should the
distance be given 1
refers to Range table
for Elevation due
to distance. & passes
it to 2.

CEASE FIRE.	1 orders "Half-cock"; 2 disconnects firing gear; 1 and 2 down sights; gun's crew close up.
RUN IN.	2 attends by-pass valve; 3 raises screw flap; 5 ships winch-handle; 4, 5, and 6 run in, and when the gun is in, 2 closes by-pass valve; 3 returns lever; 5 returns winch handle; gun's crew close up.
UNLOAD.	2 removes needle-holder, and takes out primer; 1 and 2 open the breech; 3 places loading-tray, and draws out cartridge; powderman returns it; 4 receives long rammer from 6, and forces back the projectile; 3 receives it; 5 returns it; 3 returns loading-tray; 4 returns long rammer; 1 and 2 close the breech; 2 replaces needle-holder; gun's crew close up.
SECURE.	1 sees the gun placed in securing position; 1 and 2 return sights, firing gear, pouch, and primers; 3 in tompion; 4 raises friction-break lever, returns sponge and rammer; 5 and 6 return winch handles; 5 returns projectiles; all Nos. replace gear, and, when finished, 1 orders "Fall out."

NOTE.—The practice for the 6-inch R.B.L. gun on Vavasseur mounting will be the same as laid down for other 6-inch B.L. guns.

12½-PR. AND 9-PR. R.B.L. GUNS.

Description of Guns.

12½-pr.	9-pr.
Calibre, 3 inches.	Calibre, 2·6 inches.
Weight, 8 cwt.	Weight, 5 cwt.
Preponderance, 25 lbs.	Preponderance, 10 lbs.
Length of bore, 6 ft. 9 in.	Length of bore, 6 ft. 3 in.
Length of rifling, 5 ft. 7 in.	Length of rifling, 5 ft. 4 in.
Length of chamber, 11·8 in.	Length of powder chamber, 10·15 in.
Length over all, 7 ft. 7·2 in.	Length over all, 7 feet.
Number of grooves, 10.	Number of grooves, 16.
Rifling, spirally increasing, 1 in 100 calibres at breech, 1 in 30 at 7·5 inches from muzzle, remainder 1 in 30.	Rifling, increasing, 1 in 100 at breech, 1 in 35 at 3 inches from muzzle, remainder 1 in 35.

These guns are mounted on a single-plated wrought-iron carriage, and fitted with elevating gear, on the friction-cone principle, and with a friction-compressor and iron slide mounted on chocks, and are worked by means of tackles and handspikes.

PRELIMINARY DRILL.

The gun's crew consists of 5 men and a powderman, and fall in as follows:—

P.M. 5. 3. 1. 2. 4.

Close Up. 1 in rear of the gun, facing the port; 2 on the right in line with the vent; 3 on the left, close to the ship's side; 4 on the right, close to the ship's side; 5 in rear of 3; P.M. at magazine hatch.

Projectile & Cartridge
to be rammed home
separately

Should the quick
be given the hand-
spike will be used
on the opposite side
to assist the tackle

NUMBER. The gun's crew call their Nos. in succession.

FALL OUT. As before detailed.

CAST LOOSE. 1 ships sights, and provides tube-lanyard; 2 takes up rear flap and provides tube-pocket; 3 takes out tompion, and provides loading-tube; 3 and 4 clear away port bar and chains; 2 and 5 clear away securing chains, out bolts and in plugs; 3, 4, 5, and 2 clear away side whips and training tackle; 5 and 2 provide handspikes; 5 provides projectiles; powderman, cartridge case.

LOAD. 1 opens the breech, using the lever if necessary, sees the bore clear, and superintends the loading; 2 examines the vent, and hooks on a tube; 3 places loading-tube, and receives the projectile from 5 and the cartridge from the powderman, and enters them; 4 rams home, and returns the rammer; 3 returns the loading-tube, 1 closes the breech; and the Nos. close up.

NOTE.—If using time fuzes, 2 will provide and fit them; 3 providing thimbles and pellets, which will be screwed in just before the shell is entered. If using Royal Laboratory Fuzes, 3 removes the safety-pin just before the shell is entered.

DEFLECTION OR ELEVATION. 1 adjusts the sight.

NOTE.—Should distance be given, 1 will refer to Range Table for elevation due to distance.

OBJECT (*bearing, if necessary*). 3 and 4 open the port; 4 attends the compressor. The gun is run out, and trained under the direction of 1, who retires to the extent of the tube-lanyard.

NOTE.—Orders for training are "Right," "Left," "Quick," "Slow," and, when trained, "Stop."

ELEVATE. { 3 attends elevating gear, and lays the gun under the direction of 1.

NOTE.—The orders for elevating are "Elevate," "Rest," "Raise," "Lower," and, when the gun is laid, "Well."

READY. { 1 slacks the tube-lanyard, and places his left hand over the right; 2 places the tube in the vent.

FIRE. { 1 fires by pulling the tube-lanyard downwards with a jerk, bringing his left hand on the right; 3 and 4 close the port, or the gun may be run out.

MISS-FIRE. { 2 examines the vent, and hooks on a fresh tube; 1 then orders "Ready."

SPONGE. { 1 opens the breech; 3 places the loading tube; 4 carefully sponges the gun.

CEASE FIRING. { 1 orders "Out tube"; 2 takes the tube out of the vent; and the gun's crew close up.

NOTE.—If the order "Ports closed" is given, 1 will order "Run in"; 4 attends the compressor; all Nos. run in; when in, 4 sets taut the compressor; 3 and 4 close the port.

UNLOAD. { 1 orders "Run in"; when the gun is in, 1 opens the breech; 2 returns the tube; 3 places loading tube; 4 provides long rammer, and forces back projectile; 3 receives it; 5 returns it; P.M. returns cartridge; 3 returns loading tube; 4 returns long rammer; 1 closes the breech; and the Nos. close up.

NOTE.—If the gun is loaded with a fuzed shell, it is to be fired away.

SECURE. { 1 sees the gun placed in the securing position, the flaps put down; then everything is returned and secured by the Nos. that cleared it away. When everything is finished, 1 orders "Fall out," "Stand at ease."

for Loading

PRACTICE.

Introductory Remarks.

The following drill is for the 12½-pr, and 9-pr. R.B.L. guns, and will comprise the different modes of firing, and the working of the gun generally.

It should be impressed upon the men that laying the gun cannot be too carefully performed, and requires extreme care and attention on the part of No. 1, likewise the intelligent co-operation of the remainder of the gun's crew in carrying out his orders. Loading, on the contrary, cannot be executed with too much rapidity, provided the safety of the crew or gun be not comprised.

If it is desirable to keep the ports open, the order "Ports open" will be given, and this order will remain in force until the order "Ports closed" is given.

In the "Cease firing" position, with the ports open, the gun should be close out.

With the ports closed, the muzzle of the gun should be just inside the port.

Clearing for Action.

Action.	The guns will be cast loose, and run out close to the port, and loaded with filled shrapnel shell and R.L. fuze, and the Nos. close up.
For Exercise Action.	The same as for "Action," but no powder or fuzes are provided.

Independent Firing.

In this firing, the Nos. 1 should seize the most favourable opportunity of delivering their fire. To be effective, it is

necessary that they should experience no difficulty in laying the gun by sight as soon as it is out.

INDEPENDENT FIRING.	A caution, to indicate the description of firing about to be practised.
DEFLECTION, ELEVATION, OR DISTANCE, AND OBJECT (*giving the bearing if necessary*).	The port is opened, the gun run out and trained for the object; 1 lays the gun, and gives the order "Ready."
COMMENCE.	1 fires at his own discretion, and, if necessary, orders "Run in" or "Run out"; the gun is sponged and loaded without orders, and the firing proceeded with.
CEASE FIRING.	As in Preliminary Drill.
SECURE.	As in Preliminary Drill.

The gun's crew will be taught the stowage of spare stores, and how to fit them; also the removal of wounded.

NORDENFELT GUN.

(MARK III.)

Action of the Mechanism.

1. The handle moving to the rear, the friction-roller traverses the concentric part of the action plate, and the action block remains steady. The spring and the heel of the lever acting on trigger-comb drives it from right to left.

2. As the movement continues, the toe of the action lever acts on the locking-bolt plate, and withdraws the bolts, leaving the action block free.

3. At the moment these bolts are withdrawn, the friction-roller engages in the straight part of the action plate, and the action block begins to move back, drawing with it the breech-plugs, which extract the cartridge cases.

4. When the breech-plugs are clear, the friction-roller on the action block bears against the forked lever, and so pushes the carrier to the left. At the same time (in the Mark I. and II. guns) the cocking-cam on action block begins to press against the cocking-cam on trigger-comb, carrying the latter to the right.

The bevelled side of the tenons of the hammers press against the bevelled side of the teeth of the trigger-comb, and thus carry it to the right.

The empty cartridge cases fall to the ground, and are replaced by filled ones. The tenons of the hammers pass behind the hammer stud of the trigger-comb, which is driven to the left by the spring, or by the triangular cocking piece as the action block moves forward.

The handle is now as far back as possible, and the lock in its furthest position from the barrels.

Handle moving forward.—The handle next moves forward with the following effects :—

1. The friction-roller on the action lever acts on the action plate, and moves the action block to the front. The friction-roller on action block, pressing against the fork, drives the carrier to the right, thus placing cartridges in line with the barrels.

2. The action block advances to the front, and the spiral springs are compressed by the hammers, which are kept back by the trigger-comb. The breech-plugs push the cartridges into the barrels.

3. When the cartridges are quite home the action block stops, and the toe of the action lever causes the locking-bolt plate to drive the locking bolts into the holes in the gun-frame, so that the breech-closing is complete.

4. The action lever now begins to carry the trigger-comb to the right.

Each hammer is released in turn from the tooth which retains it, and the striker pertaining to it is driven forward in consequence.

In Mark III. gun, the second barrel from the right fires first, next the third barrel from the right, next the right hand barrel, and lastly the left hand.

The action of the drill-stop is this: the hand lever is brought up by it before it has completed the back stroke, so that the hammers cannot pass behind the trigger-comb. Thus the gun is not full cocked, because the springs are not compressed when the action block moves forward.

Instructions for keeping the Gun in Working Order.

To take off the action block.—The gun's crew should be instructed to do as follows :—No. 1 places himself on the left, and No. 2 on the right of the gun. If the hopper is on, No. 1 releases the hopper catch and takes off the hopper, No. 2 opens the spring lock, and No. 1 raises the cover.

No. 2 draws back the hand lever until the breech-plugs are well clear of the cartridge receiver; No. 1 puts his right hand

and No. 2 his left hand through the cartridge slots, raise the cartridge receiver straight up, and No. 2 carries it off to the right side.

No. 2 brings forward the hand lever with his left hand, taking care that the springs are released, until the extractors come within one inch from the centre crosspiece; No. 1 takes hold of the left breech-plug with his right hand, and No. 2 the right breech-plug with his left hand; both raise the action block until the breech-plugs are clear of the centre crosspiece, taking the greatest care that the extractors do not catch against the centre crosspiece or the hopper strip; draw the action block forward until the rear end is clear of the cover arms; raise the action block straight up on end, and carry it off to the left side.

To replace the action block.—Proceed in the reverse way.

Cleaning and Oiling.

To clean and oil the gun.—The gun's crew should be specially trained to keep the gun in good working order, and great care should be taken to prevent the accumulation of rust, grit, and dust. Use Rangoon oil often, but a little at a time to prevent it from clogging.

The mechanism should be cleaned and oiled every morning; and the chambers cleaned and oiled whenever an opportunity offers during firing.

The barrels and chambers are cleaned without removing the action block, by simply opening the cover, pushing the hand lever into the "Ready" position, and cleaning from the muzzle with tow on the cleaning-rod, and then oiling the chambers from the breech.

When the mechanism is to be cleaned and oiled, the action block should be taken off, and the trigger-comb lifted out by hand; then clean hammers and firing-pins, putting on little or no oil, and see that they move quite freely in their channels; clean off all clogged oil and put on fresh oil on the trigger-comb rests, studs, and into the friction rollers, action plate, locking bolts and plate, on the sliding surfaces of the frame

for action block and cartridge receiver, on the cocking-cam, on the working surface of the cartridge receiver lever, on the trunnions, and into all the oil holes of the crosshead; feel that the locking bolts run freely; then re-assemble the gun.

Spiral Springs.

The gun's crew should be instructed how to shift spiral springs, hammers, firing-pins, and extractors.

To change spiral springs.—The action block need not be dismounted; bring back the hand lever to its rearmost position; unscrew the thumbscrew until the shoulder is free; raise the spring bar gradually and let it fall to the left, the chest being placed close behind the action block, so that the spiral springs do not jump out of the gun; change any desired spring, replace the spring bar, and screw home the thumbscrew.

To take out a firing-pin.—First remove the extractor.

To change an extractor.—The centre of the extractor spring must be held down firmly, and the extractor screw then taken out. Before putting in an extractor, care must be taken that the firing-pin is right forward, so that the lug on the rear end of the extractor is behind it; then by pressing down on the centre of the extractor the screw may be replaced.

INSTRUCTIONS FOR WORKING THE GUN.

The gun is always to be examined before firing, to ascertain—

1. That the extractors are in working order, and not broken.
2. That the firing-pins are not jammed by rust or otherwise.
3. That the trigger-comb works properly, and the springs are in place.

Elevating Screw too easy.

In case the elevating screw becomes too easy or runs down when firing.—Tighten the adjusting-break screw until the elevating hand-wheel requires a suitable force to move it, without making it too stiff or be easily worked round.

Miss-fires.

In case of repeated miss-fires during firing.—If the caps have not been struck, it is probable that the hand lever has not been moved fully backwards as far as it will go, in which case the gun has not been cocked, or that the hand lever has not been moved fully forwards as far as it will go, in which case one or more hammers have not been released, and the corresponding cartridges have been passed through the mechanism without being fired.

If the percussion caps have been insufficiently struck, it is probable either that a spiral spring, a hammer head, or a firing-pin has broken (in which case exchange the broken part), or that the firing-pin or its hole has not been cleaned.

If the percussion cap has been fairly struck, but has not fired the powder, it is probable either that the cartridge has got damp, or that the cap has been too deep set or its fulminate disturbed.

Jams.

In case the hand lever has stopped in firing by any obstruction no violence must on any account be used, but the handle should be gently drawn backwards and forwards once or twice, as far as it will go, when the obstruction will probably be cleared away.

Extractor Springs breaking.

It sometimes happens that an extractor-spring breaks during practice.

Mark III.

Since the extractor and its spring consist of one piece of metal in the Mark III. gun, if the spring breaks the extractor becomes detached, in which case proceed with the firing, leaving the corresponding column of the hopper empty, or, if there is time, put in a new extractor.

In case one barrel is injured or disabled, the remaining barrels can still be fired without difficulty by only filling the compartments of the hoppers which correspond to the barrels which are in good condition.

Without emptying any of the columns of the hopper, it is easy to continue firing (at ordinary elevations) with the remaining barrels or barrel, when others are jammed by an empty cartridge case failing to extract, in the following manner:—After cocking the gun and pushing the hand lever forward, it is brought up by a fresh cartridge striking against the base of the jammed cartridge case, then the hand lever should be brought back somewhat sharply a sufficient distance to extract the fresh cartridge, which is in the way, and it will be found that the action lever can now be pushed forward, and the gun fired as usual. If much verdigris has formed on a cartridge case it will be found very difficult to extract after firing, and most probably the rim will tear away. Such cartridges should not be fired unless well oiled all over.

If the obstruction causes a jam, so that the hand lever cannot be moved either backwards or forwards, put the hand underneath the cartridge receiver. If the jam is still not cleared off, remove the action block, as above described, and find out and remove the cause of the jam.

If the gun becomes unsteady, so that the volleys fired causes the muzzle to jump, tighten well home the upper pivot-bolt nut. If this is not sufficient, screw hard home the elevating pin, ease the check nuts, tighten pivot screws into the elevating nut, and screw up the check nuts again. If the gun is still unsteady, the cone must be raised, the check nut below the pivot-bolt eased, the lower pivot-bolt nut screwed home as hard as possible, the check nut tightened, and the cone screwed down again. If the hand lever becomes loose, drive home the taper pin, and see that the split pin is fixed.

When not actually firing, the drill-stop should always be in action, as otherwise the firing-pins are liable to be damaged by repeated snapping.

Failures that may occur with the Gun.

1. If an extractor is broken or fails to act, the cartridge will be fired, and the empty case will remain in the chamber, and will prevent a loaded cartridge from entering the barrel.

When this occurs, the hopper should be removed, and replaced by a fresh one, with that column empty which corresponds to the barrel with the broken extractor, or the firing may be continued by adopting the method previously mentioned. If time permits, shift the extractor.

Firing-pin.

2, If the firing-pin fails to act, the cartridges will pass through the mechanism unfired.

3. If the extractor and firing-pin both fail, a loaded cartridge will be left in the chamber, and the point of the bullet of the next cartridge will take against its base.

The firing should stop, and the hopper should be removed. The loaded cartridge should be driven back with the cleaning rod, care being taken that it is not driven hard against the breech-plug.

The firing may be continued with the other barrels, using a hopper with one empty column.

Whenever a jam occurs, in consequence of a *loaded* cartridge remaining in a barrel, the corresponding column of the hopper should be left empty, unless there is time to rectify the defect by removing the cause of failure.

Instructions for Mounting the Gun and for Taking it to Pieces.

The following instructions are for the use of armourers, who should alone be permitted to take the gun to pieces:—

Cone.

To mount the cone.—Screw home as tightly as possible the pivot-bolt nut and check nut underneath the cone; then place the cone, and screw tight all nuts and screws along the base angle-iron; tighten down all pivot screws with screw-driver.

Crosshead.

To mount the crosshead.—Place the crosshead on the pivot, put washer on the pivot-bolt, and screw down the upper pivot-

bolt nut as tightly as possible; ease the check nuts on the elevating pivot screws; see that these pivot screws are screwed home so that the elevating screws are steady; then tighten check nuts. If the training spindle is not fixed, place the worm in its position, with the keyway upwards; then push the spindle home with the key upwards; fix the collar with taper pin.

To mount the gun.—Raise trunnion caps, run down the outer elevating screw as far as it will go, and the inner elevating screw until the arrowhead on the threads meets the arrowhead on the upper surface of the hand-wheel collar, place the gun with the trunnions in their bearings; close the caps, and fix them by the pins; fit the eye of the inner elevating screw to the hole in the frame, and screw home the elevating-pin. If the hand lever is not fitted on the gun, put it on the lower end of the axis pin; drive in taper pin and put in split pin.

To dismount the gun crosshead and cone, proceed in the reverse way.

To remove breech-plugs.—First remove the extractors, then unscrew the plugs.

To replace a breech-plug.—Screw it in, and when home replace the extractor; it then serves to prevent the plug from unscrewing.

To remove the barrels.—Take out the bolts in the front crosspiece; slip the front crosspiece forwards off the muzzles. The barrels can be unscrewed as soon as the front crosspiece is removed.

To remove the rear crosspiece.—Dismount the mechanism, drive out the cotters, and pull out to the rear.

To remove the centre crosspiece.—Dismount the mechanism; remove the barrels and the rear crosspiece; push the rear ends of the frame outwards with the knees until the centre crosspiece can be taken out of its sockets, then pull it out to the rear.

To replace barrels, rear crosspiece, and centre crosspiece.—Proceed in the reverse way.

To test springs.—The springs in the gun should be tested at fixed intervals, and re-set if required, or replaced by spare springs. The extractor spring is tested by ascertaining that the extractor hook will stand 8 lbs. pull outwards before it can be moved, and that the firing-pin when out has to be pushed by 7 lbs. before it recedes. The tumbler spring should be strong enough to necessitate a pull of 16 lbs. to the right before it can be moved.

In Mark III. gun, the test for trigger-comb spring is 4 lbs.

PRACTICE.

The following drill is for the 2, 4, and 5-barrel Nordenfelt guns, mounted on the ship's mounting; this being one general drill which, with slight modifications, will suit the various types of machine guns.

The gun's crew fall in in single rank, in rear of the Starboard gun:—

5. 3. 1. 2. 4. 6.

The gun's crew place themselves as follows :—

CLOSE UP.	1, in rear of gun; 2, on the right, in line with sight; 3, on the left, in line with sight; 4, 5, 6, in rear.
NUMBER.	The gun's crew call their Nos. in succession.

The gun's crew place themselves as follows : Odd Nos. at the Starboard guns, even Nos. at the Port guns.

	Starboard Guns.			Port Guns.		
BOTH SIDES.	1	remains	1	2	becomes	1
	3	becomes	2	4	,,	2
	5	,,	3	6	,,	3

NUMBER.	The gun's crew call their Nos. in succession.

FALL OUT. { The gun's crew fall in in single rank, in rear of their guns.

STARBOARD (or PORT) GUNS. { The gun's crew close up at the named gun.

The following drill is for working with both sides manned. Should only one side be engaged, Nos. above 3 keep up the supply of ammunition. It is to be thoroughly understood that, when the bugle sounds "Action," machine guns' crews repair to their stations "both sides," and clear away their guns, and open the ammunition, so that, if necessary, all machine guns can be worked and supplied with ammunition for a short period. When only one side is engaged, Nos. 4, 5, 6 provide ammunition.

ACTION. { 1 sees elevating and training gear clear, then raises the cover and feels each extractor and firing-pin to see they are uninjured; 2 sees drill-stop off, releases the hand lever, and tries the mechanism; 3 provides, and, if necessary, fills hoppers and places one.

NOTE.—*To fill a hopper.*—Place it base upwards between the knees, with the highest side to the left. Draw the slide so that the cartridges can be entered, and then fill each compartment with 10, holding each cartridge with the right hand at the bullet end and guiding the rim into the slot with the left. When the compartments are full, push in the slide.

The drill-stop is only to be used for drill, and is intended to save the wear of the firing-pins and mechanism. When it is in use, neither dummy nor live cartridges can be worked through the gun.

DEFLECTION. —— YARDS { 2 and 3 adjust and attend the sights.

OBJECT. { 1, using the left sight, lays the gun, working the training wheel with his right hand and elevating wheel with his left.

COMMENCE. { 2 draws back hand lever and forces it forward half way, and fires by order of 1 by forcing it right forward, and, instantly drawing it back to its full extent, repeats the operation. When the hopper is empty, 3 replaces it with a full one.

RAPID FIRING. 2 works the mechanism continuously after 1 has given the first order "Fire." Should it be necessary to cease firing for a short time to allow smoke to clear away, or to allow 1 to relay his gun, 1 will order "Rest," and rapid firing will be continued at order "Carry on."

NOTE.—If when the motion of the gun platform is very quick the elevating gear is not required, then 1 can fire the gun himself, looking along the right sight and working the training wheel with his left hand.

CEASE FIRING. 2 discontinues the fire, and puts the drill-stop on; 3 fills empty hoppers.

NOTE.—Should the lever be either right back or going forward when the order "Cease Firing" is given, 3 off hopper, raises cover, and removes cartridge from gun.

CEASE FIRING. SECURE. 2 discontinues the fire, and puts the drill-stop on; 3 removes the hopper, pushing in the slide as he does so; 1 then opens the cover, and removes any cartridges that may be in the gun; the sights and deflection scales are set to zero; 2 fixes the hand lever by its catch, 3 returns the cartridges and empties the hoppers, and 1 trains gun to securing position. When everything is finished, 1 orders "Fall out."

DIMINISHED CREW.

With 2 men, 1 places and removes the hoppers.

AMMUNITION.

The powder charge weighs 625 grains, and is pressed into the cartridge case, care being taken that it shall always occupy the same space. The effect of this pressure is to break up the weaker grains, and to form a hard solid mass of dust with grains interspersed. The bullet weighs 7¼ oz., and is of steel,

the point being hardened; round the base is a cannelure, into which the envelope is choked, and on the base are several radial cuts into which it is set on firing.

The space between the envelope and the inside of the cartridge case is filled with pure beeswax, as a lubricator.

The rotation is given by the envelope, which is made of very thin brass, the base being shaped into the form of a gas-check, and the front end carefully turned over the shoulders of the bullet.

The cartridges are packed in bundles, containing 12.

The weight of each bundle is about 8 lbs. 9 ozs.

These bundles are stowed in an ammunition box, Mark IX. or Mark XI.; either of these boxes contains 8 bundles, that is 96 rounds.

The weight of the box, filled, is 82 lbs.

When any Nordenfelt ammunition boxes, from which a portion of the ammunition has been removed, are required to be returned into store, or to be removed for any other purpose, the vacant place should be completely filled with wood, tow, or other substance, to prevent danger of explosion by the cartridges moving about and striking against each other.

·45-INCH GATLING GUN.

Description of Gun.

Length of gun (total), 51 inches.
Length of barrel, 31·95 inches.
Length of rifling, 28·79 inches.
Calibre, 0·45.
Nature of rifling, Henry.
Number of grooves, 7.
Twist of rifling, uniform, 1 turn in 22 inches.
Weight of drum, filled, 28 lbs.
Weight of drum, empty, 16¾ lbs.
Weight of bullet, 480 grains.
Weight of charge, 85 grains.
Total weight of cartridge, including case, 1·8 oz.
Elevation, 55°.
Depression, 65°.
Weight of gun.
Preponderance.
Weight of pedestal.

Sighting.

Each gun is provided with two tangent sights, marked up to 2,000 yards, and two fore-sights.

From 1,250 yards to 1,450 yards, the left sight is obscured by the cover catch.

The main features of the gun are as follows:—

There are 10 barrels and 10 corresponding locks. In working the gun, the barrels and locks revolve together; but, irrespective of this motion, the locks have a forward and backward motion of their own. The forward motion places the cartridges in the barrels and closes the breech at the time of each discharge, while the backward motion extracts the empty cartridge cases after firing.

The gun is loaded and fired only when the barrels are in motion from left to right; that is to say, while the crank handle is being worked forward.

When the gun is in action there are always five cartridges going through the process of loading, and five cartridges in different stages of being extracted, and these several operations are continuous while the gun is being worked. Thus, as long as the gun is fed with cartridges the several operations of loading, firing, and extracting are carried on automatically, uniformly, and continuously.

The gun is fed by means of a metal drum, having 2 studs on its lower part, which fits into 2 slots on the cover. The drum has 21 compartments, with about 5 cartridges in each—about 105 rounds in drum.

To Obviate Stiffness in Working.

Should the gun be found stiff in working, it is probably due to one or other of the following causes:—

1. Cartridges which may have some defect, such as large in gauge, rim too thick, or body of case bulged in loading.
2. End of barrel burred up. This is caused by working the gun without cartridges, the lock snapping drives the end of the lock into the chamber, and throws up a burr at entrance. This can be removed by a burnisher, or by a stick and emery.
3. Insufficient freedom in shaft. This will be obviated by easing the cascable knob.
4. Steel seating on face of cam becoming indented.
5. Lubrication of locks. Should a cartridge burst at the base, a deposit will be left in the carrier or lock disc, and prevent the free working of the lock. In this case, the lock should be removed and the part cleaned.
6. Worm and worm wheel may require cleaning and oiling.

Jamming of Cartridges.

Should jams occur in firing, it is due probably to a badly-constructed or damaged cartridge.

The most common of these mishaps may arise from a miss-fire, when, if the gun be very foul, the bullet may remain in the barrel when the cartridge case is extracted, so that the

succeeding cartridge cannot be placed in its proper position. In this case, the bullet should be driven out of the barrel from the muzzle with a cleaning rod.

Another cause of jam is due to a cartridge splitting in firing, and leaving on extraction a portion in the barrel. This is easily removed by the cleaning rod—a steel rod, split at one end.

Should a jam occur which cannot be remedied immediately, the lock belonging to the barrel where the jam has occurred should be removed, and the firing may then go on with nine barrels.

General Directions.

Before men are allowed to fire the Gatling gun rapidly, they should be carefully and thoroughly drilled to its use, and should be capable of rectifying any slight impediment to a steady and continuous fire.

No man should on any account get in front of the gun when in action, whether loaded or unloaded.

Names of Parts.

The gun is surrounded by a gun-metal casing, which has the trunnions in the centre, a cover for cartridge carrier on top, and brackets for fore-sights and elevating arc. A circular disc closes the front, and a cascable plate closes the rear, of the casing.

The following are the parts working from the muzzle:—

1. Main Shaft.—Passes through whole length of casing.
2. Front Disc.—Closes the front part of casing. It has ten holes into which the muzzles tightly fit. The cylindrical part of disc fits over, and is keyed to, main shaft.
3. Front Collar.—Is in rear of, and close to, front disc, and assists to support front end of barrels by means of ten slots, in which the barrels rest.
4. Rear Collar.—Is similar to front collar, and supports rear end of barrels close to rear disc.
5. Rear Disc.—Rear end of barrels fits into this disc.
6. Cartridge Carrier.—Is immediately in rear of rear disc. It has ten slots for carrying the cartridges, and is supported

in front by the rear disc and in the rear by the lock disc. There is also a hole running horizontally through it for the steady-pin, which assists to keep it steady while it is revolving.

7. Lock Disc.—Supports front of locks by means of ten holes, in which they work. It also supports rear part of cartridge carrier, and carries besides the steady-pin, which passes through carrier and rear disc.

8. Lock Collar.—The cylindrical part of this is keyed to main shaft. It has ten slots with projections, into which the grooves of locks fit. This prevents the locks from falling out in revolving.

9. Cascable Plate.—The cylindrical part of this plate passes on, but is not fixed to, the main shaft, and carries on its upper part "the guide piece," on which the locks rest on entering. The rim of the plate has six interrupted threads, which fit into six similar threads on the rear part of gun casing, and is secured by being turned to the right about 30°.

10. Cascable Collar.—Is a small collar which fits on main shaft, in rear of cascable plate. It has several small slots in the rear part.

11. Cascable Knob.—This knob is threaded, and screws on main shaft, and carries a spring catch by which it is secured to the collar. It also adjusts the main shaft.

Worm-wheel.—Has a featherway, and fits on main shaft.

Worm.—Has a featherway, and fits on crank shaft, and gears into worm-wheel.

Crank Shaft.—Passes through bracket of cascable plate and worm.

Cocking-cam.—This is a steel cam, slotted away at the front part, that takes the rear end of needle (preventing it from being pushed forward with the lock, thus compressing the spring), which is released by the time the lock is in front of the steel seating, and fires the gun.

Safety Bolt.—Is an arrangement by means of which the cocking-cam is drawn back, thus preventing the springs from being compressed and the gun being fired.

Cam (large).—This cam is made of gun-metal, and tightly fits inside the gun casing. It has two steel seatings; also two spiral slots, by means of which the locks are pushed forward or back as the main shaft is revolved.

Cover.—Is made of gun-metal, and hinged to the frame. The opposite end is secured to the frame by a catch. On its under side are two unloading strips, which rest on the solid part of the cartridge carrier; these take against the body of the empty cartridges, forcing them upward and out of the gun. The cover also carries a stop for the drum catch.

NOTE.—The cover has also four ribs on its under side for the same purpose.

Strengthening Piece.—A piece of gun-metal, with four ribs, which pass between the projections of cartridge carrier and keeps it firm while firing.

Elevating Gear (Frictional).

Wheel.

Spindle.—Has a feather, which fits into worm.

Worm.—Is in two parts, and has a feather way.

Worm-wheel.—Is coned out on its inside part for taking the cone.

Adjusting and Check Nuts.—On end of spindle.

Shaft.—The shaft passes through from right to left, and carries the clamp-wheel, steel washer, worm-wheel, cone, pinion, cylinder, and nut.

Arc.—Marked in deg., 55° E. 65° D.

Stops.

Break.

Crosshead, with trunnion caps and keys.

Traversing Gear.

Traversing plate.

Wheel.—Same as for elevating.

Spindle.—Same as for elevating.

Worm.—Same as for elevating.

Worm-rack.

Stops.—Same as for elevating.
Adjusting and Check Nuts.—Same as for elevating.
Break.—Same as for elevating.
Pedestal.

NOTE.—On the clamp-wheel being set taut, the washer is forced against the worm-wheel, which in its turn is forced on to the cone, tightly fitting it. The cone being a fixture on the shaft causes the shaft to revolve; that in its turn drives the pinion which works the elevating arc.

PRELIMINARY DRILL.

SHIFTING LOCKS.

Turn the crank handle backward until the number of lock required to be shifted is in line with the mark on casing; then take out button, draw out the lock, and place in spare one, looking out that the grooves of lock take in projections of lock collar; then place in button, and try action.

SHIFT EXTRACTORS.

Remove the lock, raise the studs of extractor from the lock, then push extractor forward, until clear of the flanges on lock, then place spare extractor.

SHIFT NEEDLE OR SPRING.

Remove the lock, unscrew keep-screw, then shift needle or spring as required.

DISMOUNT THE GUN.

Remove the locks, cascable knob, and collar, crank-shaft worm, worm wheel, cascable plate, safety bolt; drive out pin, and remove lock collar, slide off lock disc, drive out large cam (with wood), remove cartridge carrier, then draw out from muzzle end the main shaft, barrels, and discs; drive out pin, and remove main shaft; remove barrels from discs and collars.

TO REMOUNT.

Place the numbers of barrels in line with the numbers on rear disc, then proceed reverse way to dismounting.

PRACTICE.

The gun's crew consists of 5 men, who fall in in single rank in rear of the gun.

ACTION. { 1, in rear, sees elevating and training gear clear, raises the cover and feels each extractor and firing-pin in succession, to ascertain that they are not damaged, and that they move correctly; 2, on the right, ships handle on crank shaft, puts safety-bolt to "Fire," then turns slowly forward and tries the action, which will be indicated by hearing ten firing-pins strike, then puts safety-bolt to "Safety;" 3, 4, and 5 provide filled drums; 4 and 5 fill empty ones.

NOTE.—No. 2 should notice the number of lock nearest him, and after ten rounds has been fired the lock ought to be in nearly the same position.

—YARDS. OBJECT. { 1 and 2 adjust sights; 3 receives drum from 4, places it and attends elevating and training gear, and lays the gun under the direction of 1, then, if necessary, set taut the breaks.

NOTE.—When the motion of platform is such that the elevating gear is not used, or where the distance is likely to remain the same, the stops on elevating arc are to be placed close to crosshead, and breaks set taut.

COMMENCE. { No. 1 keeps his gun bearing on the object; 2 seizes crank handle with right hand and fires, by order of 1, by turning steadily forward. When the drum is empty, 3 orders "Drum;" a filled drum will be supplied and placed, and the empty one refilled by 4 and 5.

NOTE.—Should the order "Rapid firing" be given the crank handle will be shipped on the end of main shaft, the elevating and training gear disconnected, and the gun worked by means of the elevating lever, which ships in the socket of a shaft passing through the gun casing; No. 3 attends lever.

CEASE FIRING. { No. 2 discontinues the fire; 3 removes drum; 4 returns it; 1 raises the cover and takes out any cartridges left in the gun, 2 turning the crank handle backward; 1 and 2 down sights; 2 returns crank handle; 3 returns cartridges; 4 and 5 fill drums.

NOTE.—Should it be necessary to cease fire for a short time, the order "Still" should be given.

DIMINISHED CREW.

With two men, 1 places and removes drum.

DRUM, HOW FILLED.

Turn the drum with the filling-slot up, and sight-hole to the left; open the sight-hole, place a piece of wood under the catch to raise it out of the way, take hold of a cartridge at the bullet end and guide it into the grooves; then place one in each compartment, and so continue until you can see the base of a cartridge through the sight-hole, when the drum is filled, and sight-hole closed.

The drum has 21 compartments, which revolve round, carrying the cartridges with them; running round the drum inside are two spiral grooves (one each side), in which the base of cartridge and bullet rest. Each ring of cartridges rests in its own part of the groove, the upper part of which keeps it clear of the tier above. The object of this is to keep each cartridge entirely separate from the others, and, at the same time, it only allows one to fall out of each compartment at a time, and before the second can fall out the compartment has to make a complete revolution.

The action of the drum is made automatic by the projections on catridge carrier taking against the compartments, turning them round in succession, so as to discharge a cartridge from each.

PISTOL (ENFIELD).

Nomenclature.

1. Body.
2. Barrel.
3. Barrel-joint screw.
4. Cylinder.
5. Cylinder axis.
6. Cylinder axis keeper-screw.
7. Catch.
8. Catch-spring.
9. Catch-screw.
10. Extractor.
11. Hammer.
12. Hammer axis-screw.
13. Lever.
14. Main-spring.
15. Pawl.
16. Plate.
17. Plate-screw.
18. Stock.
19. Stock-screw.
20. Shield.
21. Shield-spring.
22. Shield-screw.
23. Shield-screw keeper screw.
24. Swivel-studs.
25. Trigger.
26. Trigger-spring.
27. Trigger-spring rivet.
28. Trigger-axis screw.
29. Top strap.
30. Top-strap screw.

Names of principal parts for drill purposes.—Body, barrel, cylinder, cylinder axis, catch, hammer, extractor, pawl, plate, stock, stock-screw, shield, trigger, and guard.

Weight of pistol, 2 lbs. 8½ oz.
Length of pistol, 11⅞ inches.
Length of barrel, 5⅞ inches.
Number of grooves, 7.
Twist of rifling, 1 turn in 22 inches.
Diameter, ·45.
Weight of charge, 18 grains.
Weight of bullet, 265 grains.

To Strip a Pistol.

Unscrew stock-screw, lift off stock, unscrew strap-screw, unscrew plate-screw, and lift off plate.

Full-cock the hammer and press fork of cramp over the main-spring; release the trigger, and take out the main-spring.

Draw pawl out of slot and lift the tripper off its axis, then lift the hammer and the lever off the axis.

Take out barrel-joint screw (or axis); take off barrel and draw off the cylinder.

Take out the cylinder axis keeper-screw, unscrew and remove the cylinder axis, draw out catch-screw, and catch and spring.

Remove shield-spring, take out shield-screw keeper-screw and remove shield-screw.

NOTE.—The hammer axis and also the cylinder axis has a left-handed thread.

The trigger axis has a right-handed thread.

After stripping a pistol, all the parts should be thoroughly cleaned before replacing.

TO ASSEMBLE.

Proceed the reverse way to stripping, being very careful that the screws, &c., are all in their proper places before screwing them hard up.

NOTE.—There is a lubricating hole (which is closed by a screw) on the rear part of body (on the right), in case at any time the pistol works stiff, for oiling the gear without taking the pistol to pieces.

EXERCISE.

The men are to be in single rank, with the pistols in the holsters, and numbered from right to left.

The Instructor will here explain the principal parts of the pistol the men will come in contact with during the drill.

TO LOAD AND FIRE BY NUMBERS.

BY NUMBERS, READY.	Seize the handle of the pistol with the right hand.
TWO.	Take the pistol from the belt, and seize the handle with the left hand, holding the pistol nearly upright, the forefinger pointing to the muzzle between the trigger-guard and the cylinder; and drop the right hand to the side.

THREE. Open the breech with the forefinger and thumb of the right hand, then carry the hand to the pouch, take hold of a cartridge at the rim, put one into each chamber, pressing them well home with the thumb, turning the cylinder at the same time with the forefinger of the left hand; then close the breech and drop the right hand to the side.

FOUR. Full cock with the thumb of the right hand; then pass the pistol into the right hand, holding it upright, with the forefinger outside the trigger-guard.

PRESENT. Point the pistol a few inches below the object, with the arm slightly bent, placing the forefinger round the trigger, but without pressing it.

TWO. Raise the muzzle until the top of the foresight is brought in line with the object through the notch on the backsight, pressing the trigger at the same time without the least motion of the hand, eye, or arm, until the hammer falls, still keeping the eye fixed on the object.

THREE. Bring the pistol back in the right hand, holding it nearly horizontal, and pointing to the left front, press back the catch with the thumb of the right hand, and opening the barrel with the left hand throw out the empty cylinders; then replace the barrel, pass the pistol into the left hand, holding it as in the second motion of the "Ready," and proceed with the third motion of the "Ready," as before detailed.

READY. Complete the fourth motion of the "Ready," as before detailed.

To Half-cock, when at the "Ready."

Half-cock.	Pass the pistol into the left hand, holding it as in the second motion of "Ready," half-cock, and drop the right hand to the side.

To Return the Pistol to the Belt.

Return.	Return the pistol, and drop the hands to the sides.

Note.—If at the "Ready," first half-cock.

To Unload.

Unload.	Holding the pistol as in the third motion of the "Present," open the barrel, then pass the pistol into the left hand, holding it as at the second motion of the "Ready," open the breech, withdraw the cartridges and return them to the pouch; then close the breech and replace the barrel, return the pistol to the belt, and drop the hands to the sides.

To Load and Fire, in Quick Time.

Ready.	In four motions.
Present.	In three motions.

Note.—When the men are required simply to load, the command will be "Load," and they will perform the first three motions of the "Ready"; when the word "Ready" is given to men already loaded, they will proceed with the fourth motion.

INDEPENDENT FIRING.

Independent Firing.	A caution.
Commence.	Each man comes to the "Ready," and "Present," independently of his right or left hand man, and continues firing without reloading until all the chambers are discharged. He then reloads and proceeds as before.
Cease Firing.	Complete the loading and "Return."

The pistol can be fired without full-cocking by merely pressing the trigger each time; but this should only be resorted to when time does not admit of full-cocking it, as the increased pull of the trigger has a tendency to render the aim uncertain.

Men should be exercised in firing with the left hand as well as the right; and should be taught that when time permits a more accurate aim may be taken by supporting the pistol with the left hand.

INSPECTION OF PISTOLS.

EXAMINE.	Seize the stock of pistol with the right hand.
PISTOLS.	Take the pistol from the belt, open the barrel, then pass the pistol into the left hand as in the second motion of "Ready," open the breech, and drop the right hand to side. As the pistol is being examined, turn the cylinder with the right hand, then close the breech and barrels.
RETURN.	As before detailed.

CUTLASS EXERCISE.

This Exercise is formed on the following principles:—

I.—That the "First Guard" is the most advantgeous position which a man armed with a cutlass can assume for the purpose of "Attack" or "Defence."

II.—That as a Point can be returned with far greater rapidity and with much more deadly effect than a Cut, a Point is invariably to be returned instantly after having guarded a Cut, or parried a Point, delivered by an opponent.

III.—That after delivering a Cut or Point, the "First Guard" is to be immediately resumed ready for instant defence or attack.

The exercise consists of two diagonal "Cuts," one "Point," and three "Guards."

The division fall in in two ranks at close order, files nearly touching, with swords sheathed, and are numbered from right to left.

If with drill swords, without scabbards, the swords are to be held in the left hand as if sheathed.

NOTE.—The Instructor is himself to perform each movement before the class, taking care that it is correctly performed before passing on to the next.

DRAW. { At the word "Draw," grasp the hilt with the right hand and the scabbard with the left, the rear rank stepping back one pace at the same instant.

SWORDS. { At "Swords," draw out smartly, and rest the sword on the right shoulder in a sloping position, keeping the fore arm horizontal; this being the position of "Slope Swords."

RETURN.	At the word "Return," grasp the scabbard with the left hand, and enter the point one inch.
SWORDS.	At "Swords," return the sword smartly, and then drop the hands by the side, the rear rank taking a pace to the front at the same instant.

NOTE.—The front rank is marched across the deck and turned about, or single rank is formed in the usual manner.

PREPARE FOR EXERCISE.	A caution.
FROM THE RIGHT (LEFT, or No. — FILE) —— MARCH.	The named file remains steady, the remainder turn outwards and step off, each man glancing over the inner shoulder towards the named file; and when at three paces from the position in which the man in his rear has halted, he will halt, turn inwards and dress up, or back, as necessary, to give room for cutting.
HALF-RIGHT AND LEFT TURN.	The ranks make a half turn towards the Instructor.

NOTE.—The Instructor directs the class to turn towards him in order to observe their manner of cutting and guarding, and to afford them a target to aim at.

INWARDS TURN.	The ranks turn towards each other.
ON THE RIGHT (LEFT, or No. — FILE), CLOSE.	A caution.
—— MARCH.	The front rank close to within two paces of the rear rank, and then both ranks close on the named file.

THE CUTTING PRACTICE.

CUTTING PRACTICE.	A caution.

GUARD. — Step back with the left foot, bend both knees, and at the same time drop the point quickly to the front, raising the arm fully as high as the shoulder, and keeping it loose and free, with the elbow slightly bent, hilt in line with and covering the elbow; the left arm behind the back.

NOTE.—It will be found convenient, whilst teaching the cutlass exercise to bring the class from the "Guard" to the position of "Rest," by dropping the point of the sword on the ground outside the toe of the right foot, edge to the rear, straightening the knees, and dropping the left hand to the side.

CUT ONE. — Step smartly out one short pace with the right foot, keep the left foot firm, the body upright, and straighten the left knee; at the same instant cut diagonally downwards from right to left, from the position of "Guard."

GUARD. — Step back smartly one short pace, and form "Guard" as before detailed.

CUT TWO. — As in "Cut One," but delivered from left to right.

GUARD. — As before detailed.

SLOPE SWORDS. — Come to the position of "Attention," bringing the left foot up to the right, and "Slope" as before.

NOTE.—The Instructor is at the end of each section (that is, after "Slope Swords") to direct one or more files to "Prove," upon which they come to the position of "Guard," go through what has just been taught, and "Slope" without further orders. The Instructor will then give the order "Change Arms," and put the class through the section with the left hand in the same manner, cautioning them that in the position of "Guard" with the sword in the left hand, the right foot is to the rear, and the right arm behind the back.

THE GUARDING PRACTICE.

GUARDING PRACTICE. — A caution.

GUARD. — As before described.

SECOND. The hilt should be just above the crown of the head, the point of the sword to the left front, and slightly drooped, the edge upwards, to the front.

NOTE.—The Instructor will, as often as may be necessary, bring the class back to the "Guard" by giving the order "First."

THIRD. The hilt should be off to the right and midway between the elbow and the shoulder, elbow close to the body, the blade with the point raised and bearing away to the left front.

NOTE.—The Instructor will, as often as may be necessary, bring the class back to the "Second" Guard.

SLOPE SWORDS. As before detailed.

NOTE.—The Instructor is to explain to the class that the First Guard defends the right side from the elbow downwards, that the Second Guard defends the crown of the head and the whole of the left side, and that the Third Guard defends the right side above the elbow.

THE POINTING PRACTICE.

POINTING PRACTICE. A caution.

GUARD. As before detailed.

POINT. Step smartly out as in "Cut One," and deliver a point as quickly as possible for the centre of the breast without altering the direction of the edge, remaining out with the arm extended.

GUARD. Step smartly back and form First Guard.

PARRY. Parry as quickly as possible upwards and to the left by forming Second Guard, and (without pausing an instant) downwards and to the right by forming First Guard.

SLOPE SWORDS. As before detailed.

GUARD.	As before detailed.
SECOND.	Form Second Guard, as detailed in the "Guarding Practice."
POINT.	As before detailed.
GUARD.	As before detailed.
PARRY.	As before detailed.
SLOPE SWORDS.	As before detailed.
GUARD.	As before detailed.
THIRD.	Form Third Guard, as detailed in the "Guarding Practice."
POINT.	As before detailed.
GUARD.	As before detailed.
PARRY.	As before detailed.
SLOPE SWORDS.	As before detailed.

NOTE.—In pointing, the arm is never to be drawn back, which causes delay and gives warning to the opponent; but the point should be instantly delivered from each Guard, with the utmost rapidity, at the centre of the breast.

THE GENERAL PRACTICE.

The General Practice is intended to teach the delivery of each Cut or Point from the First Guard (which is the best position a man armed with a cutlass can assume for attack or defence), and that immediately the Cut or Point has been delivered the First Guard is to be resumed.

GENERAL PRACTICE.	A caution.
GUARD.	As before detailed.
CUT ONE.	As before detailed, in the Cutting Practice.
GUARD.	As before detailed.
POINT.	As before detailed, in the Pointing Practice.

PARRY.	Step back smartly, and parry as before.
CUT TWO.	As before detailed, in the Cutting Practice.
GUARD.	As before detailed.
POINT.	As before detailed, in the Pointing Practice.
PARRY.	As before detailed.
SLOPE SWORDS.	As before detailed.

NOTE.—At inspections, the General Practice should be gone through as above, and the whole of the division proved with each hand.

THE ATTACK AND DEFENCE PRACTICE.

The object desired to be obtained by the Attack and Defence Practice is to impress on the men that, having guarded any Cut or Point delivered by an adversary, they should *instantly* return a Point at the breast, and, having delivered the Point, at once resume the position of "First Guard," ready for immediate attack or defence.

ATTACK AND DEFENCE PRACTICE.	A caution.
FROM THE RIGHT (LEFT, or No. — FILE), —— MARCH.	The front-rank man of the named file turns about, the rear-rank man stands fast; the remainder turn outwards and step off, each man glancing over the inner shoulder towards the named file, and when at one pace and a half distance from the position in which the man in his rear has halted, he will halt and turn inwards.

FIRST SECTION.

Instructor.	Front (or Rear) Rank.	Rear (or Front) Rank.
FIRST SECTION. HEAD, POINT, AND GUARD.	A caution.	A caution.
GUARD.	As before detailed.	As before detailed.

First Section—*continued.*

Instructor.	Front (or Rear) Rank.	Rear (or Front) Rank.
FRONT (or REAR) RANK. HEAD.	Step smartly out a short pace with the right foot, and "Cut One" at head.	Defend the head with the Second Guard.
POINT.	Step smartly back a short pace with the right foot, and Parry by forming First Guard.	Step smartly out a short pace with the right foot, and deliver a Point as quickly as possible for the centre of the breast; remaining out with the arm extended and the edge of the sword up.
GUARD.	As before detailed.	Step smartly back a short pace with the right foot, and form "Guard," as before detailed.
SLOPE SWORDS.		

NOTE.—This Cut may be delivered lower at the thigh.

SECOND SECTION.

SECOND SECTION. ARM, POINT, AND GUARD.	A caution.	A caution.
GUARD.	As before detailed.	As before detailed.
FRONT (or REAR) RANK. ARM.	Step smartly out a short pace with the right foot, and "Cut Two" at the arm.	Defend the arm with the Third Guard.

Second Section—*continued.*

Instructor.	Front (or Rear) Rank.	Rear (or Front) Rank.
POINT.	Step smartly back a short pace with the right foot, and Parry by forming Second Guard.	Step smartly out a short pace with the right foot, and deliver a Point as detailed in First Section.
GUARD.	As before detailed.	Step smartly back a short pace with the right foot, and form "Guard," as before detailed.
SLOPE SWORDS.		

NOTE.—In cutting for the arm, the swords are to be disengaged from each other, so as to leave the breast of the rank that cuts open to be pointed at.

THIRD SECTION.

THIRD SECTION. LEG, POINT, AND GUARD.	A caution.	A caution.
GUARD.	As before detailed.	As before detailed.
FRONT (or REAR) RANK. LEG.	Step smartly out a short pace with the right foot, and "Cut Two" at the leg.	Defend the leg with the First Guard.
POINT.	Step smartly back a short pace with the right foot, and Parry by forming Second Guard.	Step smartly out a short pace with the right foot, and deliver a Point as detailed in First Section.

Third Section—*continued.*

Instructor.	Front (or Rear) Rank.	Rear (or Front) Rank.
GUARD.	As before detailed.	Step smartly back a short pace with right foot, and form "Guard," as before detailed.
SLOPE SWORDS.		

NOTE.—In cutting for the leg, the swords are to be disengaged from each other, o as to leave the breast of the rank that cuts open to be pointed at.

FOURTH SECTION.

FOURTH SECTION, POINT. POINT, AND GUARD.	A caution.	A caution.
GUARD.	As before detailed.	As before detailed.
FRONT (or REAR) RANK.		
POINT.	Step smartly out a short pace with the right foot, and deliver a Point as detailed in First Section.	Parry the "Point" by forming the Second Guard.
POINT.	Step smartly back a short pace with the right foot, and parry the "Point" by forming First Guard.	Step smartly out a short pace with the right foot, and deliver a Point as detailed in First Section.
GUARD.	As before detailed.	Step smartly back a short pace with the right foot, and form "Guard" as before detailed.
SLOPE SWORDS.		

In Quick Time.

The foregoing Sections of the Attack and Defence Practice are also to be performed in quick time, the Instructor denoting the point of attack, for example:—

Instructor.	Rear Rank.	Front Rank.
Attack and Defence Practice, in Quick Time.	A caution.	A caution.
Guard.	As before detailed.	As before detailed.
Rear Rank.	A caution, to show which rank is to attack.	A caution, &c.
Thigh.	"Cut One" at the thigh, parry the Point by forming Second Guard, and resume the Guard.	Defend the thigh with Second Guard, return "Point," and resume the Guard.
Slope Swords.		

LOOSE PLAY.

The men being perfect in the foregoing exercises, should now commence loose play. Only two opponents are to engage at the same time, the Instructor watching most carefully for any defects in their modes of attack and defence, and pointing them out. When a hit is received, the man hit is at once to recover to the Guard, and then drop the point of his sword in acknowledgment.

It is most important that the following points should be very clearly explained to the men:—

The eye should be fixed on that of the opponent, the weight of the body divided equally on both feet, the proper distance kept by advancing or retiring with rapidity; every effort to be used for the purpose of taking off the attention of the opponent and causing him to expose a weak point. It must *especially* be remembered that a Point can be returned very much quicker than a Cut, and with far more effect; therefore, when a man has guarded a Cut or Point, he should *instantly* return a Point at the breast, and then assume the First Guard, as being the best position from which to attack or defend. During the attack, if a man sees a weak point in his opponent more open to the delivery of a Cut than a Point, he should, of course, attack with a Cut, but having guarded a Cut or Point, he should always return a Point *instantly*.

INSPECTION OF CUTLASSES.

DRAW SWORDS. As before detailed.

PORT SWORDS. Bring the sword to a slanting position in front of the body, edge to the right, and seize with the forefinger and thumb of the left hand, the fingers closed, both elbows close to the body.

SLOPE SWORDS. As before detailed.

RETURN SWORDS. As before detailed.

PART II.

GUNS AND MOUNTINGS.

TURRET.

The slides for the turret carriages are fixtures built into the turret; the slides are formed of two upright plates with a piece of T iron riveted between them at top, the flange of which forms the bearing surface of the carriage, and at the bottom they are connected to the deck by angle-iron.

The training is effected by the revolution of the turret itself. In order to admit of a sufficient number of men being employed, the running in and out gear is worked by several winch handles outside the turret, while by means of a clutch the shaft of the gear of one slide may be connected with that of the other, so that if necessary the winch handles at both sides of the turret (*i.e.*, of both slides) may be applied to run back the same carriage. The elevating gear consists of a train of gearing attached to the cascable of the gun. It can be worked by one man, and is adapted for use with the axis of the gun at different heights.

The turret armour is 10 inches by the ports, and 9 inches elsewhere, which is secured by means of bolts and nuts to an oak backing from 11 inches to 9 inches thick. The backing is secured to upright angle-irons round the turret. An inner lining is formed of $\frac{3}{8}$-iron with a space of 10 inches from the

backing, to prevent splinters from being driven into the turret when struck by a projectile.

Diameter of turret outside, 26 ft. 6 in.
Diameter of turret inside, 21 ft. 5 in.
Height outside from flaps, 5 ft. 5·5 in.
Height inside from deck to crown, 8 ft. 8·5 in.

TURRET SIGHTS.

Each turret has five "man-holes," centre, intermediate, and wing. The centre and wing man-holes are fitted for a fore-sight and a hind-sight. They are so adjusted that a vertical plane through any pair of sights will be parallel to a vertical plane passing through the axis of the gun and slide. When the hind-sight is set at zero, and the ship on an even keel, the plane passing the notch of the hind-sight and the top of the fore-sight is a horizontal plane; the sights are also of sufficient height to allow of the line of sight clearing the edge of the turret when the hind-sight is at its maximum height.

THE 10-INCH M.L.R. GUN OF 18 TONS.

(MARK I.)

This gun consists of an "A" tube, a "B" tube, a breech coil, triple coil, trunnion-ring, and a triple coil in front of the trunnions welded together; and cascable.

CONSTRUCTION.

1. The Inner Barrel.—This is a solid-ended tube of steel, which is greatly increased in tensil strength by heating the roughly-bored tube to the required temperature in a vertical furnace, and then plunging it into a bath of rape oil, in which it is allowed to cool or soak for about twelve hours. The tube then undergoes a second boring, after which it is subjected to a hydraulic pressure of 3½ tons on the square inch. If no flaw is detected, the tube is considered safe and sound.

2. The "B" Tube.—This is composed of two single and slightly taper coils united together. The coils have been made and welded in the usual manner; the "B" tube is shrunk on over the inner barrel of steel.

3. The Breech Coil.—The breech coil or jacket consists of a triple coil, a "C" coil, and a trunnion-ring. The triple coil consists of three concentric coils, each coil being shorter than the one it surrounds, and the middle one coiled in the reverse direction so as to break joints. The triple coil is then placed in a furnace for about ten hours, at the end of which time it is at welding heat; it is then placed under a powerful hammer, and the whole welded together. The "C" coil is a triple coil constructed in a similar manner. The trunnion-ring is made of slabs of iron, consecutively welded together on the flattened end of a porter bar, and gradually formed into a ring.

All these parts—breech coil, "C" coil, and trunnion-ring—being prepared, the trunnion-ring is heated to redness and dropped on to the shoulder of the breech coil, and while the trunnion-ring is hot the "C" coil is dropped down upon the front of the breech coil through the upper portion of the trunnion-ring which was left projecting; the trunnion-ring thus forms a band over the joint, and in cooling contracts round both coils and grips them sufficiently tight to allow of the whole mass being placed in a furnace, where it is raised to a welding heat in about thirteen hours. The mass is then quickly placed on its breech-end under a most powerful hammer, and thoroughly welded; the body is then turned in a very powerful lathe to the required shape, and rough and fine bored; the female thread for the cascable is then cut, the jacket is subsequently heated for about ten hours, and shrunk on to the inner steel barrel and "B" tube.

4. The cascable is made of the best scrap-iron. The operation of screwing it into the breech-coil requires great care, as the front must bear evenly against the end of the steel barrel or "A" tube; one round of thread is turned off the end of cascable, so that an annular space may be left there, which, in connection with a channel cut along the cascable and across the thread, forms a gas escape, to give warning in case the "A" tube should split at the end. After the cascable has been finally screwed in, a hole is drilled and tapped through the male and female threads in a slanting direction on the left side, and a plug is screwed in. The gun is then fine bored.

As a rule, a length of about two calibres is left unrifled for the powder-chamber. The unrifled part should be as long as can be allowed, provided that no air space is left between the smallest charge used and the base of the projectile, as rifling tends to weaken the tube, and the seat of the charge should be the strongest part of the gun.

Two parallel lines are cut across the vent-field to indicate the unrifled part of the bore. Similar lines are engraved on the top of the gun to denote the position of the centre of gravity.

On the left trunnion are the initials of the gun factory; the register number of the gun, by which it is registered in the department, records the numeral signifying its pattern and the year of proof.

The nature of the material of the inner tube is stamped on the face of the muzzle, as is also the number of the tube as entered in the registry of manufacture.

These guns mounted in turrets, the vent is placed on the right or left hand side as convenience demands.

Hydraulic Pump.

On the outside bracket of each gun carriage is attached a reservoir, which is filled within two inches of the top with fresh water; and the addition of a little soft soap or washing soda will cause them to work well, and will keep the packing in good order.

See the rams are close down before putting the liquid into the reservoir.

To Raise the Gun.

Shut off the stop-valve, ship levers on crank spindle, and by its means the plunger is worked to and fro, being a double action pump; at the end where the lever is forced down a vacuum is created, and the liquid is drawn up through an inlet-valve into the pump. At the opposite end the lever is up, and the liquid in the pump is forced through a stop-valve into the copper pipe leading into the cylinders, under the rams, thus raising them with the weight of the gun.

To Lower the Gun.

The stop-valve is loosened, which allows the liquid in the cylinders to pass back through the copper pipe into the reservoir.

Nipping Lever.

Is connected to an iron shaft passing through the brackets of the carriage, on which are two eccentrics which work in the upper part of a link, the lower part of which is connected to

the lifting-block, over which the endless chain passes. Underneath the bottom plate of the carriage are fixed two sprocket-plates, having six sprockets projecting downwards. On moving the lever, which fits on to the end of the shaft, the eccentrics are turned, bringing the lifting-block close up, so that the sprockets take into the links of the endless chain and holds the gun for running in or out.

The nipping lever is not to be let go until the compressor is set taut.

Lifting Lever

Is an iron shaft passing through the brackets of the carriage, and has two eccentrics fitted into two gun-metal rollers. By pulling up the lever on the end of the shaft the eccentrics are turned in the rollers, and the rear end of the carriage is raised up clear of the slide, also placing the weight on the fore rollers. When running the gun in or out, the lifting lever is to be let go before setting taut the compressor, and at any time if the gun is going out too fast.

Compressor.

Long flat bars are placed between the sides of the slide, and are attached to the deck of the turret by means of a bolt passing through their inner and outer ends, which allows motion to the bars. Short plates of the same depth pass through, and are attached to the lower part of the carriage. These plates fit into the spaces between the bars attached to the turret deck, and the whole can be tightly compressed together by means of short levers (called rocking-levers) acting on the two outside plates in the carriage, and are worked by means of a wheel and handle on the outside end of the compressor shaft, which passes through both brackets of carriage. On the shaft are two male threads, also two gun-metal cylinders, which have female threads, and two lugs over which the eyes of the rocking-levers are attached. A bolt passes through the centre of the rocking-levers and through the ends of a saddle on the bottom plate of carriage; the toes of the rocking-levers fit into two square bolts. By

turning the wheel on the end of compressor-shaft towards the breech of the gun, the male thread on the shaft, working in the female thread of the gun-metal cylinders, draws them outwards, forcing the toes of the rocking-levers inwards with the bolts, which compresses bars and plates together and holds the gun and carriage; turn the wheel towards the muzzle of the gun, the gun-metal cylinders are drawn inwards on the shaft, the bolts are clear of the plates, and the gun is free to move on the slide.

When firing full charges, the compressor is to be set up by a lever supplied for that purpose. The compressor bars should be kept free from oil or grease.

NEW PATTERN B.L. GUNS.

The present class of breech-loading ordnance dates from 1880, the system being known as that of the "Interrupted Screw."

The earliest breech-loading guns of this nature did not effect construction, though by use of the breech-loading system it became possible to improve the form of construction a good deal. At the same period the manufacture of steel was brought to great perfection, the result being the present all-steel method of construction.

There are altogether five systems of construction, viz.:—

I. Steel tubes, with wrought-iron hoops, E.O.C. (Elswick Ordnance Construction).
II. The second pattern consists of steel tubes and wrought-iron jackets, R.G.F. 1st (Royal Gun Factory).
III. Steel tube, with steel and wrought-iron coils, R.G.F. 2nd.
IV. Steel tube and steel coils, R.G.F. 1st steel.
V. Steel tubes, breech piece, and steel hoops, R.G.F. 2nd steel.

In example I., the 6-inch 80-cwt. gun, the powder-chamber is coned down at each end, so as to get a small breech-screw and the Elswick cup system of obturation.

In example II., the 6-inch 81-cwt. guns, the jacket is of wrought iron, and the trunnions are welded on, and the steel tube is much thicker; and the powder-chamber is not coned at the breech end with the Elswick cup system of obturation.

In example III., which is the 9·2-inch 18-ton gun, Mark I., the inner tube is of steel, with wrought-iron coils, and inner coils of mild steel, with the cup system of obturation. Mark II. is the same, but has the De Bange pad system of obturation.

In example IV., which is the 8-inch gun of 11 tons, Mark I. and II., the inner coil of steel with mild steel breech-coil, and the trunnion-coil of forged-steel and threaded to screw on to the breech-coil. In this gun the powder-chamber is cylindrical.

In example V., which is a 6-inch gun of 84 cwt., Mark III., the breech-screw closes into the breech-coil, and not into the inner "A" tube, the object being to equalize the strain on the "A" tube and breech-coils.

The breech-piece is trepanned from a solid ingot of steel, and outside the breech piece are placed exterior hoops; the trunnions form a hoop, which is kept in place by a key-ring in two halves, and over the key-ring is shrunk the "C" hoops to keep the two halves together.

In some cases the trunnion-coil is threaded, and a locking-ring of gun-metal screwed on to keep it in place. (6-inch, *Albert*).

The 25-ton gun is of steel, the inner tube surrounded by steel hoops, over the powder-chamber being a wire-coil of peculiar construction.

The 43-ton B.L. gun is similar in construction to the 9·2-inch gun, but having a key-ring in two halves, the same as the 6-inch, as in example V.

All the newer guns of the breech-loading system are what is called chambered guns, the powder-chamber being much larger than the bore, the object being to enable a very large charge to be used, and to bring less strain on the gun, the fore end of the chamber being coned down to meet the size of the bore.

DESCRIPTION OF THE 10-INCH R.B.L. GUN OF 25 TONS.

The "A" tube is a solid ingot of highly-tempered steel, bored out to a diameter of 10 inches, and is the full length of the bore of the gun, viz., 25 feet, and is turned on the outside till the thickness of the tube is not less than 3½ inches at the muzzle and 4½ inches at the breech; the breech end is then

bored out to 14 inches in diameter for a length of 3 ft. 2 in., when it gradually decreases for 1 foot till the diameter of the bore is reached, viz., 10 inches, making the total length of the enlarged part 4 ft. 2·8 in.

This is called the powder-chamber, the rear end of which for a distance of 2½ inches is bored out to 14·4 inches in diameter; this is countersunk with a groove all round it, into which is pressed a soft copper ring which is planed down smooth, and this forms the seating for the obturator cup.

The inner jacket is next prepared from a coil of forged steel, and bored out to the diameter of the rear end of the "A" tube; it is then heated and shrunk on to the rear end of the "A" tube. It extends along the tube 10 feet, and overlaps the rear end for a distance of 1 ft. 8 in. (which is threaded with a coarse left-handed thread and divided into four sections, and into which screws the breech-block), making the total length of the jacket 11 ft. 8 in., which places its fore end before the trunnions. The thickness of this jacket is 3 inches.

The 12-coiled steel hoops, which are 15 inches in length each, are next placed on hot, and shrunk into position one at a time in front of the inner jacket. The hoops are from 3½ to 3 inches thick. The thickest is placed next the inner jacket.

The trunnion-coil is next prepared from forged steel, and placed at the centre of gravity of the gun when finished.

In rear of the trunnion or ring coil is placed two steel hoops, 3 inches in thickness and 15 inches in length. In rear of these rings a space of 5 ft. 8 in. is left.

The locking-jacket is next placed square with the rear face of the gun, and shrunk into its place. It is 3 inches thick and 16 inches in length. And into the above space of 5 ft. 8 in. is wound a coil of flat steel wire, which extends to the front and rear of the powder-chamber.

The outer jacket is next prepared of coiled steel, and extends from the rear of the trunnions to the rear face of the gun, and is 2½ inches in thickness.

The front coil is then prepared and shrunk on in front of and set into the trunnion coil. Its front end is then tapered off to nothing.

The gun is then placed in a lathe and turned down to gauge with a swell muzzle, and at about 5 feet from the breech there are six grooves or ways cut into the outer jacket, into which fit a corresponding number of teeth on the inside of the two segments that completely encircle the gun at this point, and outside these segments is shrunk on the elevating band, to which, on the right side, is attached the elevating arc patches.

The rear face of the gun is then recessed to a depth of 6 inches and a width of 3 inches, into which fits the breech-ring, which is of gun-metal, and is secured by six powerful screw-bolts. And on the right of the breech-ring is the bracket, to which, by means of a joint bolt, is fixed the platform, which is a gun-metal casting, with a spring catch on its left side, which hooks on to the breech-ring and retains the platform in its position close to the gun, and is released by a projection in a slot on the breech-block as the breech is opened, thus allowing the platform to swing to the right, where it is retained by the platform catch (its position whilst loading), which is fixed into the bracket on the breech-ring. In the centre of the platform is a hole, into which fits a spring locking-bolt, which is worked by means of a jointed lever under the platform, and its use is to retain the breech-block on the platform while the gun is being sponged and loaded, while the bolt is withdrawn by the arm of the jointed lever pressing against the face of the gun, and the downward motion of the lever withdraws the bolt from the breech-block and allows it to be pushed into the gun.

The breech-block, which is of forged steel, and turned to size, and threaded with a coarse left-handed thread, which is divided into four sections, and corresponds with the divided thread in the breech of the gun. The block is pierced through the centre for the reception of the needle-holder from the rear and vent-bolt from the front; in front of the breech-block

there is a steel disc, which is slightly coned on one side, the flat face being placed next the breech block (between these a brass disc is placed); in front of this is placed the obturator, which is a saucer-shaped disc, the lip of which fits into the soft copper seating at the rear end of the powder-chamber before described. The obturator and disc are secured to the breech-block by the vent-bolt, which is of steel, with a flat head, close up to which is a fine right-handed thread, by which it is secured to the obturator, and passed through the disc and brass washer into the breech-block; on the end of it is a coarse right-handed thread, on which is screwed a collar, which is locked by means of a split spring; the rear end of the bolt is recessed to receive the primer. The rear face of the breech-block is capped with a gun-metal casting, to which is attached two handles and two brackets, the smaller for the hammer, which is of bell-crank form, and to its shorter arm the lanyard is hooked; the longer arm carries the head, a projection on which comes in contact with the needle when the lanyard is pulled. The larger is for the locking-lever, which is fixed to the bracket by means of a joint bolt, that screws in; the lever has a cam on the boss, which, when the lever is down, fits into a recess in the rear face of the gun, thereby locking the breach, which prevents it moving when the gun is fired.

The needle-holder is a steel bolt, pierced through the centre for the reception of the needle. Close to the front end of the needle there is a collar, and in front of this collar is placed a spiral spring; over this spiral spring fits an adaptor; in front of this a screw collar closes the front end of the needle-holder, and keeps the needle in its place. The spring causes the needle to resume its normal position after having been struck by the hammer. In front of the adaptor is a slot, into which fits the head of the primer. The rear end of the needle-holder is fitted with two handles and a collar; in front of the collar is a divided thread, which has a corresponding thread in the rear end of the breech-block, into which the needle-holder locks. On its rear face is a collar, in which a slot is

cut, which, when the needle-holder is locked, allows the projection on the hammer to strike the head of the needle. This is one of the safety-arrangements which prevents the gun being fired unless the needle-holder is properly locked. There is another safety-arrangement, which consists of a bell-crank lever and a sliding guard, attached to the rear face of the breech-block in such a manner that the upper arm is acted upon by the boss of the locking-lever. When the breech is open, the sliding guard on the bell-crank lever is in such a position that the projection on the head of the hammer will strike it if an attempt is made to fire the gun, and the hammer will then be prevented from striking the firing needle in the needle-holder. When the breech-block is moved into its proper position for firing, and the locking-lever has been put down so as to lock the breech-block, a projection on the boss engages the upper arm of the bell crank lever; this raises the sliding guard out of reach of the hammer, which is then free to strike the head of the needle.

For electrical firing, the needle is removed from the needle-holder, and the front end is fitted with a special adaptor, slotted on one side to facilitate the insertion of the wires through the needle-holder. The gun is rifled with 42 grooves, with a twist which is spirally increasing from 1 turn in 100 calibres, at the breech, to 1 turn in 40 at 14½ inches from the muzzle, the remainder 1 in 40.

The gun is pierced for sights on both sides, and is provided with three sights, viz., a tangent scale, graduated up to 15 degrees, for elevation 10,000 yards full charge, and 8,400 yards reduced charge, and is fitted with a deflection-leaf marked in degrees on the rear face of the bar of the sight. It is also fitted with a vertical vernier marked in minutes for elavation for accurate adjustments. The tangent scale is inclined 1° 10′ to the left of the vertical, to compensate for deviation due to twist of rifling. If any correction is required on account of wind, or any other cause, it can be given by moving the deflection-leaf in the required direction.

The gun is also fitted with two trunnion sights. These sights consist of a steel pillar, with a gun-metal socket and collar; the top of the steel pillar forms a hog-backed sight; the socket is permanently fixed in the gun, and the pillar and collar each lock into it with a bayonet joint, so that when once the sight is in its true position it cannot be moved without first raising the collar and turning the pillar round a quarter of a circle. The sights are marked for the right or left.

The carriage is wrought-iron, double plated, and fitted with front and rear transom, into which is fixed two forged steel recoil presses. It is also fitted with differential elevating gear on the right side, and the carriage is mounted on permanent rollers.

The slide is wrought iron, extra single-plated. The upper surface, on which the carriage runs, is of forged steel, and is inclined at an angle of 5°, which is sufficient to cause the gun to run out of itself. It is fitted with front and rear buffers and side tackles with serpent-wheel winches for running in or out, and the slide is permanently fixed to the deck.

The elevating gear is differential, and is fitted to the right side of the carriage; it consists of the usual toothed arc fixed to the right of the gun with two axles, into which gears a pinion, carried on a spindle which passes through a bush in the bracket of the carriage; this bush carries on its outside end a toothed wheel, which is fixed to the bush by four screw bolts. A toothed wheel of the same diameter, but provided with two more teeth than the fixed wheel, is attached to the pinion-shaft by means of a friction-cone on the spindle. Outside the friction-cone is placed a strong saucer-shaped spring (which is kept in position by a nut and keep-pin), which sets the outer toothed-wheel on to the friction-cone, and causes sufficient friction to drive the gun under ordinary circumstances, but allows the spindle to revolve when any excessive strain comes on the pinion, such as occurs when the gun is fired.

At that part of the circle where the teeth of both wheels correspond, a planet-wheel is placed. The whole is then

surrounded by a casing, which, besides covering the whole in, it affords a bearing for the axle of the planet-wheel, and at the opposite side of the casing is placed the handle; on the outside of the casing is placed arrows, to indicate the direction in which to turn. The gear requires no clamping or stop.

Recoil Press.

The carriage is fitted with two recoil presses, which are fixed to, and recoil with, the carriage. Passing through the recoil presses are two piston-rods, which are attached to the slide, front and rear, by means of links and pins. On the centre of the piston-rods are pistons fitted with recoil valves, loaded by means of strong spiral springs, which are screwed up to the required amount of compression by means of nuts, which are kept in their place by means of locking-pins. Care should be taken, when the pistons are taken to pieces to clean or otherwise, that the nuts should be replaced in their correct position and the keep-pins replaced. The lift allowed for the valve is only ·035", and an error in replacing these nuts may lead to serious results. The pistons are packed by means of a screw-ring. The recoil presses are connected front and rear by connecting pipes, and a clack-valve is fitted to the union of the connecting pipes in front. The valve is arranged so that it closes if the carriage attempts to charge to the rear through the motion of the ship or the gun being fired, but opens automatically, and allows the carriage to run out into the firing position.

There are four filling-holes on top of the cylinders, one in front and one in rear of each, and two drain holes, one in front of each cylinder underneath, and these holes are closed by screw-plugs and washers.

Action of the Recoil Presses.

On the gun being fired, the carriage charges to the rear, and the liquid in the front end of the cylinder closes the clack-valve, and is forced through the holes in the pistons against

the loaded valve, and passes to the rear end of the cylinders through the loaded valve, thus absorbing the force of the recoil. As soon as the recoil is spent, the liquid flows along the connecting pipes from the rear end of the cylinders, lifting the clack-valve passes to the front end of the cylinders, thus allowing the gun to run out automatically.

If the gun is to be run in for cleaning or otherwise, the clack-valve must be set for the running-in position. In firing, great care must be taken by the officer in charge to see that the clack-valve is set for the firing position, for if the gun was fired with the clack-valve set for the running-in position the result would be serious.

To fill the recoil presses, the gun must be run close into the rear buffers of the slide and the four filling-plugs removed, the clack-valve adjusted for the running-in position; then screw in the filling-funnel to one of the rear filling-holes, and pour in the liquid till it overflows at front filling-holes, then screw in front filling-hole plugs, and continue to pour in the liquor till it overflows at opposite filling-hole, taking care that the cylinders are perfectly full of liquor and free from air; then remove the funnel and screw in rear filling-hole plugs, set clack-valve for firing position, and the gun is ready for firing.

To remove the liquid from the cylinders, run the gun close out and take out the drain-plugs and the rear filling-plugs, and set clack-valve for running-in position, and the cylinders will run dry.

Before firing, the cylinders should be examined to see that they are full, and the piston-rods properly oiled.

To Dismount the Carriage.

Remove the clip-plates from the inside plates of carriage, and also the rear transom of slide; then remove the piston-rods from the recoil presses, place four shackles in the holes cut to receive them, hook on the slings, and, when all is clear, pull up.

WEIGHT.

	Tons.	cwt.	qrs.	lbs.
Carriage complete, with recoil presses	5	2	2	21
Slide for ditto, with piston-rods and running in and out gear	3	11	1	15
Total weight of mounting ...	8	14	0	8

DESCRIPTION OF 8-INCH R.B.L. GUN.

This gun is made of steel, in ten parts; the inner tube being of solid steel, bored out to the required calibre, and is the full length of the gun (except the breech-block). Over the inner end is placed the inner breech-coil, which terminates in front of the trunnions; three small coils or jackets are in rear of the trunnion-ring, and form the outer breech-coil or jacket. The breech-block closes into the breech-coil or jacket, and not into the inner tube, and is of solid steel, and fitted to close on the interrupted-screw principle. To the front end is fitted a disc and obturator, and vent-bolt. At the rear end is fitted the firing hammer.

A steel band is fitted over the rear end of the gun to carry the elevating gear, and it also strengthens the gun.

The gun is rifled, on the polygroove system, with 33 grooves, and a spiral increasing twist of from 1 in 100 calibres at the breech to 1 in 40 at 10·8 inches from the muzzle, the remainder a uniform twist of 1 in 40.

The gun is vented axially, and has a central firing arrangement placed in the centre of the breech-block, which is of steel, and called the "needle-holder;" and it is also fitted with an interrupted screw, by which it is fixed in its position in the breech-block, a small stud on one side guiding it in place through a groove. To secure it when in position, it is turned to the left 60° by means of the handles, and the stud prevents it from coming out. For mechanical firing, the

needle-holder contains a steel needle, which is free to travel forward a fixed distance, and when struck by the hammer it returns to its normal position by the pressure of a spiral spring placed between a shoulder formed in the adaptor and collar in the front end of the needle-holder. The rear face of the collar rests against a shoulder in the needle-holder, which prevents the needle falling out. The adaptor is fixed into the front end of the needle-holder, and is fitted with claws to hold the base disc of the primer in such a position that when the needle-holder is inserted in the gun the primer fits accurately into its chamber in the vent-bolt.

For electric firing, the needle is removed from the needle-holder, and the front end is fitted with an electrical adaptor, slotted on one side to facilitate the insertion of the primer, with the wires attached into the needle-holder.

The firing hammer is of bell-crank form, and secured to the rear end of the breech-block with a pin and split-spring; to its shorter arm the firing lanyard is hooked; the longer arm carries the head, a projection which comes into contact with the needle when the lanyard is pulled.

The front end of the breech-block is fitted with a steel disc and obturator, which is secured in position by means of the vent-bolt. The steel disc has a flat surface, which is placed next to the breech-block, the other side being slightly curved, and fits against the flat side of the obturator. The disc is also marked to prevent its being put on the wrong way: flat face next to breech-block. (See description of Obturator).

Secured to the rear end of the gun is a metal breech-ring, to which is fitted the mechanism for opening and closing the breech. The carrier or platform is hinged to the breech-ring, with pin, washer, and keep-pin, and is kept in position by lever-catches and springs. On the breech-block being withdrawn, the catch acts automatically, and when the block is clear of the gun the carrier is unhooked from the breech-ring, and swings clear of the breech of the gun. Another spring and catch keeps the breech-block in position while loading, or steady if the ship has much motion.

After the loading is completed, the carrier is brought up to the gun and kept in position by the clip retaining-lever, which hooks on to the breech-ring. At the same moment the pressure on the tumbler-arm causes the withdrawal of the catch which holds the breech-block on the carrier; the breech-block is then pushed into the gun, and the locking-lever turned down to the left through an angle of 45° till the bracket on the end of breech-block comes in contact with a stop on the breech-ring. The lever is then turned down, which causes the cam on the boss to lock itself into a recess in the rear face of the gun, and prevents any movement of the breech-block at the moment of firing.

Should there be any difficulty in putting the locking-lever down by hand, the small tube-lever (with hook used for extracting the needle-holder) will give ample power.

The tube-lever can also be used for starting the breech-block after firing, should it become necessary in unscrewing.

When the breech-block has been unscrewed after firing, it can be started when withdrawing it from the gun by turning down the locking-lever when the cam on the boss bears against the face of the gun.

Safety-Arrangements.

A safety-arrangement is provided which prevents the gun from being fired until the breech-block is properly closed, and the needle-holder is in its proper position. This arrangement consists of a bell-crank lever and a sliding-guard, which are attached to the breech-screw in such a manner that the upper arm is acted upon by the stud on the boss of the locking-lever.

When the breech is open, the sliding-guard attached to the bell-crank lever is in such a position that the projection on the head of the firing-hammer will strike it if an attempt is made to fire the gun, and the hammer will then be prevented from striking the needle in the needle-holder.

The rear face of the needle-holder is formed with a projecting rim, slotted away in one place to the width of the shank of the hammer; this acts as an additional safety-arrange-

ment, and prevents the hammer striking the needle except when the needle-holder is secured in proper firing position.

When the breech-block is moved into proper position for firing, and the locking-lever has been turned down so as to lock the breech-screw, a projecting stud on the boss of the lever engages the upper arm of the bell-crank lever, and raises the sliding-guard out of reach of the hammer, which is then free to strike the head of the needle.

Sighting.

The gun is fitted for sights on both sides, the tangent scales (or side sights) being graduated up to 12°, and marked in distance of yards for full and reduced charges, the former up to 7,700 yards, the latter 7,000 yards; each sight is fitted with a deflection-leaf marked to ½° each way, in divisions of 5′ on the rear face. The tangent scale is inclined to an angle of 1° 30′ to the left of the vertical, to compensate for deviation of projectile due to the twist of rifling.

The deflection-leaf is used when the wind is blowing across the range or any other cause by moving the leaf in the required direction; it is also used when firing at moving objects, such as a ship, or *vice versâ*.

The Trunnion Sights.

These sights consist of a steel pillar, with a gun-metal socket and collar; the top of the sight forms a hog-backed sight, the socket permanently fixed in the gun, and the pillar and collar each lock into it with a bayonet joint, so that when once the sight is fixed in its true position it cannot be moved without first raising the collar and turning the pillar round a quarter of a circle.

The Carriage and Slide.

The carriage is made of wrought-iron, and is mounted on permanent rollers. It is fitted with frictional elevating gear on the left, and a self-acting Elswick plate compressor. The carriage admits of 13° elevation and 5° depression.

The slide is of wrought-iron, and the surface on which the carriage runs is placed at an angle of 4°, which is sufficient to

cause the gun to run out of itself when the compressor is eased up. It is held by a front pivot, and fitted with training and running-in gear, worked by means of winches at the rear end of the slide.

The training gear consists of a worm shaft to the rear part of the slide, and gears into a worm-wheel attached to the training-shaft, which works a pinion in the training-rack in the deck. The slide can be trained 25° each way.

Elevating Gear.

The elevating gear is fitted on the left of the carriage, and is worked by means of a hand wheel, bolted on a spindle, passing through the carriage cheek, and having a pinion formed on it outside, which works the spur (or cone) wheel. This wheel is carried on a spindle, but is free to rotate on it. The outer face has a coned recess, into which is fitted a metal cone. The part of the spindle carrying the cone is hexagonal, and the cone consequently rotates with it. The spindle passes through a bush fixed in the cheek of the carriage, and has on its inner end a pinion, which engages the elevating arc fixed to the side of the gun. A dished spring is placed on the spindle next the cone. The outer end of the spindle is screwed for the nut, which forces the dished spring against the face of the cone.

This causes sufficient friction between the spur (or cone) wheel and the cone to elevate or depress the gun, but will allow the pinion-spindle and cone to revolve without putting all the gear in motion.

A friction brake is provided for holding the spur-wheel when the requisite elevation or depression is given, the rubbing pieces being forced up against the face of the spur-wheel by moving the handle of the clamp.

Running-in Gear.

For running the gun in, the winch handles are shipped on the pinion-spindles of the winches for running in on the sides of the slide; tackles are then hooked to the front loops of the carriage and the rear part of the slide, and the falls passed

over the V pulleys on the winches ; the gun can then be run in and out quite easily.

Securing Gear.

The gun is secured by means of chains to the deck, the front chains being secured to a band round the muzzle of the gun, and the rear chains to a half-band on the breech end of the gun.

The carriage must be run in until the buffers are against the brackets on the slide ; the securing chains are then set up, the slide is further secured by chocks of wood, fitted to the racer and rear rollers of the slide. Clip plates are placed at the fore part, which engage a clip racer, and prevent the slide from tipping.

The compressor should be set well taut.

Racers.

The racers are of gun-metal, and are secured to the deck by means of gun-metal coach screws, except the joints, where galvanized bolts are provided, to go through the deck.

Care must be taken that the racers are laid very level, in one plane, and well bedded.

Weight.

	tons.	cwt.	qr.	lbs.
Carriages, complete	3	1	0	0
Slide	3	9	2	0
Racers and deck fittings	0	12	1	0
Securing chains	0	3	2	0
Total	7	6	1	0

In order to preserve the carriage in working order, the axles, spindles, pinions, and all bearings must be kept clear of clotted oil and rust, and well lubricated. Should the carriage have been stationary for any length of time before practice is carried out, it should be run in and out, and the compressor-lever worked to clear away the rust.

THE ELSWICK COMPRESSOR.

"Albert's" 8-inch Gun.

This compressor is the Service pattern adopted for the carriages and slides of 7, S, and 9-inch M.L.R. Guns.

It consists of 15 long flat bars placed between the sides of the slide, and are attached to it at their inner and outer ends by means of a bolt passing through them, which allows motion to the bars; 16 plates of the same depth pass through and are attached to the bottom plate of the carriage; these plates fit into the spaces between the bars in the slide, and the whole can be compressed tightly together by means of short levers, called "rocking-levers," acting on the two outside plates in the carriage, and which are worked by means of a compressor-lever, fitted to a shaft called the compressor-shaft, which passes through the brackets of the carriage. After the gun is out, the whole of the bars are compressed tightly together by the lever. Very considerable friction is caused on recoil, and is continued until the whole force of the recoil is expended and overcome.

The compressor-shaft passes through the sides of the carriage, and is threaded with a right and a left-handed thread, upon which work two metal nuts also threaded on the inside, the end of the shaft passing through the left side of carriage, and secured with cap and screw nut. The rocking-levers are bolted to the bottom plate of the carriage, the toes of which press against the two outside plates, which are made thicker than the others to take the strain of the rocking-levers. The heads of the levers are fitted into the metal nuts on the shaft, and in moving the compressor-lever both rocking-levers are worked, and the compressor set taut or eased-up.

The compressor-lever is fitted to the shaft, and has a circular disc attached for adjustment on the right of the carriage, the lever being secured to the disc by means of a pin. The disc for adjustment is provided with 25 holes in it, and are numbered, 1, 2, 3, 4, &c., and to tighten the compressor the pin

must be taken out of the lever, the lever moved round to a higher hole, and the pin replaced; if one hole is too much, half-a-hole adjustments may be obtained by putting the pin into the intermediate hole at the opposite end of the lever. A catch is fitted on the right of the carriage to prevent the lever from flying up on the gun being fired; also a tripper on the slide, which will force down the lever should it be left up when the gun is fired, a buffer being fitted to the carriage to take the force of the blow.

The efficient working of the compressor is a most important point, and depends on the careful management of the compressor-lever.

When using full charges, the lever should be just forced below the catch, care being taken not to bring too much strain on the carriage.

The compressor-bars and plates should be kept free from oil or grease.

Directions for Dismounting.

1st. Place the carriage in the centre of the slide, so that both compressor-bar pins are clear, with the plates over the centre bottom plate of slide. Take out the rear compressor-bar pin and remove the washers, so as to give more lateral motion to the bars.

2nd. Slack the compressor, taking care the carriage is shored up. Take off compressor-lever and disc; then remove the screws and take out compressor-bearing from right of carriage.

3rd. Push the shaft to the left, and run the right compressor nut off on to the smooth space between the two threads.

4th. Take off the cap from the left end of the compressor-shaft; then push the shaft to the right, and run off the left nut from the end of the shaft. The shaft may now be drawn out.

5th. The bars may be drawn out to the rear, and the plates taken out or dropped through the carriage under the slide.

To Remount.

1st. The bars having been placed in the slide, bolt them to the front bracket, leaving the rear ends unbolted, so as to be free to move on either side.

2nd. Place the plates in their places (with respect to each bar) just before the centre bottom plate of the slide, the two thickest outside.

3rd. Pass the shaft through the right of carriage, and put on the right compressor-nut, and let it remain on the smooth space between the two threads; then put on left nut and run it up on the thread as far as it will go; the two nuts will now be close together.

4th. Push the shaft to the left so that the end will project through the left side of the carriage; then put the cap on the end of the shaft and run the right nut on to its thread, leaving the inner surface of the nut even with the end of the thread.

5th. Push the shaft to the right until the cap on the end of it comes in contact with the left bracket of the carriage; then replace the bearing in the right bracket. Adjust the nuts so that the threads are equal, replace the compressor-lever and disc, and adjust as required, replacing the compressor-bar pins and washers.

DESCRIPTION OF 6-INCH R.B.L. GUN OF 4 TONS.

This gun differs in construction from the 8-inch gun, not being made in so many parts, but its general principles are the same.

It is built up of steel hoops or jackets, except the trunnion jacket, which is of wrought iron. It is in seven parts, namely, the inner tube of steel, over the breech end of which is placed an inner breech-coil, extending as far as the centre of the trunnion-ring, and met by another coil in front of the trunnions; over this is placed the trunnion-ring (or coil), and butts against a shoulder on the inner coils; the front end of the trunnion-ring is threaded and a metal locking-ring is

screwed on, which keeps the trunnion-coil from shifting; in front of the trunnions is another coil, being let into it and secured; over the rear end is placed the outer breach-coil, and, with the breech-block, completes the gun. Round the centre of the powder-chamber is placed a wrought-iron band to carry the elevating gear, and this also strengthens the gun.

The system of the breech-closing is the same as the 8-inch gun, except that the lever is turned to the left 60° in locking.

The 6-inch gun is mounted on a naval hydraulic automatic centre-pivot carriage and slide.

The carriage is hydraulic, and has a gun-metal recoil press on each side, into which the trunnions of the gun engage; over the trunnions are bolted cap-squares, to keep the gun in position. The recoil presses are connected by means of a cast-steel transom.

The slide is of the central-pivot type. It is fitted with rollers front and rear, elevating gear on the right side, and training gear which can be worked from either side; it is also fitted with automatic run-out gear.

The slide is also fitted to receive a pivot-bar, if required; the rollers are made very narrow, and arranged with their axis parallel to the axis of the gun, in order that they may work moderately well either from a front or a central pivot.

A shield is provided, 1¼ inch thick, to protect the gun's crew from machine gun fire. A clip ring is bolted to the deck in front of the carriage, to prevent it jumping up when firing.

The Recoil Press.

The recoil press consists of two metal cylinders attached to the gun, and working over four fixed piston rods, fixed at their outside ends to brackets, which are cast on the slide girders, and their inside ends are screwed into a metal piston which contains a recoil valve, which is kept in position by means of a spiral spring. The piston also contains a clack-valve, to allow the gun to run out quickly after recoil, at the same time the automatic gear is in motion; the cylinders are filled with water or any other suitable liquid, oil, glycerine, &c.

Action of Recoil Press.

When the recoil takes place, the glycerine in the front end of the cylinders is forced through the recoil-valve against the resistance offered by the spiral spring, and passes to the other side of the piston, thus absorbing the force of the recoil. As soon as the recoil is spent, the glycerine flows through the check valve to the front end of the cylinder, and allows the gun to run out into firing position automatically. The carriage is then ready for firing without any attention being required. The recoil presses are connected at the front ends by means of a pipe, which equalizes the pressure. In the pipe a drain-cock is fitted, in order to drain the cylinders when required.

Automatic Run-out Gear.

Under the transom of the carriage are fitted two metal rollers, which work on two inclined parallel bars, which are kept parallel to the top of the slide, and supported by parallel levers. Strong spiral springs, which are screwed up by means of a screwed spindle, are fitted to adjust the bars; at the outer end of the bars are screwed spindles for regulating the height of the bars.

The front end of the bars are cut down, so that the rollers shall not bear on the bars when the gun is in firing position. The rear end of the bars are raised, so that the weight of the gun and carriage is taken on the rollers immediately the gun begins to recoil, the pressure on the springs being regulated so that they will just lift the weight without causing pressure on the clips.

To Fill the Recoil Presses.

Run the carriage back to extreme recoil; take out the plugs from the filling holes, pour in at the front end until it overflows at the rear end, then screw in the rear plugs, and fill up until the cylinders are full; replace the plugs, run the carriage out, and it is ready for firing.

Training Gear.

The training gear is worked by means of winch handles at the fore-part of the slide, which work a cross shaft on the centre of which is a worm. This worm gears into a worm-wheel, keyed to a shaft, on the end of which is a bevil pinion which works in a training rack, bolted to the base plate. The rear end of the shaft is carried in a lifting block, which can be lifted up and down by means of a lever, on the spindle of which is an eccentric which engages the lifting block. This enables the training gear to be thrown out of action at any time if it should be disabled. The slide may then be trained with tackles.

Elevating Gear.

The elevating gear is worked by means of a hand-wheel, which works a shaft by means of bevil gear. On the end of the shaft is a worm, gearing into a worm-wheel which drives a shaft, on the end of which is a pinion inside the slide. This pinion gears into a cog-wheel (friction clutch-wheel), which is attached to another shaft by means of a compressor friction clutch. On the end of this shaft is keyed a lever with double arms, and another at the rear part of the slide. To these levers are connected two elevating bars ; the upper bar is of I-shaped section, the lower one being round. To the upper bar is fitted a sliding slipper, which engages under the top flange to prevent it leaving the bar.

The slipper is attached to the gun by means of a pin through a double eye on a bracket fixed to the gun.

On working the hand-wheel the bars are moved up or down, and the gun consequently elevated or depressed as desired, the bars always retaining a position parallel to the top of the slide by means of the double-arm levers.

The action of the friction-clutch is as follows :—Into the clutch-wheel are fitted four discs, which have notches in their outer circumference and fit into the wheel, with projecting pieces to correspond, and by which they are compelled to go round with the wheel.

On the shaft is fixed a square block or collar, on which are fitted three smaller discs, which come alternately between the large discs; the outside disc is made much thicker than the rest, in order to distribute the pressure from the spring.

The small discs being fitted into the square block, they are compelled to go round with the shaft, so that if the spring is not set up the wheel will revolve without driving the shaft, merely carrying round the large discs with the wheel, the small discs sliding between the large ones.

When the spring is set up the pressure causes a friction between these discs on each surface, and as there are seven surfaces it makes a very powerful clutch.

The spring is screwed up against the compressor-plates by means of adjusting-nuts and the bush, the pressure against the wheel being resisted by the collar on the shaft.

The pressure on the spring is adjusted so that the friction is sufficient to elevate and depress the gun, but it will slip when any undue strain comes on the gear, such as occurs when the gun is fired.

Should the clutch need tightening up, a thin brass washer may be introduced between the bush and the spring, and the nuts screwed hard up again.

Preservation of Carriage and Fittings.

In order to preserve the carriage and fittings in working condition, the axles, spindles, pinions, and all bearings should be kept clear of clotted oil and rust, and be well lubricated.

When not required for immediate use, the elevating arcs, &c., should be coated with a mixture of white lead and tallow.

The recoil-presses should be kept filled with oil in order to keep the internal parts from rusting, and the parts of the piston-rods outside of the cylinder should be coated with white lead and tallow to preserve them from rust. Before firing, the cylinders should be examined, to see that they are full; and the piston-rods and other working parts should be cleaned and oiled.

Weight.

	Tons.	cwt.	qrs.	lbs.
Carriage	0	16	0	8
Slide, complete	1	18	2	16
Deck base plate	1	12	0	7
Racers, racks, clips, pivots, and securing gear	0	14	1	10
Shield, with stays	3	0	0	0
Total	8	1	0	13

DESCRIPTION OF 6-INCH R.B.L. VAVASSEUR MOUNTINGS.

The carriage is on the hydraulic system, and is of steel, with a forged steel recoil cylinder fitted on each side. It is fitted with bearings for the gun trunnions, and with frictional elevating gear on the left side.

The gun is secured by metal cap-squares, which slide in grooves, and retained in position by steel pins.

The carriage admits of 20° elevation and 7° depression.

Slide.

The slide is of the central-pivot type. It is fitted with cast-iron front and rear rollers, which run on a steel racer cast on the pivot plate. It is also fitted with rollers on the upper surface of the cheeks which carry the carriage. Clips are fixed on the roller-brackets, which engage the racer to prevent the slide from tipping.

A steel shield is bolted to the front of the slide, to protect the men from machine-gun bullets and splinters of shell.

Running-in Gear.

The gear is fitted on the left side, and consists of a screw-shaft, which passes through a guide-bracket fixed on the carriage.

On the bracket is hinged a screwed flap, which is engaged to the shaft by forcing its thread into that of the shaft by

means of the iron lever. It will then remain in gear while the carriage is run in. The screw-shaft is worked by means of winch gear at the rear end of the slide. The screw-flap must be out of gear before the gun is fired.

Training Gear.

The training gear is worked by means of winch handles at each side of the slide.

On turning these handles the pinions engage intermediate wheels, which gear into similar wheels keyed on the worm-shaft.

The worm is keyed on the shaft, and engages the training-rack fitted on the pivot-plate.

The Friction Gear.

The lever is attached to the clamping-nut, which is screwed on to a bush on the shaft. This bush is prevented from revolving by means of a key, which engages the base-plate of the slide.

Action of the Friction Lever.

On the lever being raised the nut is screwed outwards and jams against the lower wheel, thus forcing the worm-shaft outwards until the worm jams against the bed-plate. This causes sufficient friction to prevent the carriage taking charge if the winch handle should be left when the ship is rolling.

Elevating Gear.

Elevation is obtained by a shaft, with hand-wheel transmitting motion through a worm and worm-wheel to a spindle-pinion, which gears into the steel graduated arc.

The worm-wheel and the spindle-pinion are connected by a series of friction-plates, the friction between which is regulated by a nut and spring washer, so as to allow sufficient slip, and prevent damage to the gear from concussion in firing.

The shaft is fixed to the slide by the bracket, and allows the worm to slide along it on recoil to the groove, which marks

the limit of extreme safe recoil. The hand-wheel remains stationary, thus enabling the gun to be laid and fired simultaneously.

An adjustable pointer indicates the degrees of elevation and depression on the graduated arc.

The recoil is checked by tension and compression buffers, which are connected by a pipe with suitable valves, to control the running out or to keep the gun in at the end of recoil.

The right hydraulic buffer is in tension, and has its piston-rod fixed to the front of the slide; the left, being in compression, has its piston-rod fixed to the rear part of slide.

Valve Box.

The valve box is fitted with a non-return valve and a by-pass valve.

There are two ports in each piston, which are open when the gun is out, and are gradually closed during recoil by means of a rotary valve on the face of the piston, which is turned by two studs running in rifled grooves in the buffers. By this means the pressure in the buffers is kept nearly constant during recoil.

Action of Recoil Buffers.

During recoil the left buffer piston-rod entering the buffer displaces part of the fluid, which flows through the pipe past the non-return valve into the space in the right buffer left by its piston-rod. At the end of recoil the running out valve being non-return, immediately closes, and prevents the backward flow of the fluid, which can only return through the by-pass valve.

By closing the by-pass valve the fluid will remain in the right buffer, and prevent its piston-rod entering, thus retaining the carriage in on recoil.

By means of the by-pass valve the running out can be controlled.

The running-out valve is loaded by steel springs, the pressure of which can be regulated to counteract any running-in tendency of the carriage when the ship is rolling.

Note.—Two volute-spring buffers are fixed to the front of slide.

INSTRUCTIONS AND DESCRIPTION OF THE 12½-PR. R.B.L. GUN.

The "A" tube is a solid ingot of steel, highly tempered, and bored out to a diameter of 3 inches, and is the full length of the bore of the gun, viz., 6 ft. 9 in.; it is then turned down on the outside till the thickness of the tube is 1·25 inches at the muzzle and 2 inches at the breech. The breech end is then bored out to 4·20 inches in diameter, which gradually decreases till the diameter of the bore is reached, viz., 3 inches at a distance of 13½ inches from the breech end, thus forming the powder-chamber; the rear end of this is further coned out for a distance of 3 inches to form a seating for the obturating wad.

The trunnion jacket is prepared of forged steel, and shrunk into position; the front end is then tapered down to nothing, it is 1 inch in thickness and 18 inches in length.

The breech-coil is prepared of coiled steel, and shrunk into position; the fore end of it overlaps the trunnion jacket ·5 of an inch, and the rear end is flanged down on to the rear end of the "A" tube; the breech end of the gun is turned down for the breech-ring to be fixed in flush, forming the rear face of the gun, The coil is 2 inches thick and 15 inches in length.

The breech-ring is a gun-metal casting, and is secured to the rear face of the gun with five screw bolts; on its right side is a bracket for the platform, and a slot for the reception of the tangent scale, and on the left there are two recesses for the reception of the elevating-arc axles, and in rear on the lower side is a steel catch for retaining the platform into position when it is close up to the gun; there are also two stops, which prevent the locking-lever being moved beyond the required angle; the slot in the rear face of the gun is for the boss on the locking-lever to fit into when the breech is properly closed,

The platform, which is a gun-metal casting, is attached to the breech-ring by means of a joint bolt, and on its underneath side is fitted the platform-catch, which is a lever pivoted nearly in its centre; the front end is turned down so as to form a grip, and just in rear of this there is a projection

upwards in which a recess is fitted to contain a stud, around which is placed a spiral spring which always has a tendency to keep the catch down; in rear of the pivot is a knuckle on the lever, which passes through the platform, and is acted on by the projection in the slot on the breech-block, which bears the rear end down and frees the catch, and allows the platform to come to the rear and swing to the right to the loading position. Should the platform remain stationary at any time after the breech-block is withdrawn, place the thumb of the left hand on the lever under the rear end of the platform, and bear down; this will free the catch, and allow the platform to swing to the right.

The breech-block is of forged steel, and is turned down to gauge, and threaded with a left-handed thread, which is then divided into three sections (the rear end of the "A" tube is enlarged and fitted with a corresponding divided thread, into which the breech-block locks); it is then pierced through the centre; the hole is of two sizes, the smallest being in front, forming a shoulder in the centre; on the rear face of the block is fixed a gun-metal casting, through the centre of which is a hole to correspond with the hole in the block. Across the face of it is a handle by which the block is worked, and on its upper side is a bracket for the locking-lever, which is connected by a joint bolt, and has a cam on the boss which fits into a slot in the rear face of the gun, thereby locking the block in the firing position; this lever is kept up by means of a spiral spring and stud, which are acted upon by the lever being forcibly pulled up or down.

The obturating-wad consists of an asbestos wad, with a hole through the centre; on either side of this wad fits accurately a soft metal disc (composed of lead and tin), whose outer edges are protected by a brass ring; the wad fits accurately into the rear end of the "A" tube, which is coned out for the purpose; it is placed in front of, and secured to, the breech-block.

The obturating-spindle has a dome-shaped head, is of forged steel, and its smaller end is threaded with a right-handed thread, on to which screws a keep and adjusting nut.

The obturating spindle-spring is a powerful spiral spring, and made to fit around the obturating-spindle and into the recess in the centre of the breech-block.

To mount the obturator, place the wad in front of the breech-block, pass the obturator spindle through the wad into the breech-block, place obturator spindle-spring, then screw home the adjusting-nut, push the breech-block into the gun, and adjust the nut so that it requires moderate force to place the locking-lever in the locking position; then screw home the keep nut.

Action of the Obturator on the Gun being Fired.—The gas generated in the gun presses against the dome-shaped head of the obturating spindle, forcing it to the rear; the circumference of the obturating-wad is thereby expanded so as to tighten against the surface of the bore, which is coned out to receive it, thus forming a gas-tight joint.

In closing the breech, great care must be taken that the platform is close up to the gun before the catch is freed to allow the block to move forward, whereby the obturating wad is liable to be damaged against the female thread of the breech-screw. Care is also to be taken that the head of the obturating-spindle attached to the breech-screw, together with the obturating-wad, are kept uninjured and free from burrs. Should any notches or burrs occur or be observed, the damaged part should be removed and replaced by another one.

To close the breech, bring the platform close up to the gun, and free the catch and push the breech-block close in; then turn the locking-lever over to the stop on the left through an angle of 60°; then turn the lever down, thus locking the breech with the cam on the boss in the slot in the rear face of the gun, which prevents the breech-block moving when the gun is fired.

To open the breech, raise the locking-lever till the cam on the boss is free from slot in the gun, then bring the lever perpendicular, thus unscrewing the breech-block; then draw the block on to the platform, free the catch and swing it round to the right.

Should there at any time be any difficulty in putting the locking-lever down by hand, the small tube-lever supplied for that purpose will give ample power. The tube-lever can also be used in starting the breech-screw after firing, should this action be found necessary in unscrewing. When the breech-screw has been unscrewed after firing, it can be started when withdrawing it from the gun by bearing down on the locking-lever, thus causing the cam on the boss to bear against the face of the gun, thus bringing the block to the rear. In firing, the threads of the breech-screw should be kept properly clean and free from dust or grit, and well lubricated.

The gun is sighted on the right side, and is provided with two sights, viz., one tangent scale of steel, graduated up to 15°, with head forged solid, and is fitted with a bronze sliding-leaf marked in tens of minutes for deflection up to 1° on either side. This leaf is fitted with a milled-edge thumbscrew for clamping. It has a V-shaped notch for rough laying, and is pierced with a small hole for fine-sighting at long ranges.

The trunnion sight consists of a pillar, collar, and socket of gun-metal; the socket is permanently fixed in the gun. The pillar is screwed into the socket, and prevented from leaving its true position by the collar, which is sliding, and fitted with a key which drops into a recess in the socket. The head of the pillar is cylindrical, and bored horizontally to receive a bush, on which are fixed cross wires, thus forming a reading window for use with the small hole in the deflection-leaf when fine-laying is needed. Above the cylindrical window the pillar terminates in a hog-backed sight, for use with the V-shaped notch on the deflection-leaf.

The bush carrying the cross wires is removable, being held in its position in the pillar with a screw with part of the head filed off. Spare bushes are carried, and should the wires become damaged the bush can be replaced.

The gun is vented vertically by means of a vent-bolt, which is of steel, with the vent-hole pierced through it, and the hole at the top ·2 of an inch, and at the bottom ·1 of an inch in diameter. The head of the bolt is round and flat,

and on the bolt is placed a small copper washer; the bolt is passed through the hole (this hole is on the top side of the gun, and 11·64″ from the rear) in the gun from in out, and the end of the bolt is threaded with a right-handed thread, on to which is screwed a nut (vent-bolt nut).

Spare nut-bolts are carried, so that in case the gun requires re-venting it can be done in a few minutes by unscrewing the nut and driving the old bolt into the gun, and replace it with another.

The gun is rifled with 10 flat grooves, at equal distances apart, thus forming 10 grooves and 10 projections. The rifling is spirally increasing from 1 turn in 100 calibres at breech to 1 turn in 30 calibres at 7·5 from the muzzle; the remainder uniform, 1 in 30. Length of rifling, 5ft. 7·5in.

When the gun is placed in store, all the movable parts, with sights, &c., should be unshipped, and well lubricated, and stowed in a dry place.

Venting.—The gun is vented vertically, being fitted with a removable steel vent, held in position by a nut on the top of the gun. A copper washer, which acts as a gas-check, is placed between the head of the vent and the bore of the gun. When the vent channel becomes worn by firing it should be removed, and replaced by another, before the channel has become so much enlarged as to allow the gas to act upon the metal of the gun. The lower part of the vent-channel is contracted where the greatest wear takes place. This operation is performed by unscrewing the nut, when the vent-bolt will fall into the chamber of the gun. On being withdrawn, a new vent-bolt and copper washer is inserted from the inside, and secured by the nut. Two spare vents are supplied with each gun.

12½-POUNDER MOUNTINGS.

The naval carriage is made of wrought-iron, single plated, and consists of two brackets, bottom plate, transom, and rear stays. The brackets are fitted with brass trunnion bearings and breeching bushes, and are connected together by the

bottom plate, transom, and rear stays. Under the bottom plate is fitted the guides (angle-iron), one on either side, which are to keep the carriage running parallel with the slide. The clips are bolted on at the front and rear of the bottom plates, passing through the guides. These clips are to prevent the carriage jumping. It is also fitted with iron cap-squares, and cap-square keys.

Angles of elevation and depression that can be obtained with the 9-pr. gun, mounted on naval slide and carriage, on board H.M.V.S. *Albert*:—

Elevation, 15°.
Depression, 8°.
Training, from 45° before to 45° abaft the beam.

From 12½-pr. gun, mounted on board H.M.V.S. *Victoria*:—

Elevation, 20°.
Depression, 3°.

Elevating gear is fitted on the left side, and consists of an arc with teeth on its front edge, and is fixed to the gun by means of two arc-axles that screw into the recesses in the breech-ring on the gun.

A gun-metal bush is bolted to the outside of the left bracket, which has formed on its outer end a male screw thread on which the clamp-lever works.

The elevating-spindle is passed through the bush from in out, and on its inner end is forged a pinion, which gears into the elevating arc. The spindle is made hexagonal for a portion of its length after it has passed through the bush, and upon this part is fitted a steel friction cone. The elevating hand-wheel is bored to fit the cone, and is forced on to it by the pressure of the dished steel spring, which is compressed by means of the nut screwed on to the extremity of the spindles. This causes sufficient friction between the hand-wheel and the cone to allow of the gun being depressed, but permits the pinion-spindle and cone to revolve when

the gun is fired without setting the hand-wheel in motion, and thus overstraining the gear. The elevating gear is clamped into position when the requisite elevation or depression has been given by moving the clamp-lever, the head of which is forced up against the back of the steel cone by its travel on the screwed part of the bush.

The slide is made of wrought-iron girders, connected together by plates and angle-irons, and is fitted at the front and rear with wood blocks on the under side, which bear on the deck; the upper surface of the slide on which the carriage rests is placed at an angle of 5°, which allows the gun to be run in or out very easily. It is mounted on a front pivot, and trained by means of rope-tackles and handspikes.

Compressor Gear.

There are two compressor-plates on each side of the carriage carried by brackets fixed outside the brackets of the carriage, and one compressor-bar and wood-filling on either side of the slide girder. These engage each other alternately, and are clamped together by means of a bolt passing through the carriage and the plates, having on its left extremity a head and threaded at the right extremity for a nut, which is furnished with a lever for tightening it up against the plates, thereby setting up sufficient friction to regulate the recoil. Care must be taken to adjust the compression to suit the varying condition of the bars, so that as long a recoil as is consistent with safety may be secured. This will prevent the gear being unduly strained. The compressor-bars must on no account be oiled, and, if wet, fine sand or ashes should be sprinkled over them; the friction will be more regular and effective if the plates are slightly rusty. The gear should never be left unclamped when firing, as there is no self-acting arrangement providing for clamping it, and the carriage and slide would be severely strained should the full energy of recoil be allowed to drive the carriage against the spring-buffers at the rear of the slide.

Training Gear.

The gun is trained by means of tackles hooked to bolts at the rear end of slide, and to bolts on the ship's side. Handspikes are used to assist the tackles if found necessary.

Running-in and out Gear.

To run the gun in, the side ropes are hooked to the bolts at the rear end of slide, and passed over a sheave carried on the outer compressor-plates on the carriage, and by hauling on the ropes the gun is run in. To run out, the side ropes are hooked to the bolts on the fore end of slide there as for run in. The compressor is always to be eased before the side ropes are hauled upon.

Securing Gear.

The slide is secured by means of flaps dropped over pivot bolts fixed in the deck. The flaps are fixed to the front and rear of the slide. The carriage is secured to the slide by clamping the compressor, and the gun is secured to the carriage by clamping the elevating gear. The whole is further secured to the deck by the securing chains, which hook over the cap-squares, and are shackled to bolts screwed into the deck for that purpose. The chains are set taut by means of a screw purchase.

Weight.

	Cwt.	qrs.	lbs.
Weight of carriage, complete	4	1	3
Weight of slide, complete	5	0	18
Total	9	1	21
Weight of gun, carriage, and slide, complete	17	1	21

In order to preserve the carriage and slide in working condition, the axles, spindles, and pinion, and all bearings, must be kept clear of clotted oil and rust, and be well lubricated.

Should the carriage have been stationary for any length of time before practice is carried on, it should be run in and out, and the compressor clamp-lever worked backwards and forwards while the carriage is in motion to clear away any excess of rust that may have been formed.

INSTRUCTIONS AND DESCRIPTION OF 9-PR. R.B.L. GUN (5 CWT.)

The "A" tube is a solid ingot of steel, highly tempered, and bored out to 2·6 inches in diameter, and is the full length of the bore of the gun, viz., 6 ft. 3 in. It is then turned down on the outside till the thickness of the tube varies from ·75 of an inch at the muzzle to 1·25 at the breech, having a series of shoulders formed on the outside to form butts for the coils and jackets to be set into. The breech end is then bored out to 3·55 in diameter, which gradually decreases till the diameter of the bore is reached, 2·6 inches at 10·7 inches from the breech end, thus forming the powder-chamber. The rear end of this is further coned out for a distance of 1·5 inches to form a seating for the obturating wad, and also to facilitate loading.

The inner jacket is prepared of coiled steel to gauge, and shrunk into position on the first shoulder on the "A" tube, being put on from the front. The front end of this jacket is recessed for ·25 of an inch, for the reception of the inner edge of the trunnion ring. It is 1·1 inch in thickness, and is 8·65 in length.

The trunnion-ring is prepared from forged steel to gauge, and shrunk into position in front of inner jacket on to the second shoulder. The rear end is set into the inner jacket for ·25 of an inch, and the front edge is recessed for ·25 of an inch for the reception of the outer jacket. It is 1 inch thick, except in line with trunnions and shoulder, and is 5·25 inches long, and is recessed on the right side for the reception of the trunnion-sight.

The outer jacket is prepared of coiled steel to gauge, and shrunk into position in front of the trunnion-ring, which overlaps the rear end for ·25 of an inch, its front end being turned down to nothing. It averages 1 inch in thickness, and is 10·75 inches long.

The breech-coil is prepared of coiled steel, and shrunk into position, being recessed at both ends. The front recess allows the coil to overlap the inner jacket ·25 of an inch, and the rear recess allows the breech-ring to be set into it for ·25 of an inch. Its thickness is 1·3 inch, and it is 11·12 inches in length, the front and rear ends being rounded off.

The breech-ring is a gun-metal casting, similar to 12½-pr., but that it extends along the "A" tube for 3·25 inches, and the front edge is set into the breech-coil ·25 of an inch.

Remainder as for 12½-pr., except rifling.

The gun is rifled with 16 flat grooves, at equal distances apart, thus forming 16 grooves and 16 projections. The rifling is spirally increasing from 1 turn in 100 calibres at the breech to 1 turn in 35 at 3 inches from the muzzle, the remainder 1 in 35.

Weight.

	Cwt.	qrs.	lbs.
Weight of carriage, complete	2	3	2
Weight of slide	3	2	14
	6	1	16
Weight of gun, carriage, and slide, complete	11	1	16

OBTURATORS.

THE ELSWICK.

The system of obturation adopted for the Armstrong breech-loading guns is known as the Elswick cup.

(1.) It consists of a steel cup, the rim or lip of which bears against a copper seating let into a groove at the rear end of the powder-chamber. This ring is made of tough copper, and is expanded into the groove, and bored to fit the cup by means of special tools.

(2.) The back of the cup (or obturator) is flat, but rests on the curved face of the steel disc attached to the breech-block; when the pressure of the gas acts on the cup, it is bent over the curved surface of the disc and expanded in circumference, fitting the copper seating, and thus preventing any escape of gas to the rear.

(3.) The cup and disc are fixed to the breech-screw by the vent-bolt; the cup is screwed on to the bolt, which is inserted into the breech-screw and fixed with a nut and spring washer.

(4.) When it is required to replace the obturator-cup by another, unscrew the collar of the vent-bolt with the forked key supplied for the purpose. In this case, care must be taken to replace the disc with the engraved side next the breech-screw.

(5.) The cup should be adjusted to bear against the shoulder in the gun. This can be tested in closing the breech, by moving the lever of the breech slowly until the cup is in contact with the shoulder in the gun; the lever at this point should, with 6-inch guns, be about ·5 inch* from the stop, so that some force is required to fully close the breech by bringing the lever against the stop.

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* This distance varies according to the nature of gun. With guns smaller than 6-inch it will be less than ·5 inch; and with larger guns, more. The screw is adjustable, so as to obtain the proper degree of tightness; but a limit of ·2 inch either way should not be exceeded.

(6.) With ordinary care, the cups and copper seating are not liable to injury, but should the edge of the cup accidentally get burred or notched it should be replaced with a spare one; slight injuries to the edge of the cup can generally be removed with a dead-smooth file.

(7.) If the flat face of the cup should, by repeated firing, lose its flatness and become hollow, so that the edge does not bear against the shoulder in the gun, and the lever can be brought against the stop without resistance being felt, it may be packed up by inserting, between the cup and disc, one of the small copper discs supplied for the purpose. These discs are of two thicknesses, to meet the different degrees of hollowness. The disc between the cup and vent-bolt should be reduced in thickness the same amount as the disc inserted between the cup and the disc.

(8.) Occasionally a cup may crack from various causes, or expand permanently from being too soft. In either case, the opening of the breech of the gun will be difficult, but the screw can be withdrawn by driving a wooden wedge between the lever and the breech of the gun, or by using a tool made specially for this purpose. If the cup is cracked or expanded, it should be exchanged for a new one. The copper seating in the gun should be carefully examined to see that it has not been injured.

(9.) It may happen, after repeated firing, that the copper seating for the obturating cup will become expanded; this is caused by the copper becoming condensed, or being more perfectly forced home into the groove than was accomplished at proof. If the ordinary sized cup be used, under these circumstances, it may become injured from not receiving sufficient support from the seating. Two cups ·005 inch larger in diameter, are supplied with each gun, and, when it is found by trial that one of these can without difficulty be entered into the copper-seating, it should be substituted for the smaller size.

(10.) When the gun is not in use, the cup should be removed from the breech-screw and kept in a dry place, oiled and free from rust. A lever is supplied to close and open the

breech-screw should it be a little tight; there is also a claw on the small end of the lever to start the needle-holder after firing, if required.

THE DE BANGE.

In this system, a large mushroom-headed piece of steel is fitted to the breech-block, the stalk (or spindle) passing through it. The mushroom-head fits the bore closely, and between it and the face of the breech-block on the stalk (or spindle) is placed the pad; this is a ring of asbestos and grease, enclosed in a canvas bag, and pressed into shape by heavy hydraulic pressure.

It is held in its place by two plates (or discs) of block tin, strengthened by brass edging, which fit loosely over the spindle, each edge of brass being split to take the form of a spring. Small steel discs are supplied for backing up the pad. When required, these can be placed on the spindle between the face of the breech-block and the tin plates, thus causing the pad to go further into the gun when the breech is locked.

On firing, the head is forced back by the gaseous pressure, and causes the pad to expand, tightly fitting the bore, and completely stopping all escape of gas to the rear.

The pad is sufficiently elastic to regain its shape on the cessation of pressure; and any tendency to stick hardly effects the unlocking turn being given, as the pad does not turn with the spindle in consequence of its loose fit; also, since the chamber is slightly coned over the seat of the pad, if it can be once started, small opposition will be felt to the withdrawal of the breech-block. For this purpose, the locking-lever is constructed so as to form a prize whereby the starting is effected.

In the 6-inch gun, the centre of the mushroom is fitted with a vent-bolt for the primer and a needle-holder, the same as the other guns.

A strong spiral-spring is put on the spindle and adjusting nuts, to set up with.

GENERAL INSTRUCTIONS FOR B.L. GUNS.

The guns should, as far as possible, be examined regularly by a properly-instructed officer after firing every 50 rounds with projectiles.

The bores of guns from which practice is carried on should be kept slightly oiled to prevent rusting. At the close of each day's practice they should accordingly be washed and slightly depressed; and, as soon as dry, oiled with a sponge, the muzzles being then closed with tompions.

NOTE.—When guns are not likely to be used for some length of time the whole of the sights, the obturator cup, vent-bolt, and firing hammer should be removed and kept in store, the holes in the guns being filled with a plug of greased tow to keep out water and dirt. These plugs can be readily removed when it is required to fit the sights, &c., to the guns, and particular attention should be paid to the prevention of rust or grit accumulating in the sight recesses, &c.

The sights and other fittings should be kept clean, free from grit, and oiled; the sliding-leaf and elevating-nut of the tangent scales, as well as the collars of the centre, fore, and trunnion sights, should have free play.

The exposed portions of the sights are bronzed if made of gun metal, and blued if of steel. This is done to preserve them from corrosion, and on no account are these parts to be burnished or cleaned in such a manner as to remove the bronzing or blueing.

The bore and all working parts must at all times be kept slightly oiled, and perfectly free from rust.

During firing, the male and female screws of the breech must be kept perfectly clean, free from dirt, and well greased with a mixture of oil and tallow. It will be found convenient, although not absolutely necessary, if the No. in charge of the breech-screw runs over these surfaces with a piece of oily waste after each round.

The officer in charge of the gun must always see that the safety-arrangement is in good working order, and that the breech-screw handle and needle-holder are in their proper position before firing.

Care should be taken that the edge of the obturator attached to the breech-screw, and intended to prevent the escape of any gas, is kept uninjured and free from burrs. Should any burrs or notches be observed, the obturator should be removed and replaced by another one; this operation can be performed in a minute or two. Abrasions on the edge of the injured cup can generally be removed with a dead-smooth file. The proper action of the obturator depends upon the slightly convex form of the base upon which it rests. Each time the gun is fired the flat underside of the obturator is forced by the pressure of the gas to take the form of the base, and the circumference is thereby expanded so as to tighten against the ring of copper which surrounds it. If the underside of the obturator should by continued firing partially lose its flatness, and take a permanently hollow form, it may be packed up by inserting beneath it one of the thin brass discs provided for the purpose. These discs are of two thicknesses, to meet different degrees of hollowness. Care should be taken that the locking-lever bracket does not close against the stop without the exercise of a moderate force. In pulling the lock-lever down a toe-piece on it will lock into a slot in the gun, and force the locking-lever bracket against the stop.

It may occasionally happen, after repeated firing, that the copper seating for the obturator will become expanded. If this occurs, the cup may become injured, on account of its not receiving sufficient support from the seating. With each gun, two obturators, of somewhat larger diameter than the ordinary size, are supplied; and one of these must be substituted when the copper is large enough to allow of its use.

PART III.

MAGAZINES.

Magazines.—Iron ships' magazines, with their handing-rooms and light-rooms, are built as an iron tank or water-tight compartment of $\frac{1}{4}$-inch iron plates, stiffened with angle irons and lined inside with two thicknesses of teak everywhere; the first lining nearest the iron is $1\frac{1}{2}$ inches thick, and the second $\frac{3}{4}$ inch at the sides and crown. The flat is 2 inches and 1 inch respectively. The first lining is secured to wood quartering attached to the back of the angle irons, from 3 to 4 inches from the iron plates, so as to leave an air-tight space between the wood and iron, which is sometimes filled with fire-proof cement. The joints of the first lining are tongued and grooved (iron tongued), the second plain joints breaking the joints of the first.

Handing-room.—The handing-room should be inside the iron tank, and partitioned off by a bulkhead of $2\frac{1}{2}$-inch teak, lined on each side with teak planks; all fastenings to be of copper. The doors should be 3 inches thick, and lined with copper, and to open outward from the magazine. Holes are made in the doors to pass the cases through. They should be one and a half the diameter of the bore of the largest gun in the ship.

Precautions necessary in a Magazine on Going into Action.—Open the scuttles and let down the pockets, pass the cases from the "ready" rack, pass in the empty cartridge cases, loosen the lid of the powder cases; magazine screens to be hung round the hatchways. See the leaden floors of the handing-rooms sprinkled with water, which is supplied from a tank fitted there.

"Cerberus."

FORE MAGAZINE.

Will stow 135 full charges on Port side, and 153 reduced charges on Starboard side. The Light-rooms are at each end.

AFTER MAGAZINE

Will stow 84 full charges on Starboard side, and 84 reduced charges on Port side. The Light-rooms are at each end.

The charges are placed in zinc cylinders, which are stowed one over the other on permanent platforms fitted in the bays and stacks so as to divide the weight. Voice tubes are led to the magazines for communicating orders to the magazine men from the fore and after part of battery deck.

"Victoria."

FORE MAGAZINE.

In this magazine are stowed the charges for the 10-inch gun, 12½-prs., and bursting charges for all shell in the ship.

The Starboard after rack stows 23 special corrugated cases, containing 23 full charges for 10-inch gun; Starboard foremost rack stows 17 special corrugated cases containing 25½ reduced charges for 10-inch gun. Port after rack stows 7 corrugated A cases, containing the bursting charges for all shell in the ship; Port foremost rack stows 2 special corrugated cases, containing 2 full charges for 10-inch gun, and is also the ready rack for 12½ charges.

Under the lights at fore end of passage are stowed 8 corrugated cases, containing 200 cartridges for the 12½-pr. guns.

The 10-in. cartridge cases are hung from the crown of the magazine.

Keys for powder cases are in brackets on the rack facing the door.

The flooding-cock is abaft the magazine hatch on upper deck, the sea-cock is worked from inside the funnel casing.

The magazine is light from two light-boxes, side by side on after part of lower deck, Port side; the bullseyes being in the foremost bulkhead of magazine.

AFTER MAGAZINE.

In this magazine are stowed the charges for the 6-inch gun.

The after rack stows 8 special corrugated cases, containing 48 reduced charges for 6-inch gun; the Port rack stows 5 special corrugated cases, containing 30 full charges for 6-inch gun. Under the Port rack are stowed 2 special corrugated cases, containing 12 reduced charges, and on the Starboard side is stowed 2 special corrugated cases, containing 12 full charges for the 6-inch gun. Total, 102 charges.

Cartridge cases are kept in Port rack.

Keys for powder cases are on Starboard bulkhead.

Flooding-cock is behind engine-room ladder; sea-cock in engine-room.

This magazine is light from bullseye in foremost bulkhead. Lamp is fitted in engine-room.

Magazine men will always wear the slippers provided for them, and kept in magazine.

"Albert."

FORE MAGAZINE.

Magazine.—The fore magazine is built of wood, and is a watertight compartment, in direct communication with the upper deck from a hatch and magazine door below. When the magazine is open, a fearnought screen is fitted to cover the hatch on the upper deck, through which the supply of powder is received, the door being kept closed.

Light-room.—The light-room is placed in the fore compartment (lower deck), and is outside the magazine, giving light through a bullseye into the passage of magazine.

Flooding.—The flooding arrangement is from a sea-cock to the bottom of the magazine through a stop-cock, which is kept locked (the key in charge of Commanding Officer), and fitted on the upper deck.

Ventilation.—The magazine is ventilated from the upper deck, through which the foul air escapes; it is also fitted with one or two diaphragms of wire gauze, to prevent the fire passing down. The fore magazine is fitted with shelves and racks to hold the powder cases, which are of corrugated metal, and are special cases for the charges of the 8-inch gun of 100 lbs., and 65 lbs. of prismatic and pebble powder, made up in half-charges, also the charges for the 9-pr. guns. The cases are stowed so that all charges may be readily passed up.

Capacity.—34 corrugated **A** large metal cases, 1½ charges in each case: total, 51 full charges. 36 corrugated **A** large metal cases, 1½ charges in each case: total, 51 reduced charges. 4 corrugated metal cases, containing 200 9-pr. charges. 4 corrugated metal cases, bursters of shell; 1 metal-lined ½-case, bursters of shell.

All cartridge cases, tackle, and screens are kept in the handing-room.

AFTER MAGAZINE.

Magazine.—The after magazine is constructed on the same principle as the fore, except that the shell-room is in the same compartment, but outside the magazine, which contains all the charges for the 6-inch gun.

Light-room.—The light-box is placed outside, and is lit from the engine-room, Port side.

Flooding.—The flooding arrangements are the same, and are placed in the engine-room, in charge of the engineer.

Ventilation.—The same as fore magazine.

Capacity.—7 corrugated metal cases, 6 charges in each case: total, 42 battering charges. 10 corrugated metal cases, 6 charges in each case: total, 60 full charges. 3 corrugated metal cases, bursters for shell.

SHELL-ROOMS.

The shell-rooms are constructed on the same principle as the magazines, and are also flooded in the same way. Voice-tubes are led to the shell-rooms for communicating orders; they are close to the voice-tubes of the magazine.

The shells are stowed on billets of wood, hollowed out slightly for each projectile, this being used to separate them from each other, so as to pass the slings round them for raising.

They are transported from the bays to the hatch by means of a rail overhead, fitted with a travelling purchase, and from the hatch to turret by a hand-winch, which is fitted with chain purchase.

The first supply of shell taken from the shell-room is from the "ready" rack, immediately under the hatch; they are stored heads up, with slings on ready for hoisting.

"Man and arm boat" gear is stowed in the shell-rooms; also fuzes, fuze implements, metal-lined cases containing fire-works, and life-buoy portfires.

"Cerberus."

FORE SHELL-ROOM.

The fore shell-room will hold 194 projectiles.

AFTER SHELL-ROOM.

The after shell-room will hold 167 projectiles.

"Victoria."

FORE SHELL-ROOM.

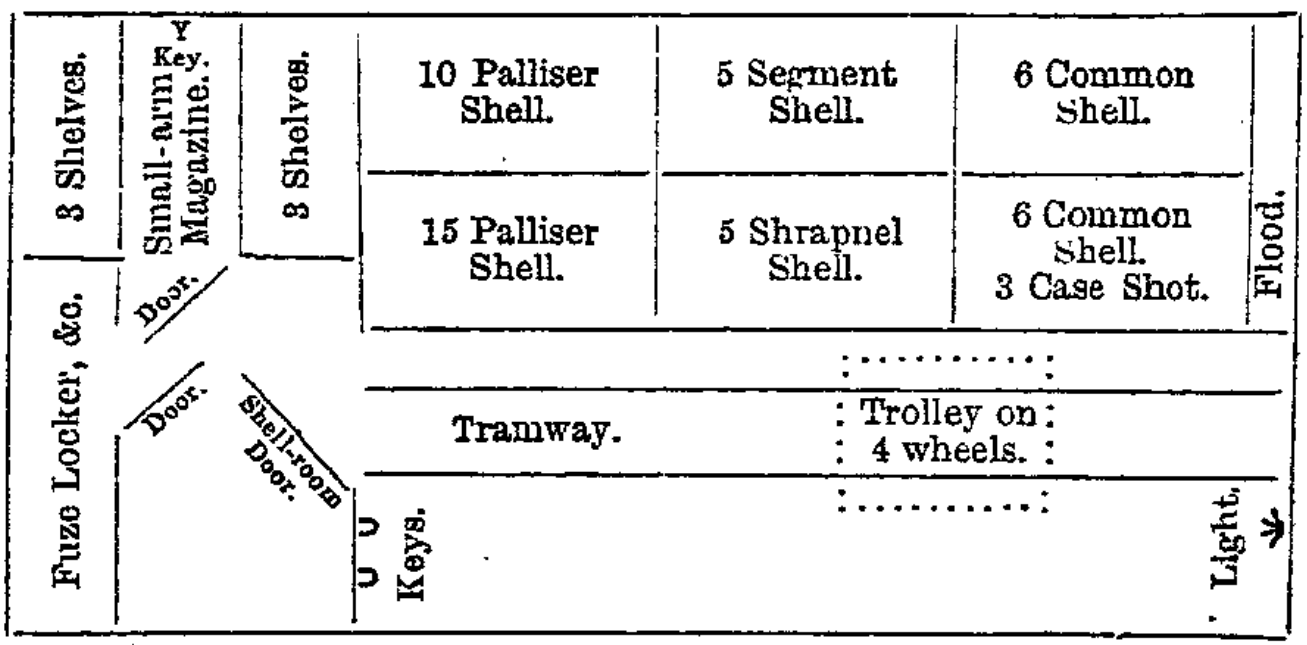
This shell-room is fitted with six well-racks and a platform, and overhead are bolts, to which are hooked Martin's patent

pulleys, for working the projectiles, and on the platform is a tramway, fitted with a transporting trolly, for moving the projectiles under the square of the hatch, from where they are hoisted on deck by the shell-whip at the gun. The door is on the Starboard side; the lighting and flooding arrangements on the Port side.

Lighting.—This shell-room is lighted from the light-box placed in the gunner's store-room, the bullseye being in the Port bulkhead.

Flooding.—This shell-room is flooded through the same sea-cock as the fore magazine, and the flooding-cock is on the upper deck, on the Port side of the tower, and just abaft the capstan; the pipe enters the shell-room on the Port side, down in the after corner, close to the rack.

Stowage.—The projectiles are stowed in open well-racks, with chocks between to admit of the slings being put round them—50 projectiles—as follows:—



On after bulkhead is fitted a shelf with four compartments, in which are stowed 200 projectiles for 12½-pr. guns.

Keys for Fuze-hole Plugs and Rimer are kept in brackets, just inside the shell-room door.

Men in Charge.—It requires three men, but can be worked with two, as they have small-arm ammunition and fuzes to supply; as well, also, the filled hoppers for the Nordenfelts.

Small-arm Magazine is fitted with three open shelves, on either side of passage:—

Looking to Starboard.	*Looking to Port.*
Nordenfelt hoppers, and 400 rounds Nordenfelt.	600 rounds pistol. 1,200 rounds blank, for rifle.
800 rounds Nordenfelt.	1,500 rounds, M.-H. rifle.
2,000 rounds M.-H. rifle. 500 rounds blank, for rifle.	2,000 rounds, M.-H. rifle.

This ammunition is stowed in whole, half, and quarter ML cases, and Mark V ammunition boxes; and on the bulkhead, facing the door, are the keys for the cases.

Fuze Locker has two shelves, on which are stowed the boxes containing the time and concussion fuzes, with keys, &c. These are flooded from shell-room.

Above the small-arm magazine and fuze-locker are two store-rooms for gunners' use, but are above the water-line, so cannot be utilised for explosives.

AFTER SHELL-ROOM

Is built under the ward-room, and fitted with racks on either side, in which are stowed 100 projectiles for the 6-inch gun.

Flooding.—This shell-room is not fitted with separate flooding arrangements, but is flooded over the after magazine door sill as part of after magazine.

Lighting.—This shell-room is light from light-box, fitted in after part of passage.

Keys, &c.—Fuze and plug-keys, with rimer, are kept in brackets on after bulkhead.

"Albert."

FORE SHELL-ROOM.

The fore shell-room contains all the shell for the 8-inch gun, and 9-pr. guns—100 rounds for each gun. The shell are supplied by means of tackles and a travelling purchase to the gun. Spare stores are also stowed in the fore shell-room.

AFTER SHELL-ROOM.

The after shell-room is in the same compartment as the magazine, and contains the shell for the 6-inch gun, placed in racks the same as the 8-inch shell, and contains 100 rounds for 6-inch gun.

SMALL-ARM MAGAZINE.

The magazine for small-arm ammunition, fuzes, primers, tubes, &c., is built on exactly the same principle as the main magazine, and is just a space sufficiently large to stow the required number of ammunition boxes and metal-lined cases, which are kept in their places by battens on the shelves, and is placed next to the fore shell-room.

All ammunition for machine guns, Nordenfelt, &c., should be kept in the small-arm magazine, or in a magazine built specially for it.

MANUFACTURE OF PROJECTILES.

COMMON SHELL.

Iron.—The quality of the iron mainly depends on the quantity and condition of the carbon associated with it. The various impurities, such as sulphur, silicon, phosphorus, &c., which are generally found in pig-iron, are more or less injurious. Sulphur is thought to diminish the strength, but is sure to be present, as the coke which is used for fuel is not free from it. Phosphorus is said not to be so injurious, and it increases its fusibility and hardness, while silicon is said to diminish its strength. Cast-iron generally contains from 2 to 5 per cent. of carbon.

The metal employed is melted in cupola furnaces.

About 1½ cwt. of coke and ½ cwt. of chalk is used to 10 cwt. of iron. The use of the chalk is to combine with the silica; if it was omitted, the silica would combine with the iron and cause a loss.

Moulding.—The material used is sand and coal-dust, brought to the desired consistency by mixing green sand and burnt sand in equal proportions, with ⅛ coal-dust added.

The shell are cast base down, as most strength is required there to resist the shock of discharge.

Core.—The core is formed in cast-iron boxes, which represents the interior of the shell, but have an allowance made for the shrinking of the metal. They are formed on perforated iron spindles supported by small pegs of wood or cast-iron rings, with arms nicked so as to break easily. Spunyarn is wrapped round the spindle. Both yarn and pegs are charred by the heat, and allows the core to break up readily and separates from the spindle. A projection round the neck of the core makes a groove in the neck of the shell, which facilitates breaking off in trimming.

Fuze-hole.—The shell has its nose cut to proper length, and turned down to the proper curve. The fuze-hole is then bored

out to proper size, tapped, and has a recessed groove cut at the bottom. The gun-metal bush is then screwed in, and violently jammed home to expand into the recessed groove. It is then tapped with a screw thread, G.S. gauge, and countersunk to the depth of ·2 inches.

Extractor Holes.—The extractor holes in the head are bored, and the body, if too large, ground down by grinding stones.

Stud Holes are bored one at a time, and undercut.

Lacquering.—The lacquer consists of resin, spanish brown, plaster of paris, and turpentine, is poured in hot (a gun-metal bush being screwed into the fuze-hole to prevent the lacquer filling up the threads of the proper bush), and immediately poured out again.

Pressing.—The gun-metal or copper studs are pressed in; they have a concave hollow in the lower part, which causes them to expand into the undercut holes. The studs are turned down to project the required distance from the shell, then planed, the loading and driving side to fit the rifling. Lastly, all studs are filed, trimmed by hand, and the projectile is weighed and gauged.

Stamped and Painted.—The shell is stamped and painted black, on the body the letters R. /\ L.; also the numeral will be found above one of the front studs in all calibres above the 64-pr. inclusive; and upon 7-inch and upwards a X, to indicate the studs have been planed as well as turned.

The general form of common shell is about 3 calibres in length, with ogival head, 1½ diameters radius, for studded projectiles.

PALLISER PROJECTILES.

These projectiles are specially intended for the penetration of wrought-iron and steel plates, which offer a great resistance to the passage of the shot. In order that the greatest penetration should be obtained from the projectile, it is necessary that its construction should be strong, its head of the best form suited to penetration, and the metal hard and unyielding. It is essential that the shot should not set-up or

bulge, and that none of the work should be wasted in heating it.

Iron.—Different mixtures of Ridsdale and Cwmbran iron have been used in combination with about 20 per cent. of store scrap-iron for manufacturing these projectiles, and since $\frac{1}{74}$ projectiles have been cast of iron consisting of old gun and shell iron.

Casting.—The projectiles are cast head downwards, so as to ensure density and soundness there. The head is cast in an iron chill or mould, in which, by virtue of the conducting power of the metal, the molten mass is rapidly solidified, and all, or nearly all, the carbon remains chemically combined with the iron, so that the head is composed of white iron. The iron thus rendered white possesses generally the qualities of ordinary white iron; that is, intense hardness and crushing strength and considerable brittleness.

It is necessary for the body of the projectile to have a hard unyielding metal, though not quite so hard as, and more tenacious than, the head. If the body was of soft metal, while the head was hard, there would be considerable loss of power on impact, owing to the setting-up of the soft metal. This point is gained by casting the bodies in sand, sand being a bad conductor; the bodies have time to cool gradually, and the carbon in the iron has time to partly separate in a free condition. Extractor-holes and stud-holes are formed at the same time.

Core.—The core is formed on a hollow spindle, to allow for the escape of gas. The core-box in which it is formed is divided vertically into two parts, which can be opened or closed as required. The spindle has a cast-iron ring fixed to its base, having vertical grooves, and also horizontal steps running round its exterior, in order to unite it firmly with the metal of the shell in casting. At the base of the spindle and below the cast-iron ring is placed a sand and coal-dust ring, which forms an undercut recess between the cast-iron ring and the base of the shell. When the core is finished, the box is drawn asunder and the core removed. The projectiles

remain in the mould until they are sufficiently set, for about an hour. When the shells are sufficiently cooled, the core is scraped out, and while hot they are lacquered internally, and are tested by water pressure of 100lbs. to the square inch, and the bases are carefully hammered all over with sharp-pointed hammers to detect flaws.

The body is ground down to the final dimensions on a revolving grindstone, as the metal is too hard to be turned.

The cast-iron bush is tapped in the base for the gas-check plug or base plug; the studs are then pressed in one at a time, turned and planed to correspond with the rifling. A lead ring is hammered in, sealing the junction of the bush and body, the studs trimmed by hand, and the interior cleaned out; the gas-check or base-plug (smeared with equal parts of cocoa-nut oil and ground chalk), which are not interchangeable, is screwed in.

Finally the shells are gauged and examined.

Marks.—On the base of a projectile will be found "Palliser shot" or "Palliser shell," also the calibre of the gun, and if there are two guns of the same calibre the weight of the gun is added, the month and date of casting. Also the Roman numeral and nature of iron employed; the month and year will be found on one of the rear studs, and also a X and the numeral. The general form of chilled projectiles are from 2 to $2\frac{1}{2}$ calibres in length, their heads struck with a radius of $1\frac{1}{2}$ diameters.

STUDLESS PROJECTILES.

Studless projectiles are manufactured in the same way as the studded projectiles, except having no studs; and the base, instead of being flat, is cast with undercut flutings on the rounded base of the projectiles. The flutings somewhat resemble a raised pattern of fluted and truncated willow leaves, with sharp edges, the leaves pointing to the rear, and is intercepted by two undercut rings, serving to still better attach the gas-check to the projectile. The heads are struck

with a radius of 2 diameters; they are marked on the base thus, "R. ⋀ L. 10in.," and date of casting.

Projectiles for R.B.L. guns are also studless projectiles, the gas-checks of which are formed by driving-rings, secured to the body of the projectile near the base.

Shrapnel shell, the head is painted red.

SHRAPNEL SHELL.

Casting.—The method of casting the body is similar in most respects to that given for common shell. The mould and core for the body are the same, except that, as the body consists of a cylinder open at the top and closed only at the bottom, the top of the core is so formed as to fit without leaving any space between it and the top of the mould.

The shell consists of a hollow body of cast-iron, with a head made of elm, covered with a light shell of Bessemer metal. The body is weakened internally by six longitudinal grooves running down the entire length of the interior. The base is formed into a chamber to contain the bursting charge. Over the mouth of the powder-chamber rests a disc of iron or diaphragm. The diaphragm is pierced in the centre, and partly tapped to take a wrought-iron tube, which is screwed into it. This tube is tapped at the top to take a gun-metal primer, used to assist in carrying the flash of the fuze to the bursting charge in the chamber. On the diaphragm are placed sand shot, which are fixed by resin being run in among them, brown paper being laid round the inside of the shell. Over the shot and resin is placed a kamptulicon disc. The wood head is bored out to contain a tin socket, fitting round the iron tube of the body, and holding a gun-metal bush of G.S. gauge.

Shrapnel shell are for use against boats and bodies of men exposed. The 64-pr., from 300 yards up to the range of the 15-sec. fuze; 7-inch and heavier natures, from 700 yards to the limit of the 15-sec. fuze; smaller guns, from 300 to 3,000 yards.

Primers for Shrapnel Shell consist of gun-metal cylinders, open at the bottom and closed at the top, having a conical-shaped cup at the head. At the bottom there are three fire-holes situated, in the form of a triangle; it is threaded on the exterior for screwing it into the socket or tube. It has a recess cut across the top for the screwdriver to place it in the shell. The interior is filled with L.G. powder; the bottom is closed with a disc of shalloon.

SEGMENT SHELL.

Segment shell consists of a cast-iron shell or jacket, lined with cast-iron segments, a cylindrical space being left in the centre to contain the bursting charge, with lead run in round the segments to bind them together. The segments stand on a loose disc of cast-iron at the bottom.

Segment shell are used against boats and bodies of men exposed beyond the range of case shot.

CASE SHOT.

Consists of an envelope of tinned iron, with fringed ends, formed into a cylinder and riveted together. An iron disc or bottom is secured to the lower fringe, which is turned in, resting on which is a wrought-iron disc, loose. On this disc stands a lining of three wrought-iron segments; within are placed sand shot of 8oz. weight, packed in a mixture of half clay and half sand, and covered with an iron top, fringed and soldered down, to which handles are fixed for convenience of carrying. The segments are to prevent injury to the rifling of the bore of the gun during its passage through.

Case shot is essentially a close-quarter projectile, for firing against men exposed and boats at short distances, and may be used from Woolwich guns up to 700 yards, 64-prs. and below up to 300 yards.

As a general rule, the same elevation is required as that given for common shell. When battering charges are used up to 450 yards, double shotting is the most effective.

INSTRUCTIONS FOR FILLING SHELL.

The following instructions for filling shell apply in all cases, with these exceptions :—

1. The common shell for 10-inch R.B.L. gun and 6-inch Vavasseur is the only common shell in use in the Naval Forces of Victoria that is filled from the base. All others are filled through the fuze-hole in the usual manner.

2. No bags are used in filling shell for the small guns, the 13-pr. and 9-pr. R.B.L.

Common Shell.

The shell is to be placed upon its point, which may be inserted in a block of wood hollowed for the purpose, or in any convenient place to steady it. No special pattern of block is necessary; it can be provided on the spot, and the recess cut by any carpenter.

To remove the plug, the shell is to be held firmly by one man while another applies the removing wrench to the plug, and unscrews it. Place the filling-rod in the bag, and fold the latter round the rod; insert it through the plug-hole, taking care not to force the end of the rod through the bottom of the bag; carefully push in the bag until the neck only is in the plug-hole, a portion being kept outside, as the whole bag must not be allowed to slip into the shell during the operation of filling; then withdraw the rod, and insert the funnel in the neck of the bag, pressing the funnel well down into the plug-hole; pass the filling-rod down through the funnel, and gradually pour in two or three pounds of powder; take out the funnel and rod, lift up the bag, and jerk it, so as to "set" the powder well down to the bottom, and to open the bag. Then re-insert the funnel and rod as before, and continue the filling. The filling-rod should be moved up and down while pouring in the powder to facilitate its passage through the funnel, the powder in the shell being tamped on at the same time. The use of a large mallet against the side of the shell

(any piece of wood will answer the same purpose) will materially assist in getting the maximum amount* of powder into the shell.

When the shell is quite full, withdraw the funnel and filling-rod, and tie the neck of the bag with two half-hitches of twine close to the top of the plug-hole. Cut off the superfluous choke, and push the neck of the bag well down, and to one side of the plug-hole; then screw in the plug as required.

No preparation of the bag by pricking or otherwise is necessary.

Segment Shell.

The operation of filling segment shell is the same as that described for common shell, except that the shell is stood on its base, and the burster-bag and charge are inserted through the fuze-hole. In this case, care must be taken to push the choke of the bag well down to one side, out of the way of the flush from the fuze.

Shrapnel Shell.

Remove the plug from the fuze-hole, and, after seeing that the fuze-hole is clear from dirt, grit, &c., insert the funnel, and pour in the bursting charge; this must be done gradually, for if the whole of the powder is put in at once the tube may become choked. Shake the shell from side to side on its base until the whole of the powder has passed down the tube, taking care that none of the powder is left at the bottom of the fuze-hole; drop in the metal primer, and by means of the large diaphragm shrapnel screwdriver screw it tightly into the tube; then screw in the fuze-hole plug.

Note.—The bursting charge for B.L. gun shrapnel, with the exception of the 10-inch, is in the head.

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* A very much larger bursting charge can be got into any shell by mixing F.G. with the usual L.G. powder, or by filling with pebble, and the interstices between the pebbles with F.G. powder.

Chilled Shell.

An order, of 31st July, 1885, states—The use of bursting charges with Palliser shell will be discontinued. Bursting charges will be removed from filled Palliser shells in store, but charges already in shells of this description in charge of the Royal Navy or Royal Artillery will remain undisturbed, unless special orders are given to the contrary, until the shells are returned to store, when they will be emptied. Palliser shells temporarily lodged in Ordnance Store charge during the refit of a vessel will also be emptied.

Bags, serge, burster, Palliser shell will be considered obsolete, and will be dealt with accordingly.

An order, of 12th March, 1886, states—Bursting charges for Palliser shells having been abolished, those projectiles when empty will be termed "shot," and will have their white points painted black. Those filled and in charge of the Royal Navy or Royal Artillery will be termed "shell" until emptied.

Old-pattern Palliser shot, the manufacture of which has been discontinued, will as far as practicable be issued and used up first; then the shot which have been hitherto described as shell, before those of later manufacture.

GAS-CHECKS.

Gas-checks are circular discs of copper of the same diameter as the shell which they are supplied for use with. They are slightly convex to the rear, so that the pressure of the powder-gas on firing flattens it, and so helps to expand the metal of the flange, thus sealing the windage.

Their principal use is to prevent the gas, on the first ignition of the charge, from rushing over the projectile, which causes the metal of the gun immediately over the seat of the shot to be eaten away by erosion, forming very irregular grooves.

Fixing Gas-checks with Plug and Nut.

Unscrew the nut and remove it; then apply the "wrench removing-plug" to the gas-check plug, and screw it well up in the direction of the arrow, to ensure its being well home.

When unscrewing the nut, if there is any tendency for the plug to unscrew also, the "wrench removing-plug" should be applied to the head of the plug, and turned in the direction of the arrow, at the same time as the nut is being turned in the opposite direction. Place the gas-check on the base of the projectile, with the concave or unpainted side next the base; then screw the nut on to the end of the plug with the "spanner gas-check nut" until the nut binds against the gas-check. With Mark II. gas-check, the nut will be screwed down to the shoulder of the plug.

With gas-checks having projections for studded projectiles, see that the projections are in line with the studs before screwing the plug home.

Projectiles fitted with Gas-checks Rotating without Plugs.

These gas-checks are automatic, and become fixed to the projectile when the gun is fired. When fitting the gas-check before loading, place it on the base of the projectile and strike it with a pointed hammer or chisel, so as to make an indent at two or three points on that part which surrounds the neck of the projection on the base of the projectile.

All gas-checks are marked, either by stamping or in casting, with the nature of ordnance they are to be used with.

GUNPOWDER

Remains practically as the only agent for propulsion of projectiles. For all other purposes of explosion it may be said to be superseded by gun-cotton and dynamite.

It is an intimate mechanical mixture of—

Saltpetre, 75 parts.
Charcoal, 15 ,,
Sulphur, 10 ,,

The exploding temperature of gunpowder is about 600° Fahr.

It is possible, but it is very difficult, to explode gunpowder by concussion.

Experiment has shown that the larger descriptions (Prism. P^2, P) can be exploded by the impact of a bullet having a velocity of 600 feet per second.

Gunpowder possesses the quality of standing climate well.

It should never be allowed in direct contact with metal, as if there is the least damp the saltpetre will attack and corrode the metal.

The physical properties influencing its behaviour when fired are—

Density,
Hardness,
Size of grain,
Shape of grain,
Amount of glaze,
Moisture.

The gradual firing or ignition of charges in guns is of the utmost importance. No gun could stand the shock of the whole force being at once generated. In heavy rifled guns, greater attention has been given to this, and results in the use of slower-burning powders. By using prismatic and cocoa-prismatic powder, we are able to give greater charges without increasing the strain on the gun.

Although it is very necessary to employ (comparatively) very slow-burning powder for the heavier guns, it is equally important to use a quick powder for the smaller bores, because the projectiles of the latter move away so readily. The best way to impart speed to a heavy carriage is to pull or push for some considerable time, but a cricket ball, which offers but little resistance to motion, must be struck quickly if it is wished to give it a high velocity.

By a combination of air-spacing to diminish the maximum pressure in the bore of the gun, and chambering to shorten the cartridge, very large charges can be burnt in the heavy, long guns, while the projectile receives a well-sustained pressure during all the time it passes down the bore, and it leaves the muzzle with a very high velocity, ranging far and accurately.

Recent experiments with later powders, such as cocoa-prismatic, point to the possibility of giving up air-spacing, and filling the whole of the large chamber of a modern gun with a very slow-burning powder, which will give a well-sustained pressure without an undue maximum strain to the piece.

MAKING AND FILLING CARTRIDGES

FOR M.L.R. GUNS AND B.L.R. GUNS.

The cartridges should be cut so that the width of the material runs in the width of the cartridge.

The cartridges, before being sewn, will be printed in black with the nature of the gun, charge, &c., and with lines for the hoops and seams. All marking on cartridges will be done with printer's ink.

All cartridges will be made up with their edges overlapping 1½ inches, and sewn together with three rows of stitches, with the following exception, viz., the 7-pr. M.L. cartridges, the edges of which will overlap 1 inch, and will have two rows of stitches; and the 12-pr., 9-pr., and 6-pr. B.L. exercising and saluting cartridges, the edges of which will be simply hemmed together and turned inwards. Serge cartridges will be sewn with worsted, and silk-cloth cartridges with sewing silk or twist.

Filling Cartridges.—Care will be taken to see that the cartridge-bags are properly dry before being filled, and the proper charge will be carefully weighed out and inserted in the bag by means of the "funnel copper cartridge." They will then be choked by drawing together the mouth of the cartridge into several pleats with a brass needle, threaded with three strands of worsted for serge cartridges, or with silk twist for silk-cloth cartridges; the silk twist being doubled for 9-inch cartridges and upwards. After drawing together the mouth of the cartridge, three turns will be taken round the pleats, and the choke thus formed will be further secured by passing the needle five times through it alternately above and below the turns, thereby stitching down the turns round the choke at four points equidistant from each other.

Hooping, with Braid Hoops.—Draw the braid through the serge or silk cloth until the knot of the loop comes home to the serge or silk cloth, the single end being already passed

through the loop from underneath. Pass the single end to one side of, and under, the loop, then draw the hoop tight, and keep it so by placing the forefinger of the left hand firmly on the loop, bringing the running end between itself and the loop, and not on the single end, otherwise the knot will slip. The maintenance of the proper form of the cartridge depends on the hooping being thus secured; the centre hoop is secured first, and then alternately until completed.

Filling Cartridges with Prismatic Powder.—A zinc envelope, open at both ends, having as many sides and of the same length as the finished cartridge, is used in building them up. This envelope just fits tightly into the interior of the empty silk cartridge. It is provided with a movable wooden bottom. On this bottom the prisms are built up carefully by hand till the envelope contains the required number of layers of prisms; the cartridge bag is drawn over the envelope, the latter up-ended, and the wooden bottom withdrawn. The envelope itself is now slid out between the prisms and the cartridge bag, leaving the latter closely round the prisms. The cartridge is sewn to the exact shape of the built-up prisms.

In each end a hole is fitted with open net-work, and these holes have a small piece of red shalloon shellaced over them to protect the powder in store and transit. The piece of shalloon which covers the rear end of the cartridge, when in axial vent gun, is detached before loading.

Cartridges are distinguished from each other by being marked, with printer's ink, the calibre of the gun intended for, the weight of the charge, and the nature of the powder. It is marked P. if pebble powder; R.L.G. if rifle large grain.

Thus—10 inch M.L., 70lbs. P,
10 inch M.L., 60lbs. R.L.G.

If Pebble is used in a cartridge marked R.L.G., the lines R.L.G. will be obliterated, and *vice versâ* if R.L.G. is used.

Drill cartridges for M.L. guns are of wood, covered with raw hide. The B.L. cartridges are of wood, with a thick covering of felt covered with leather, and have a metal plate at the bottom where the flash from the friction-tube strikes.

FUZES.

Fuzes are classed under two heads:—

1. Time.
2. Percussion.

Time Fuzes.

Time Fuzes, when used.—Where the distance is accurately known, and it is desired to burst the shell in the air, time fuzes are the best to use.

This is the case when firing shrapnel at bodies of men or boats, as owing to the construction of the shell the bullets retain their direction, and to obtain the best effect the shell should be burst in the air some distance in front of the object.

When firing against unarmoured ships or fortifications, or where the distance is not accurately known, percussion fuzes should be used.

Disadvantages.—As regards the use of time fuzes, the following disadvantages are incurred:—

1. The distance must be known or the effect of the shell is frequently lost, either from bursting too soon or from a blind fuze.

2. The same effect may be produced by irregularity of burning, owing to deterioration in the fuze or atmospheric conditions.

3. They require fitting.

Advantages of Metal Fuzes.—The plan introduced with the Armstrong shell of always using a percussion fuze in the shell, so that in the event of failure in the time fuze the percussion fuze would act, has been further developed by the improvement and introduction of time and combination fuzes.

Taking into consideration the chances of failure of a wood time fuze, the value of the projectile with which it is employed, and the small number used in time of peace, it is

probable that the use of a metal fuze would be in reality more economical, and metal time fuzes can be fitted up to the moment of loading.

For the condition of sea service, no time fuze can be considered efficient which cannot be fitted on the gun deck; and to be able to do this with common shell, containing a large bursting charge, it is necessary for safety that the fuze should be of such a nature that it can be fitted without removing it from the shell.

Disadvantages of Wood Fuzes.—With wood time fuzes no one at the gun can see whether the fuze is correctly fitted; once fitted it cannot be altered, unless for a shorter distance.

The result of these disadvantages is, that unless the range is known beforehand and is not likely to alter, wood time fuzes could never be used with common shell from heavy guns in ships, as the time required to fit, and pass up from below, a broadside of shell would be considerable, and once fitted they cannot be altered without passing them below, as it would not be safe to open them on the gun-deck.

Wood Time Fuzes.

Seasoned beech-wood is used as the material of the body, which is made conical, this shape having an advantage over the cylindrical form, as there is less risk of the fuze setting into the shell on the shock of firing, and they are more easily inserted.

Channels.—The fuze-composition is contained in a channel, which is central or eccentric according to the number and position of the powder channels, which are used in all fuzes except the 20-second (now obsolete).

They are essential in fuzes for shrapnel shell, where the bursting charge is not immediately surrounding the fuze, and consequently a strong flash is required; they also would be necessary in the case of common shell when the fuze is bored short, because the flash would be obstructed by the side of the fuze-hole.

If only one powder channel were used, it is obvious that there would not be room for the side holes to be bored in a

fuze reading to tenths of inches of fuze-composition, the diameter of each side hole being ·125″. By the use of two powder-channels we are, therefore, enabled to graduate the fuze just twice as finely as we could do with one powder-channel; and in the 15-second, for similar reasons, there are six.

The powder-channels are connected at the bottom by a groove, filled with quick-match to cause them both to act at the same time, giving a strong downward flash.

In all time fuzes the last hole in the row is bored through into the composition, to ensure the action of the fuze when fixed in the shell without preparation.

Ignition.—Wood time fuzes with M.L. guns should not be uncapped till the shell is placed in the bore. The heads are closed, otherwise they would burn much quicker on account of the pressure of the air, and would be more likely to be extinguished on graze.

In M.L. guns the fuze is ignited by the flash of discharge.

In B.L. guns by a detonating arrangement in the head of the fuze.

In all wood time fuzes, a small hole is bored in the top of the fuze-composition; this renders ignition more certain.

The channel containing the fuze-composition has a paper lining, as in hot climates the wood was found to shrink.

Time of Burning.—Fuze-composition burns at the rate of about 1 inch in 5 seconds; mealed powder at the rate of 1 inch in 2½ seconds, twice as fast as fuze-composition.

Metal Time Fuzes.

Advantages.—There are several patterns of these fuzes, but they differ only in size and time of burning. They have been much improved of late, and are fast superseding wood time fuzes, and have several important advantages. They can be set to very small intervals, a point of the greatest importance; they can be altered again after fitting; they are open to inspection, so that the officer or No. 1 of a gun can see that they are correct; they can also be fitted at the gun. This is of great importance, especially with shrapnel shells.

There are three sizes of these fuzes, viz., large, medium, and small; also, "medium time and percussion," known as combination fuzes.

"PERCUSSION" FUZES.

There are three kinds of percussion fuzes used in the Naval Service—

1. The Naval Concussion.
2. Pettman's General Service.
3. R.L. (Royal Laboratory).

Use.—Percussion fuzes are employed in shells intended to act against solid obstacles, such as wooden ships, earthworks, brick or stone walls, buildings, &c., and they are also used in shells against boats or troops in the field.

On Graze.—For the first purpose it is desirable that the fuze should act on graze and almost instantaneously, as otherwise the shell has time to rise to a considerable height before bursting, and thus its effect is diminished.

This action is secured in the naval concussion, R.L., and combination fuzes.

This nature of fuze is necessary to develop the effect of segment shell when used against men exposed, and good results are obtained from shrapnel shell at moderate distances, but where the range is known time fuzes are more effective.

Fuzes of this class are useful in firing trial shells to ascertain the range, as the effect of the burst is easily seen.

Safety-pins are used in all fuzes that act on graze, and serve to protect the "feathers" in the fuze, which only come into action when the safety-pin is withdrawn, guarding against risk while the shell is being rammed home.

For the second purpose it is desirable that the fuze should only act on direct impact, and a very instantaneous action is not required. The G.S. fuze is specially designed to act on direct impact.

Preserving.—Cap-composition is used for the detonators of fuzes, as experience has proved that when properly protected,

pressed, and varnished, it resists climate well. Usually this consists of about 3½ grains of fulminate of mercury.

Conical Screw.—All percussion fuzes are tapped with a screw-thread, to fit into the fuze-hole of the shell. A fuze having its screwed portion conical, can be screwed home much more rapidly than any other form, as the fuze will enter some distance into the fuze-hole before the screw takes.

There is no necessity for a shoulder, as the fuze cannot be screwed too far home.

A great advantage of percussion fuzes is that they require no preparation beyond withdrawing the safety-pins in those which act on graze.

The following are the fuzes used at present in the Victorian Naval Forces :—

FUZE TABLE.

Fuze.	Nature of Shell, &c.	Guns.
Armstrong's, large, Time	Common Shrapnel and Segment Shells, 6-inch to 10-inch	B.L.R.
Ditto, small	Ditto, 9-pr. to 6-inch	B.L.R.
Medium, Time and Concussion	Common Shrapnel and Segment, from 4-inch to 12-inch, inclusive	B.L.R.
Small, Time and Concussion	Ditto	B.L.R.
R.L.	Common and Shrapnel, 9-pr. and 7-pr.	M.L.R.
	Common Shrapnel and Segment, 6-inch and below	B.L.R.
Direct Action, Large Naval, Concussion	Common Double and Shrapnel, 64-pr. to 12-inch. except when loaded with hydraulic power	M.L.R.
Bolt, Percussion	Common Shrapnel and Segment, 5-inch to 10-inch, inclusive	B.L.R.
Direct Action Small Naval, Concussion Bolt, Percussion	Common Shrapnel and Segment, 4-inch and above, when fired with charge of 12 lbs. of powder	B.L.R.

FUZE TABLE—*continued.*

Fuze.	Nature of Shell, &c.	Guns.
Pettman's G.S.	Common Shell, 64-pr. and upwards	M.L.R.
15 seconds, Wood, Time, without Detonator	Common and Shrapnel, except 9-inch, when using Gas Checks	M.L.R.
15 seconds, Wood, Time, with Detonator	Common and Shrapnel, 9-inch, when using Gas Checks	M.L.R.

DESCRIPTION OF FUZES.

SIR WILLIAM ARMSTRONG'S LARGE TIME FUZE.

The principal parts of this fuze are the body, of white metal; collar, of gun-metal; nut, thimble, and pellet, of gun-metal.

The lower part of the body is tapped to the G.S. gauge and pitch (14 threads to an inch), and is hollowed out for the reception of the magazine or blowing chamber, which contains a small bag of F.G. powder; the bottom is closed with a screw plug, which is filled with pressed F.G. powder and pierced. A small hole is made in the centre of the plug, and closed with a thin disc of brass.

The projecting rim of the fuze is graduated for lengths of fuze in inches and tenths up to 5·6 inches.

The fuze-composition is pit-mealed powder, pressed into a groove round the upper part of the body of the fuze, and burns at the rate of 1 inch in 2·6 seconds, and can only burn in one direction, from left to right.

The top of the fuze is hollowed out, and contains a steel needle, under which is placed a pellet of mealed powder, which is in communication with the composition through a channel in the side of the fuze, which is filled with quick-match.

The movable collar is of gun-metal, and has a leather washer to cover the groove of composition. At one part of the collar is a channel, with a small bag of F.G. powder, which communicates with a groove of pressed mealed powder round the interior, and marked on the outside with an arrow /\. This groove is connected by a vertical fire-hole with the magazine or blowing chamber, and primed with mealed powder, pierced.

The collar is kept in its place by a nut which screws on to the neck, and fitted to take the Armstrong key, and the body has a small hole on the outside for screwing the fuze into the shell, and also a mark which shows the commencement of the composition.

The fuze is ignited by means of the thimble and pellet (or hammer) made of gun-metal, and fitted to screw into the top of the fuze.

The pellet (or hammer) is a hollow cylinder, containing cap-composition and mealed powder, and is kept in position by a brass suspending wire passing through the thimble and pellet.

The thimble is hollowed out for the reception of the pellet. It is pierced with four fire-holes, is threaded at the bottom to screw into the nut, and has a groove cut for the ends of the suspending wire.

The thimble and pellet is not to be screwed into the fuze until it has been fitted, and at the moment of loading.

The fuze is set by loosening the nut with the Armstrong key, and turning the collar till the arrow head cuts the desired length of fuze composition, as shown by the graduations on the outside of the fuze. The fuze may be set to half-tenths if required.

Action.—On the shock of discharge the suspending wire is sheared, and the detonating composition in the pellet strikes the needle point, which ignites the fuze. The flame passes to

the fuze-composition by the channel of quick-match, and burns round to where the arrow is set, when the flash communicates with the groove of mealed powder in the collar, and passes through the channel in the neck of the fuze through the vertical fire-hole into the magazine, ignites the bag of F.G. powder and bottom pellet of powder, blows out the brass disc, and ignites the bursting charge of the shell.

NOTE.—Great care is to be taken, after the thimble and pellet is screwed in, that the shell is not dropped, particularly on its base.

Supply.—Each fuze is supplied wrapped in waterproof paper, in a tin box hermetically sealed by a tin band, having a wire for opening, painted *blue*, and marked, "Fuze, Time, Large Pattern."

The thimbles and pellets are supplied separate from the fuzes, in tin boxes painted *drab*, and marked, "Thimbles and Pellets."

FUZE, TIME, SMALL.

This fuze is similar in construction to the large fuze, but is smaller, and is graduated in inches and tenths up to 4 inches of fuze-composition, which burns at rest 7·6 seconds. The bottom plug is not filled with F.G. powder, but closed by a thin disc of brass only.

The action is the same as the large time fuze. The thimbles and pellets are smaller. They are supplied the same as the large fuze, and marked "Fuze, Time, Small."

FUZE, TIME AND CONCUSSION. ARMSTRONG, MEDIUM. MARK I.

This fuze is a combination fuze, and graduated to 5 inches, and burns about 11·1 seconds. The time arrangement is the same as the large time fuze. The concussion arrangement is contained in the bottom part of the fuze. It consists of a white metal pellet or hammer, containing the detonating composition, and a gun metal guard, suspended by means of a brass shearing ring, which is fitted round the pellet, and rests on a projecting rim. The ring is divided, so as to be

free to expand. The pellet is hollowed out to receive the detonator and a pellet of mealed powder, pierced. The detonator is kept in position by the edges of the pellet being turned down over it. The upper part of the pellet has a feather edge, which sets up into a recess in the metal guard.

The interior of the guard is recessed for the feather edge of the pellet, and fitted with a shoulder, which rests on the shearing ring. A steel needle is fitted to the interior of the fuze, and pointing downward. The bottom is closed with a screw plug, and a thin brass disc.

The action of time arrangement is the same as in the large fuze.

The action of concussion arrangement is as follows:—On the shock of discharge, the guard sets back the brass ring over the projecting rim of the pellet or shears it off, and the feather edge is dovetailed into the recess, locking the guard and pellet together, which remain in the bottom of the fuze during its flight. On graze or impact, the pellet and guard fly forward, the detonating composition comes in contact with the needle point, and igniting the flame passes to the pellet of mealed powder, blows out the disc, and ignites the bursting-charge of the shell.

If it is required as a percussion fuze only, thimble and pellet are not required; the arrow on the collar must be set between the zero point and the extreme length of fuze-composition, care being taken that it is not set too near the zero point, to avoid premature explosion.

Small thimbles and pellets are used with medium or small time and combination fuzes.

Supply.—The same as large time fuzes. Box painted *red*, marked "Fuze, Time. Mark II. Medium pattern."

Fuze, Combination, Small.

This fuze is similar to the medium pattern, and is graduated to 4 inches of fuze-composition, which burns at rest 7·6 seconds, and is supplied the same as the other fuzes. Box painted *drab*, marked "Fuze, Time. Mark II. Small pattern."

FUZE, PERCUSSION. MARK II. R.L.

The body of the fuze is of gun-metal, with a projecting rim, and is tapped with the G.S. pitch and on the interior of the bottom to receive the bottom plug. On the top is a square hole to take the G.S. key.

From the lower surface of the head, and projecting downward, is placed a steel needle. Inside the body is a gun-metal guard, which rests on two projections or feathers of a white metal pellet, and is recessed to take the feather edge at the top.

The pellet is hollowed out for the reception of the detonator, which is a copper cap containing 3½ grains of cap-composition, closed at the top with a thin disc of brass, and at the bottom by a disc of copper with four fire-holes, the lugs of the cap being turned down over it to keep it in place. The cap is secured in the top by the metal of the pellet being spun over it.

A safety-pin is used, which is made of twisted wire, and passes through one side of the head of the fuze, through the metal guard, and between the needle point and detonator (on one side) into the other side of the head, and is secured by the ends being opened out into a recess, which is closed with a lead plug or brass disc soldered over.

The bottom plug screws into the bottom, and has a fire-hole in the centre, which is closed with a thin brass disc.

When the safety-pin is withdrawn, the hole is closed by a small lead pellet, which moves freely in a recess made in the head of the fuze, and closed by a thin brass disc. When the shell is rammed home the pellet sets back and closes the safety-pin hole, and prevents premature explosion.

Action.—On the shock of discharge, the guard sets back and shears the feathers, and the edge of the pellet is forced into the recess in the guard; pellet and guard are locked together, and remain in the bottom of the fuze during flight. On graze or impact they fly forward, the cap strikes the needle point and ignites the composition, the flash passes

through the fire-holes and pellet and blows out the brass disc into the bursting charge of the shell.

The safety-pin is withdrawn with B.L. guns just before entering the shell in the gun, and with M.L. guns after the shell is entered in the gun.

This fuze is principally used in field service, but also in the Navy for all guns up to 80-pr., M.L. or B.L., with common shrapnel, and segment shells.

Naval Concussion Fuze.

This fuze is made of gun-metal; the principal parts are—the body, top plug, needle, guard ball, metal guard and pellet, suspending wire, and safety-pin.

The body is conical, and tapped with a screw to take the G.S. fuze-hole to within half-an-inch of the bottom, which is left plain, with a hole for the safety-pin; it is slightly hollowed out on the inside to allow sufficient play for the guard ball; the bottom is solid, with a fire-hole in the centre primed with mealed powder and pierced and closed with a thin disc of brass.

The top of the fuze is closed with a screw plug, countersunk, having a steel needle in the centre projecting downward from the interior, and on top a slot to take the Armstrong key. The needle is protected by a small brass ball (dome-shaped), hollowed out in the centre, and resting on the metal guard or pellet.

The guard is of gun-metal, and is hollowed out at the lower part to take the pellet, and is recessed on the interior. A small hole is made through both for the suspending wire to keep them in position, the ends of the wire being turned down into grooves on the outside of the guard; the upper part of the guard has a projecting neck, which is cupped out for the reception of the detonator, which is similar to the R.L. fuze, and is primed with mealed powder.

The pellet is also of gun-metal, hollowed out in the centre, and primed with mealed powder; through the side is a hole for the suspending wire, and another through the lower part for the safety-pin. A leaden cup or ring is fitted to the upper

part, with a feather edge, which sets up into the recess in the guard, the pellet resting on a paper disc in the bottom of the fuze.

The safety-pin is of brass, and passes through the side of the fuze and through the pellet, and is kept in position by a tape band passing round the fuze, the guard being supported by the safety-pin.

Action.—On the shock of discharge, the suspending wire is sheared, the guard sets back over the pellet, and the leaden cup or ring is forced into the recess of the guard, locking them both together; the guard ball falls off its supports, and lays in the body of the fuze, exposing the needle. On graze or impact, the guard and pellet fly forward, and the detonator strikes the needle point and fires the fuze. The flash ignites the mealed powder in the guard and pellet, and blows out the disc in the bottom of the fuze into the bursting charge of the shell. The safety-pin is removed before screwing the fuze into the shell.

Supply.—Each fuze is in brown paper, 20 fuzes in a tin box, painted *drab*, hermetically sealed.

Petman's Percussion G.S. Mark II.

This fuze consists of the following parts—Body, top plug, plain ball, steady plug, detonating ball, cone plug, lead cup, and suspending wire.

The body, top plug, cone plug, detonating ball, and steady plug are made of gun-metal; the plain ball is made of brass, and the suspending wire of copper.

The body is conical, tapped throughout with a screw, to take the General Service fuze-hole; it is about ·2″ thick, a strong case being essential to resist the shock of heavy discharge. It is slightly hollowed out in the centre of the interior, to allow sufficient play to the detonating ball, and is also hollowed out at the base to allow the lead cup to dovetail into the recess when it is crushed up. It is tapped at the top to receive the top plug. The bottom is solid, with a hole in the centre of the base to allow the cone plug to set back through it.

The top plug is screwed into the fuze, and has two holes in the upper part to enable it to be screwed into the fuze, and a cup-shaped recess in its lower part into which the plain ball fits.

The plain ball is a small solid ball, turned from brass wire.

The steady plug is a disc recessed at the top, and roughened to receive a ring of detonating composition, and having a cup in the centre to receive the plain ball, and three fire-holes to allow the flame to pass down; the bottom of the central hole is enlarged, to receive the projection of the detonating ball; detonating composition is pressed into the recess, and is covered over by a thin copper washer and lacquered.

The detonating ball is roughed by a number of vertical grooves, and has a deep horizontal groove near the centre. These grooves retain the composition with which the ball is coated, and also render ignition certain when the ball strikes against the body. At the top of the ball is a cylindrical projection, which fits into the steady plug, and at the bottom is a smaller rounded-off projection which fits the cone plug. Over the composition is a layer of thin gut, then two thicknesses of thin silk, then two thin copper hemispheres, and finally another thickness of gut and three parts of silk; each layer of silk and gut is varnished.

The object of the two copper hemispheres (or cups), and of the copper washer over the steady plug, is to reduce the sensitiveness of the composition, so that the shock of grazing will not explode it, while the shock of direct impact against a solid body will make it act.

The cone plug is pierced with three fire-holes, the central one being enlarged to support the detonating ball. The bottom of the plug is filled with mealed powder, driven and pierced like a tube; it is recessed near the top to allow the lead cup to dovetail on to it, and pierced near the base for the suspending wire, and closed at the bottom by a small cardboard disc.

The lead cup is a hollow cylinder, having a flange on the head to fit the recess on the cone plug.

The fuze is protected from damp by the top plug and bottom disc being covered with cement. It is specially designed to act on impact, not on graze; it will not explode on a shell passing through a wave, but will do so on striking a wooden ship.

Action M.L. Guns.—On the explosion of the charge, the wire suspending the cone plug is sheared, the lead cup is crushed up, the lower edges being forced into the undercut portion of the lower part of the body of the fuze, the tube of the cone plug is forced through the fire-hole in the bottom of the fuze, and kept in that position by the crushed lead cup; the steady plug also falls a distance equal to the height of the lead cup before being crushed towards the bottom of the fuze. The rotation of the shell disengages the detonating ball from its supports, and it rests in the body of the fuze. On the shell striking a hard substance, the ball is thrown forward with great force, and the detonating composition is brought violently into contact with the body of the fuze, is exploded, and the flame passes down through the escape holes in the cone plug, ignites the mealed powder in the tube and the bursting charge of the shell.

Action B.L. Guns.—In B.L. guns, with no windage, owing to the absence of any lateral motion of the shell in the bore, the disengagement of the detonating ball from its supports cannot always be relied upon. It is to obviate this that the small plain ball and annular groove of detonating composition are placed in the upper part of the steady plug; on impact, the steady plug is driven with great force against the top plug, and the plain ball which was thrown out of the cup on the explosion of the charge, is driven against the groove of detonating composition, causing it to explode, and the fire passes through the fire-holes in the steady plug and cone plug, and ignites the bursting charge of the shell.

This fuze requires no preparation other than screwing it into the shell; and filled common shell are generally supplied with the fuzes in them.

Each fuze is wrapped in brown paper, and 5 fuzes in a tin box hermetically sealed.

Bolt Percussion Fuze.

The bolt percussion fuze consists of the following parts:—Body, pellet, copper cover, guard, bolt, split pin, bottom plug and safety pin.

The body is of gun-metal, and has a steel needle fixed in the centre of the head, and a slot on one side for the bolt to slide in.

The bolt projects into the interior between the pellet and top of the body, and is kept in that position by the brass split-pin which passes through a hole in it, and on each side of a shearing wire fixed across the hole. The guard and pellet are both of gun-metal. The copper cover in form of a tube fits over the pellet, the upper edge being bent inwards so as to rest on the top of it; the lower edge being cut into wings and bent outwards so as to support the guard. The pellet has a copper cap in the top, the detonating composition being covered with a ·005 in. brass disc, and a powder pellet in the lower part, with a fire-hole connecting them. The bottom of the body is closed by the bottom plug, which screws in, and is filled with pressed gunpowder. The safety-pin passes through the head and split-pin, and prevents the latter bearing on the shearing wire.

The fuze is screwed into the shell, and the safety-pin withdrawn at the moment of loading.

On discharge, the split-pin shears the shearing wire and drops through the bolt into a pocket; the bolt then slides back by centrifugal force.

The guard straightens the wings of the copper cover, and sets down over the pellet, which is then free to move forward against the needle on impact or graze.

Direct Action Percussion Fuze.

This fuze, which was introduced into the Navy as a temporary measure, in consequence of the failure of Pettman G.S. fuzes at Alexandria, differs from all other description of percussion fuze, in being intended to fire by a single direct blow.

In all other percussion fuzes, the fuze is first "put in action" either by the shock of discharge, the rotation of the shell, or some other cause connected with the firing of the gun; so that, until the gun is actually fired, the fuze is practically more or less safe from accidental ignition; but, in the direct-action fuze, a single blow on the head is sufficient to ignite it.

It is not probable that this fuze will be long retained in the Navy; but, in the meantime, the greatest precautions are necessary in dealing with it.

The parts of the fuze are—The body, having a division in the centre through which nine fire-holes convey the flame from the detonator on the top of the division to the blowing-charge underneath.

The needle disc, of thin copper, carrying a steel needle (a striker).

This disc is secured between two screw plugs in the upper part of the body, and is just above the detonator on the division in the centre of the body.

The head of the fuze is covered by a cap, and the bottom closed by a plug with holes in it. The fuze acts on impact or on graze, at such an angle that the nose of the shell enters the ground, the needle being crushed down on to the detonating composition, which fires and ignites the blowing-charge.

Naval Concussion, Large.

This fuze is similar in construction to the smaller naval concussion, except that it is much longer, and has a blowing-chamber filled with fine-grain powder.

15-second Wood Time Fuze.

As metal time fuzes are fast superseding wood time fuzes, the 15-second will be described, which is the latest pattern for M.L. and B.L. guns.

The body of the fuze is made of beech wood, and conical in shape, and resembles the 9-second and 5-second fuzes. It has the composition channel in the centre of the fuze, driven with 2″ of slow-burning composition (1 inch in 7½ seconds). Above

this is a ·75″ pellet of mealed powder, having a hole bored down its centre to a depth of ·55″. There are six powder channels, connected at the bottom by quick-match placed in an annular groove, and pressed into the bottom of each channel.

The bottom hole of one channel is bored through, and threaded with quick-match; the paper scale on the exterior gives intervals of $\frac{1}{3}$ seconds and $\frac{1}{4}$ seconds of time. This fuze burns at rest about 15 seconds; when fired from rifled guns, 13 to 14 seconds only.

The upper part of the composition-bore is closed by a metal plug, screwed permanently into it, flush with the top of the fuze. From the centre of this plug projects downwards a copper pin, round which are looped small pieces of quick-match, the ends passing through two escape holes which are provided in the side of the head of the fuze for the escape of flame from the burning composition.

The quick-match is laid in a groove round the head of a fuze, and is covered with, first, a tape band, then a strip of thin sheet copper, which is covered with another strip of tape, one end of the copper band on either side being left exposed and loose.

Action.—The tape and copper band is stripped off on loading. The flash of discharge ignites the quick-match, and the flame passing through the escape holes sets fire to the fuze-composition, which burns down until it reaches the hole that has been bored into, when the flame ignites the powder in the powder channels, and fires the bursting charge of the shell.

This fuze has a white paper covering and a black head, and is marked spirally, from 1 to 30, in half-tenths of fuze, corresponding to quarter-seconds of time.

15-second Time Fuze with Detonator.

This fuze is similar to the M.L. fuze, but has a detonating arrangement in the head, and is used from M.L. guns with gas-checks, or from B.L. guns.

Fitting Fuzes.—Wood time fuzes are prepared for any desired range by boring into the required side hole for the

length of fuze-composition. A hook-borer is used, and when using it place the fuze in the hook, in the proper position for boring the required hole, enter the bit into the side hole and screw up until the bit has entered as far as the borer will allow, taking care not to press upon the fuze so as to prevent its bedding in the hook.

Unscrew, and, when the bit is clear, remove the fuze from the hook; the fuze is then screwed into the shell by hand, or a smart blow is given.

Wood time fuzes may be bored into at any hole irrespective of the projectile in which they are used.

Metal Time Fuzes.

Fitting Fuzes.—These fuzes may be prepared for the desired range after they have been screwed into the shell.

Loosen the nut with the key, so as to free the collar; then move it round until the arrow ↑ points to the required length of fuze; then screw up the nut, steadying the collar at the same time; then tighten the nut with the key.

Should the fuze be removed from the shell, the arrow should be set at the blank space before it is returned.

Fixing Fuzes.

Wood Time Fuzes, M.L. Guns.—Wood time fuzes are fixed in the fuze-hole by screwing the fuze round by hand until it is held firmly in the fuze-hole, or by a smart blow with a piece of wood, taking care not to split the fuze. The fuze must not be uncapped until the shell is in the muzzle of the gun. These fuzes are "uncapped" by taking hold of the copper band and unwinding it smartly, so as to leave the priming fully exposed.

B.L. Guns.—These fuzes are screwed into the fuze-hole by hand, and on no account are they to be struck against anything. The safety-pin is not to be removed until the moment of loading.

Metal Fuzes.—These fuzes are screwed firmly down with the Armstrong key, after the plug is removed, the thimble and pellet being screwed in at the moment of loading.

G.S. Fuze.—These require no preparation; they are simply screwed firmly into the fuze-hole by means of the key. Should there be any difficulty in extracting a percussion fuze, the shell should be either fired away or thrown overboard.

R.L. Fuze.—These fuzes require no preparation except the removal of the safety-pin; they are screwed firmly into the shell by means of the key. The safety-pin is *not* to be removed until the moment of loading.

Naval Concussion Fuze.—In these fuzes the safety-pin is withdrawn, before the fuze is screwed into the shell, by the tape band round the lower part.

FRICTION-TUBES.

Quill friction-tubes are used for the ignition of all gun charges, and also for firing rockets.

There are three descriptions, viz.:—Long quill friction-tubes, short quill friction-tubes, and copper friction-tubes, with wire loop.

The quill is driven with mealed powder, pierced up the centre with a fine hole (to expose a large surface of the powder to immediate ignition), and a roughened copper friction-bar is passed through it, above the mealed powder (on the top of which the detonating composition is placed); the head is then filled with gunpowder and clay, and closed with shellac-putty, to protect the composition from damp. The head of the tube is kept in place during the pull of the tube-lanyard by a leather loop, which goes over the tube-pin in the gun.

The long tube is 4 inches long, and is formed by cementing two quills together, and is used for guns from the 64-pr. and all above. This tube will strike fire through two thicknesses of serge, when in a vent, at a distance of 21 inches.

The short tube is $2\frac{3}{4}$ inches long, and is used for guns below the 64-pr., and is also used for the signal-rocket tube, and with life-buoy portfires. It will strike fire, as above, at a distance of 14 inches.

Copper tubes are 5 inches long, and resemble generally in their manufacture the quill-tube above described, but have no loop for the friction-pin. A wire loop is attached to prevent them from flying about, which has been found dangerous on the explosion of the gun when used without it. It will strike fire, as before mentioned, at a distance of 30 inches.

Tubes are supplied in tin cylinders, each containing 25. The cylinders are hermetically sealed by a strip of tin, the end of which is exposed to facilitate opening, when the tubes are required for use.

Quill tubes are packed on their sides, copper tubes on their ends. In the cylinder for copper tubes a loop is formed by a

corrugated strip of tin, soldered round the inside, forming a rack for each tube.

All friction-tubes are stored in the gunner's store-room, in a locker lined with metal, and fitted with a lock and key for security.

PRIMERS.

The mechanical primer consists of a body of brass, which is hollowed out for the reception of the priming, and fitted with an anvil carrying a percussion cap. The base of the primer, when struck by the firing needle, comes in contact with the cap and fires the priming, which consists of two pellets of fine-grain powder, with a slight space between them. The anvil contains a little dust gun-cotton, to facilitate ignition.

The electrical primer is similar in outer form to the mechanical, but the priming is fired by the incandescence of a platinum wire, which passes through a small quantity of gun-cotton at the rear of the priming.

Two insulated copper wires are passed through a small channel in the base of the primer-case; and are soldered to two base plugs inserted in a cylinder of ebonite, fitting the interior.

A fine platinum wire is soldered across the heads of these brass plugs, and when the electric current passes through this wire it is heated sufficiently to ignite the gun-cotton surrounding it, and thus fires the priming of gunpowder.

SIGNAL ROCKETS.

The case is made of thick brown paper, rolled up into a cylinder: the rocket composition is driven by hand, over a conical former, which is afterwards removed. A light paper case is attached to the head, terminating in a cone filled with 28 pellets of composition, which, when ignited, form stars. At the bottom of the pellet-case is a small quantity of meal'd powder, which serves to open the case and to scatter them, on the rocket attaining its highest position. The star-chamber is separated from the composition by clay driven in on top of it. A hole is pierced through to allow the gas to enter the pellet-case from the composition. The rocket is choked near the base, and has a priming made up of L.G. powder and isinglass. The vent is secured by a paper cap.

They are fired from a machine, which consists of an oval tube of sheet iron (2ft. 8in. by 2ft. 3in.) to take the rocket with the portion of the stick at its side, a round tube of sheet-iron being fixed on to it to take the remainder of the stick in its interior.

The two tubes are joined together by being entered into the opposite ends of a middle piece of gun-metal, about 6ft. 2in. long, to which both are riveted. The larger part of the finished tube being 1ft. 8in., and the smaller, 7ft. 6in. long. The metal at the mouth of the finished tube is wire-edged; at the opposite end is a ground-spike.

A vent is made in the close portion of the base of the oval tube opposite to the vent of the rocket to take a quill tube for firing, which is prevented from falling out, when the tube machine is pointed up into the air, by a hinged-piece of gun-metal which shuts in behind its head.

To fire the Rocket, force the stick into the copper socket at the side of the rocket, and when the projection on the socket is clear of the notch on the stick, attach them; this is done by pressing the projection into the notch; tear off the paper cap at the bottom of the rocket, thus exposing the priming,

and place it in position ; enter the friction-tube, loop over the stud, hinged-piece put over and trigger hooked, place it in a vertical position, see all clear overhead, and then fire.

Signal rockets rise to an altitude of about 400 or 500 yards, and can be seen on a clear night at a distance of 30 miles. They are used for signalling at night, and for display when required.

To fire them by hand, attach the stick to the rocket and straighten out the tail ; remove the paper cap at the bottom, and hold the rocket over a piece of slow match, a light, or a portfire, with the tail clear. A stick with rope tail is attached to the rocket when firing them by hand.

Rocket composition : saltpetre, sulphur, and dogwood-charcoal.

LIGHTS.

The lights used in the Victorian Naval Forces are two—long and short.

The long light consists of a cylinder of brown paper 9·5 inches in length, and 1·78 inches in diameter; the bottom is left open to a depth of 2·2 inches for the reception of the holder. Above this opening is pressed a layer of clay ·2 inches in thickness, which forms the base for the composition, and it prevents the holder from being burnt by the composition when the light is burning; on the top of the clay is pressed, by hydraulic pressure, 6·6 inches of long light composition, the open cavity being smeared with powder paste, and capped with a metallic cap. The top of the case is strengthened by a band of tin. It will burn from five to six minutes.

Long-light composition consists of saltpetre, sulphur, and red orpiment or realgar.

The short light is a cylinder of brown paper, 5·2 inches in length, and 1·78 inch in diameter. It is driven with 2·3 inch of signal-light composition, and is identical with the long light. It will burn one minute.

Short-light composition consists of saltpetre, sulphur, red orpiment, magnesium, and paraffin wax.

The lights, when burning, are held by a hollow wooden handle made of beech, about 10 inches in length, with a screw-knob at one end; it is recessed to contain ten primers; the opposite end fits into the light, which has two holes to fix the light on the holder by means of a wooden peg. At one side of the holder is a groove, as a guide for the entrance of the peg at night.

They are ignited by means of a detonating primer, which is placed into a hole at the top side of the light, marked by a black dot; the paper end of the primer is placed in the hole, and is ignited by striking the copper wire of the primer against any moderately hard substance.

The General Service primer consists of a cylinder of copper, ·4 inches in length, open at both ends, one of which is fitted

with a collar of the same material. A small piece of wire, wedge-shaped at one end and roughened, and smeared with detonating composition, is inserted into the collar of the cylinder; the other end is tightly pinched together on the composition. The flattened end is bound by a few turns of copper wire to increase friction, and is protected by paper shellaced over to exclude moisture.

They are supplied in tin boxes, holding 5 or 10.

If no primers are available, these lights can be ignited by a piece of slow-match, taking off the metallic cap and touching the composition with a spark of fire. They are used for signalling at night and for illuminating.

PORTFIRES

Are of two descriptions, viz., common and life-buoy portfires.

Common portfire is a paper cylinder, 16 inches long and rather more than half-an-inch in diameter, driven with portfire composition, which consists of saltpetre, sulphur, and mealed powder, the bottom being turned in to form the base for driving. The upper end is primed with mealed powder to make it light easily. They are used for incendiary purposes, and will burn from twelve to fifteen minutes. They are ignited by slow-match.

Life-buoy portfire consists of seven pieces of portfire of different lengths, secured at right angles to each other to a gun-metal plate by means of copper wire—the first length, and also the last piece but one, is driven with a quicker burning composition, in order to resist the water on immersion of the buoy in falling from the side, and to increase the action of the flame. They will burn from twenty to twenty-four minutes. They serve to indicate the position of the life-buoy at night to the man overboard, and also to the boat's crew who are rescuing him. They are ignited by a friction-tube fixed in position on the plate. A hook, fixed to the metal cover on the ship's side, is hooked to the eye of friction-bar; on the buoy being released from the side, the weight of it falling causes the friction-bar to be withdrawn, which fires the portfire.

MATCH.

"SLOW."

Slow match is pure hemp, slightly twisted, boiled in a solution of water and wood ashes, in the proportion of water 50 gallons, wood ashes 1 bushel. This serves for 100lbs. of yarn. It burns at the rate of one yard in eight hours, and serves as a means for incendiary purposes.

"QUICK."

Quick match is made of cotton wick boiled with a solution of mealed powder and gum arabic. It is used for the priming of fuses, and is used to fire explosives of a dangerous nature when it would be unsafe to approach. It burns, unconfined, one yard in thirteen seconds; confined, instantaneous.

BICKFORD'S FUZE.

Bickford's fuze consists of a column of gunpowder enclosed in flax covered with gutta percha, and coated with varnished tape. It is used for submarine mining, &c., and can also be used to detonate gun-cotton in connexion with a detonator. It burns 1 yard a minute.

AMMUNITION.

SMALL-ARM.

Ball Cartridges for the Martini-Henry rifle consist of a case formed of two turns and an overlap of ·004″ brass, lined with tissue paper to prevent the injurious action which would take place if the powder and brass were in contact. Between the folds at the base is a strip of brass of the same thickness as that composing the body, to give additional strength. A small sight-hole is punched in the case to see that this strip is present. The cartridge is made of a bottle-necked shape by crimping in the upper part, so that the whole fits into the shot chamber of the rifle. The base is further strengthened by two base cups of brass (an inner and outer), and the bottom is closed by a carbonized wrought-iron disc. Inside is pressed a paper pellet, having a hole in the centre against the bottom of the cartridge. A cap-chamber pierced passes through the disc, cups, and pellet, and rivets the whole of the parts together, the top of which is bulged out over the paper pellet, the base of this chamber being flanged to fit a countersink in the iron disc. The cap-chamber contains a brass anvil, on the shoulders of which rests the cap, containing ·2 grains of cap-composition, pressed and varnished. On the top of the powder is placed a millboard disc, then a wad of beeswax, cupped out to the front to ensure its expanding in cold weather, then two more millboard discs, and lastly the bullet, which is composed of lead hardened with tin, 12 parts lead to 1 part tin.

Weight of bullet, 480 grains; length, 1·27″; diameter increases from ·439″ at the shoulder to ·45″ at base.

Description of powder, R.F.G^2; weight 85 grains.

The cartridges are packed in bundles of ten, stowed head and tail, in white and brown paper. Weight of each package, about 1lb. 2oz.; supplied in quarter metal-lined cases and ammunition boxes.

The action is as follows:—On firing, the cap-composition is forced against the point of the anvil, and the flash thus produced reaches the charge through the hole in the cap-chamber, the case unwinds, and being pressed firmly against the sides of the bore prevents the gas from escaping in the direction of the breech; after firing, the cartridge contracts to its original proportions, making extraction easy.

Blank Cartridge consists of a brown paper case in lieu of brass, having a base disc, cap-chamber, cap and anvil, one base-cup, and paper-pellet; an additional piece of paper is inserted in the case, forming a head to the cartridge, which is done by turning in the top after the powder is entered.

Description of powder and weight used for blank cartridge:—68 to 72 grains of R.F.G. F.G. and S.G. may also be used. These powders may also be used for blank charges of ordnance.

Blank cartridges are packed in bundles of ten, head and tail, in two coverings of purple paper. On the outside covering is printed the nature of contents, weight of charge, and B.L.; also, the mark and year of manufacture. They are supplied in metal-lined half-cases.

GATLING GUN.

The cartridge for the ·45 gun consists of a solid brass case, somewhat contracted at the top; the base is formed by pressing out the material of the case, so as to form the projecting rim necessary for extraction. There is no anvil, but the cap strikes against a small boss or nipple in the chamber, which is pierced with two fire-holes. The material of the case is not lined with paper, but lacquered. The charge, bullet, wads, &c., are identical with those used in the Martini-Henry cartridge.

They are stowed in bundles of ten, head and tail, supplied in ammunition-boxes, each package weighing 1lb. 2oz., wrapped in paper similar to the ball cartridge for the Martini-Henry.

PISTOL (ENFIELD).

The cartridge for the Enfield pistol is made of solid-drawn brass, the centre of the base forming the cap-chamber, into which a cap and anvil are placed. The cap-chamber is pierced as usual.

Weight of bullet, ·265 grains (same alloy as the Martini bullets); length of bullet, ·897 inches; diameter of bullet, ·455 inches; charge, 18 grains pistol or Adams' pistol powder; weight of bundle of 12, about 10 oz.

HOW PACKED, ETC.

In order that the particular kind of ammunition packed in small-arm ammunition boxes may be readily distinguished, all such boxes issued from Woolwich have now labels, with distinguishing marks of various colours. The distinguishing labels are placed on each side and on each end. The following is the detail:—

Contents of Boxes.	Distinguishing Marks.		Colour of Marks.
	On each side.	On each end.	
Ball Ammunition for—	M.-H. RIFLE.		
Martini-Henry Rifle			Red
	GATLING, 0·45"		
Gatling Gun, 0·45			Black
	NORDENFELT.		
Nordenfelt Gun (service) ..			Green

Contents of Boxes.	Distinguishing Marks. On each side.	Distinguishing Marks. On each end.	Colour of Marks.
	NORDENFELT.		
Nordenfelt Gun (practice) ..			Green
	NORDENFELT.		
„ „ (dummy drill)			Green
	PISTOL, ADAMS'.		
Adams' Revolver Pistol ..			Brown
	PISTOL ENFIELD.		
Enfield „ „ ..			Brown

All wrappers and labels for the ammunition bear, in addition to the other particulars, the distinguishing marks above shown painted upon them in black. Each small arm ammunition box, in addition to the above distinguishing marks, has upon it a label giving the number and nature of the contents. Stencilled upon it, also, is its gross weight, date of packing, lot, and nature of powder with which the cartridges it contains are made up.

MANNING AND ARMING BOATS.

STORES.

Cutters.—Rifle ball-cartridges, not less than 60 rounds per rifle; Pistol ball-cartridges, not less than 60 rounds per pistol. Coxswain and bowmen are armed with pistols; the remainder of boats' crews with rifles, which are placed in beckets under thwarts fitted for them. Boarding-pikes, 4; tomahawks, 2; water and provision barricoes, 1 of each, unless other orders are given; boats' compasses in senior boats; anchor and cable.

Boat's Bag contains lead and line, oar lanyards, spun-yarns and marline spike, ensign, pendant and answering pendant, corks, grease, and fearnought.

Boatsman's Bag.—Canvas, palm and needle, twine, cable, punch, and cold chisel.

Carpenter's Bag contains fearnought, chalk, grease, nails, set of tools, strip of copper for oars, corks, and plugs for stopping bullet-holes, and sheet-lead for stopping leaks.

Surgical Bag contains bandages, lint, and tourniquets.

Whaler.—As above, except boarding pikes 2, tomahawk 1, tourniquet 1.

Boat's Magazine.—Fixed inside lid: portfires, 2; signal-rockets, 2; stick-rockets with rope tails, 2. In large compartment: one leather case, containing not less than 60 rounds per rifle; pistol ball-cartridge, not less than 60 rounds per pistol; rifle, blank, as required; slow match, 2 yards; long lights, 1; short lights, 1; holder for lights, 1; detonating primers, 6, inside the holder.

DEFLECTION SCALE.

When the ship is moving, the deflection scale must be used.

Allow 5′ deflection for each knot of speed.

An allowance for wind across the range, or for the speed of the enemy, may also be made on the deflection scale.

If the speed for which allowance is made is from right to left in the ship firing, and from left to right in the ship fired at, right deflection is to be used, and *vice versâ*.

When the deflection vernier is insufficiently marked, the aim should be taken the distance to the right or left of the object given in the following table:—

TABLE OF ALLOWANCE IN AIMING WHEN PASSING AN OBJECT, OR VICE VERSÂ.

Distance of the Object.	SPEED IN KNOTS.											
	2	4	6	8	10	12	14	16	18	20	22	24
Yards.	Yd.	Yd.	Yd.	Yd.	Yd.	Yd.	Yd.	Yd.	Yd.	Yd.	Yd.	Yd.
200	1	1	2	2	3	3	4	4	5	5	6	6
400	1	2	3	4	5	6	7	8	9	10	11	12
600	2	3	5	6	8	9	11	12	14	16	17	18
800	2	4	6	9	11	13	15	18	20	22	24	26
1,000	3	5	8	11	13	16	19	22	24	26	29	32
1,500	4	8	12	17	21	25	29	34	38	42	46	50
2,000	6	11	17	23	28	34	40	46	51	56	62	68
3,000	9	18	27	36	45	54	63	72	81	90	99	108
4,000	3	25	38	50	63	75	88	100	113	126	138	150

If two ships are going in the *same* direction, the difference of their speeds, must be used in the above table, and if in *opposite* directions the sum of their speeds.

When using guns with deflection leaf for speed on the foresight, the drill must be altered as follows:—

For—

—DEFLECTION. —YARDS. } 1 and 2 adjust the sights.

Read—

—KNOTS. 3 and 4 adjust trunnion sights.

—DEFLECTION. —YARDS. } 1 and 2 adjust hind sights.

NOTE.—The adjustment of the trunnion sight is not to be altered until new speed is named.

JUDGING DISTANCES AT SEA.

Sir H. Douglas's method, in which an observer on deck ascertains with a sextant the angle subtended by the enemy's masthead and hammock-netting or waterline.

This method is found very useful for laying out targets and keeping station with the squadron, &c., &c.

By Sound.

Sound travels at the rate of about 380 yards a second. If the interval between the flash and the report of a gun in seconds be multiplied by 380, the product will be the distance in yards.

Admiral Ryder's (or the horizon) method, namely, to observe from the crosstrees or other convenient place the angle subtended between the horizon and the enemy's waterline or other object, or if on shore from a fort (the higher the better), and is corrected by the dip angle due to the height.

Example (1).—Let the angle subtended between the horizon and the enemy's waterline, ascertained by an observer at a ship's masthead or from a fort (say a height of 205 feet), be 2°. Required the distance.

The dip of the horizon due to a height of 205 feet, see Table II., is 15′ 11″, 2° + 15′ 11″ = 2° 15′ neglecting the seconds.

The distance due to an angle of 2° 15′, if the height had been 20 feet, would have been, from Table I., column 2, 169 yards.

The correction for each foot of additional height, column 3, Table I., is 8·5 yards.

Distance = 169 yards + (205 - 20) 8·5 = 1,741 yards.

This is a sufficiently close approximation to the distance given in Table IV. in Admiral Ryder's work, viz., 1,743 yards, showing that Table I. can be safely used with "horizon" method within the prescribed limits.

TABLE I.—MASTHEAD ANGLES.

Height, 20 Feet.

Masthead angle.	Distance in yards.	Correction for 1 foot in height.	Masthead angle.	Distance in yards.	Correction for 1 foot in height.	Masthead angle.	Distance in yards.	Correction for 1 foot in height.	Masthead angle.	Distance in yards.	Correction for 1 foot in height.
° ′	yds.	yds.	° ′	yds.	yds.	° ′	yds.	yds.	° ′	yds.	yds.
5 0	76	3·8	1 52	204	10·2	1 4	358	17·9	0 38	602	30·2
4 30	85	4·2	1 50	208	10·4	1 2	369	18·5	0 37	618	31·0
4 0	95	4·8	1 48	212	10·6	1 0	382	19·1	0 36	636	31·8
3 50	99	5·0	1 46	216	10·8	0 59	388	19·4	0 35	654	32·2
3 40	104	5·2	1 44	220	11·0	0 58	395	19·7	0 34	673	33·7
3 30	109	5·4	1 42	224	11·2	0 57	402	20·1	0 33	694	34·7
3 20	114	5·7	1 40	229	11·4	0 56	409	20·5	0 32	715	35·8
3 10	120	6·0	1 38	234	11·7	0 55	416	20·8	0 31	739	37·0
3 0	127	6·4	1 36	238	11·9	0 54	424	21·2	0 30	763	38·2
2 55	131	6·5	1 34	243	12·2	0 53	432	21·6	0 29	790	39·5
2 50	135	6·7	1 32	249	12·5	0 52	440	22·0	0 28	818	40·9
2 45	139	6·9	1 30	254	12·7	0 51	449	22·5	0 27	848	42·4
2 40	143	7·1	1 28	260	13·0	0 50	458	22·9	0 26	881	44·1
2 35	148	7·4	1 26	266	13·3	0 49	467	23·4	0 25	916	45·8
2 30	152	7·6	1 24	273	13·6	0 48	477	23·9	0 24	954	47·7
2 25	158	7·9	1 22	279	14·0	0 47	487	24·4	0 23	997	49·8
2 20	163	8·2	1 20	286	14·3	0 46	498	25·0	0 22	1041	52·1
2 15	169	8·5	1 18	293	14·7	0 45	509	25·5	0 21	1090	54·6
2 10	176	8·8	1 16	301	15·1	0 44	520	26·0	0 20	1145	57·3
2 5	183	9·2	1 14	309	15·5	0 43	532	26·6	0 19	1204	60·3
2 0	191	9·5	1 12	318	15·6	0 42	545	27·3	0 18	1272	63·6
1 58	194	9·7	1 10	327	16·4	0 41	558	28·0	0 17	1347	67·4
1 56	197	9·9	1 8	337	16·8	0 41	572	28·9	0 16	1431	71·6
1 54	201	10·0	1 6	347	17·4	0 39	587	29·4	6 15	1526	76·4

TABLE II.—A DIP TABLE.

Height of eye above water in feet.	Amount of Dip.	Height of eye above water in feet.	Amount of Dip.	Height of eye above water in feet.	Amount of Dip.
20	4·40	85	9·45	150	13·0
25	5·11	90	10·3	155	13·13
30	5·43	95	10·19	160	13·27
35	6·11	100	10·35	165	13·39
40	6·40	105	10·51	170	13·51
45	7·5	110	11·7	175	14·3
50	7·30	115	11·22	180	14·15
55	7·51	120	11·38	185	14·26
60	8·12	125	11·52	190	14·38
65	8·32	130	12·6	195	14·49
70	8·52	135	12·19	200	15·1
75	9·10	140	12·33	205	15·11
80	9·28	145	12·46	210	15·22

The correction for each foot of additional height, column 3, Table I., is 60·3 yards; distance = 1,204 × (95–20) 60·3 = 5,726 yards.

On ascertaining the distance for the same height and angle from Table IV. in Admiral's Ryder's work, it will be found to be 7,229 yards, showing an error of 1,503 yards, introduced by using Table I. with the "horizon" method beyond the prescribed limits. This example is given to enforce the necessity of confining the use of Table I. for the "horizon" method to the limits laid down above. Of course, if there is any index correction it must be applied, but it will be found more convenient and less embarrassing to the observer aloft to use a sextant that has no index error.

Example (2).—Let the angle subtended between the horizon and the enemy's waterline, ascertained by an observer in a ship's top or the upper battery of a fort (say 95 feet above the water) be 9′.

The dip of the horizon due to a height of 95 feet (see Table II.) is 10′ 19″, 9′ × 10′ 19″, neglecting seconds. The distance due to an angle of 19′, if the height had been 20 feet, would have been, from Table I., column 2, 1,204 yards.

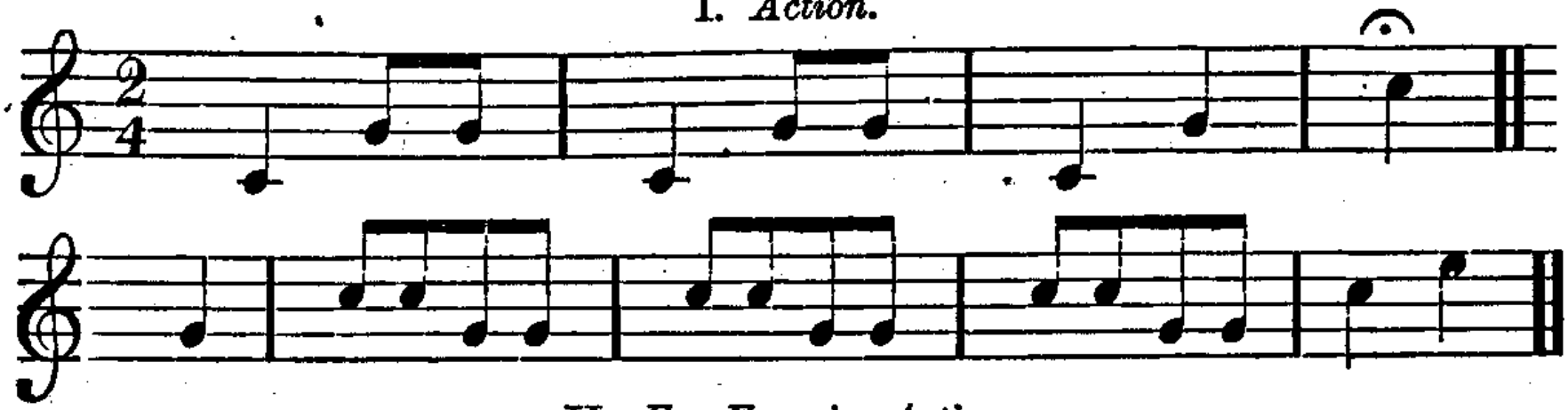
SCALE OF POINTS TO BE ALLOWED AT TARGET PRACTICE.

Elevation.					Direction.	
Under 1500 yds.		Over 1500 yds.			At all Ranges.	
From Short.	To Over.	From Short.	To Over.	Points.	Right or Left.	Points.
	Hit Direct			12		
5	50	5	30	6	Under 5 yards ..	4
15	80	10	50	5	From 5 to 10 yards	3
25	110	15	70	4	From 10 to 15 „	2
30	130	20	90	3		

Note.—All ties to be decided by counting back.

BUGLE CALLS.

I. *Action.*



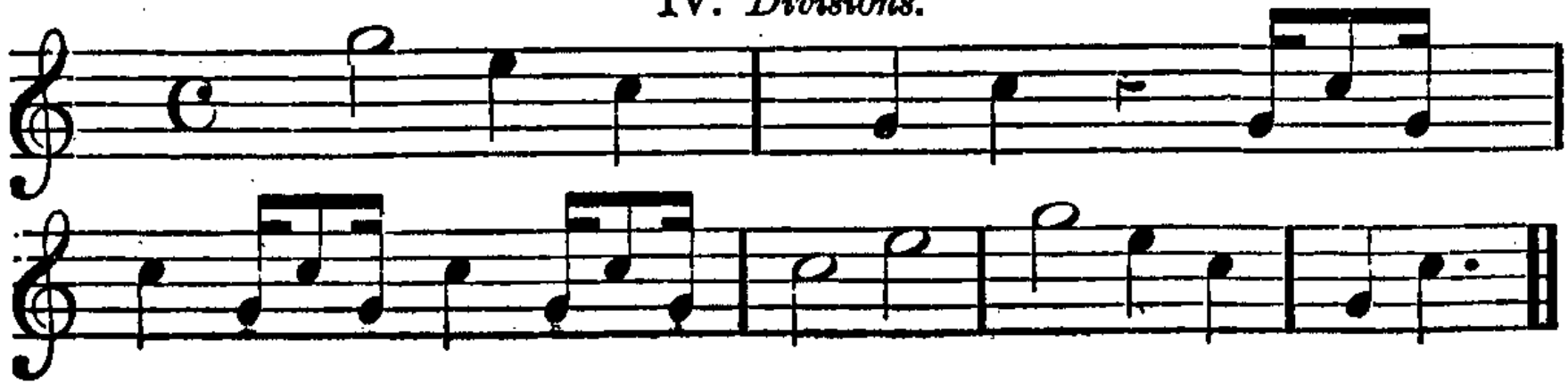
II. *For Exercise Action.*

As for Action, but preceded and followed by one "G."

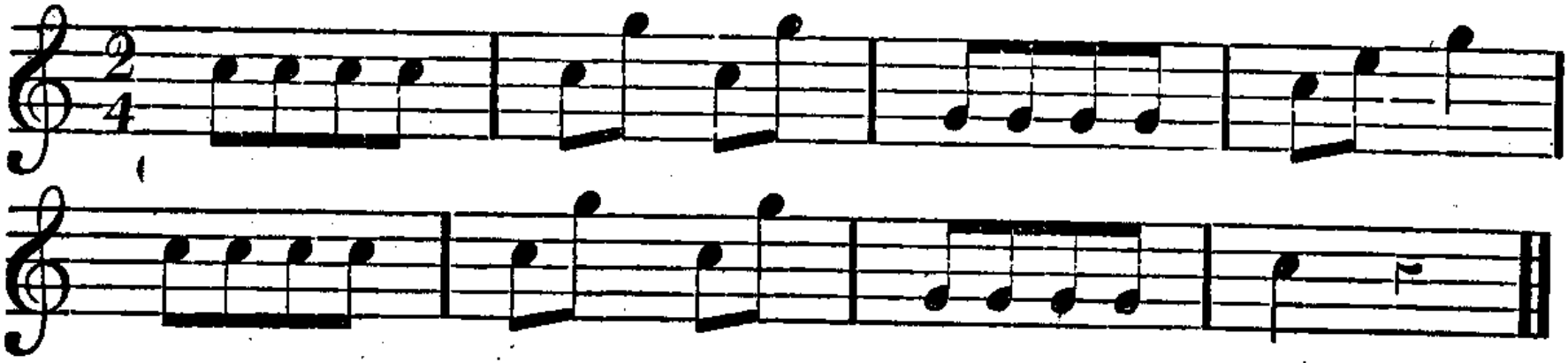
III. *Quarters for Inspection.*

As for Action, but preceded and followed by two "G's."

IV. *Divisions.*

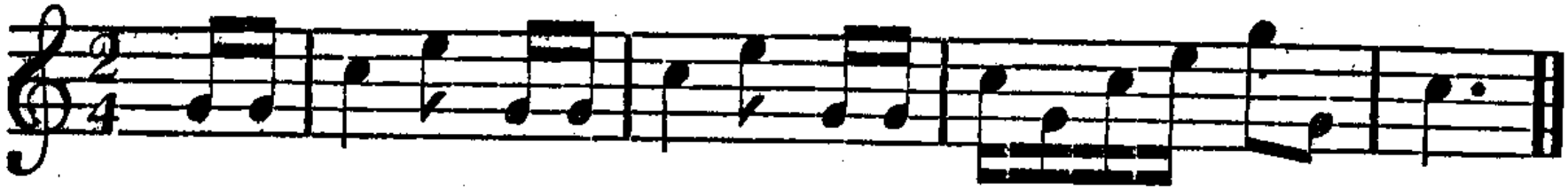


V. *Landing Party Fall in for Landing.*



The same Call, preceded and followed by one "G," refers to the Rifle companies and Field Gun's crews only; to fall in for exercise on board.

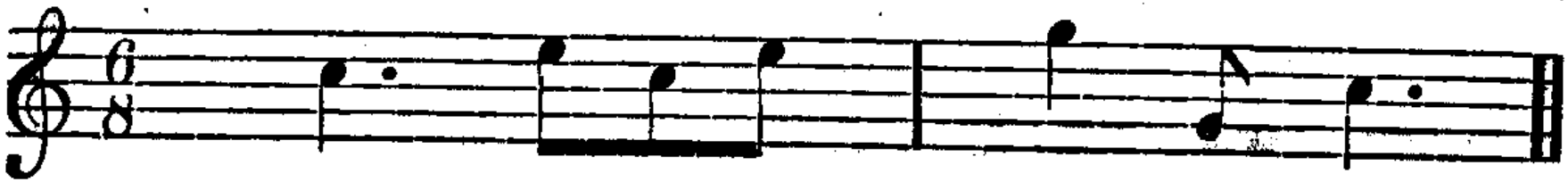
VI. *Clean Guns.*



VII. *Clean Arms.*

The same as Clean Guns, with one "G."

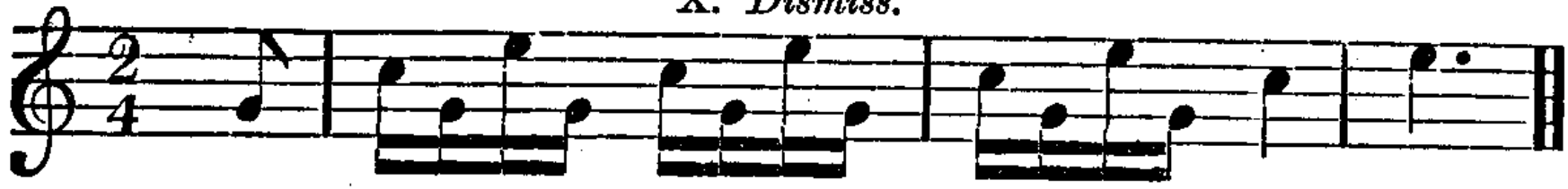
VIII. *Return Arms.*



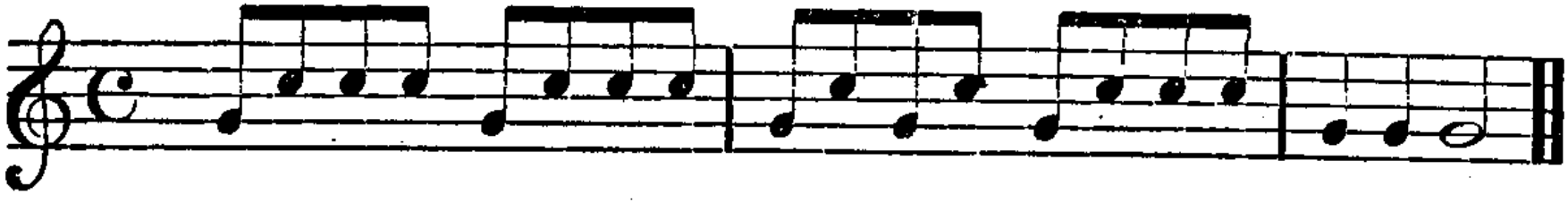
IX. *Secure Guns.*

The same as Return Arms, with one "G."

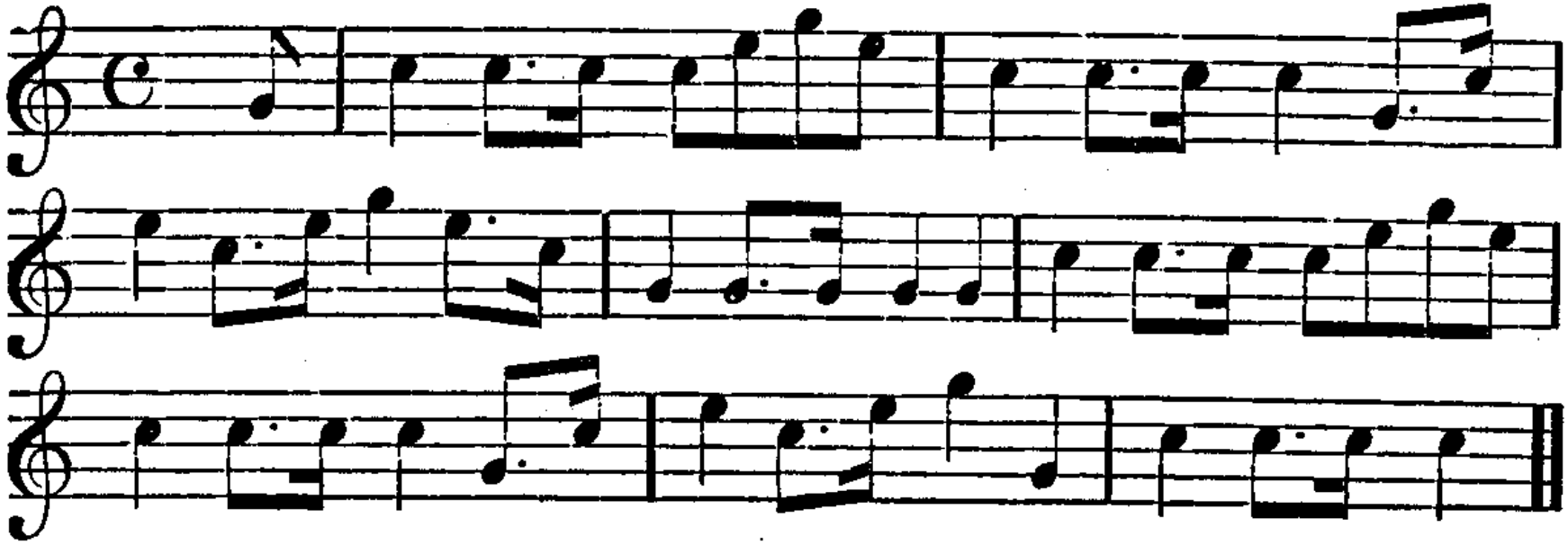
X. *Dismiss.*



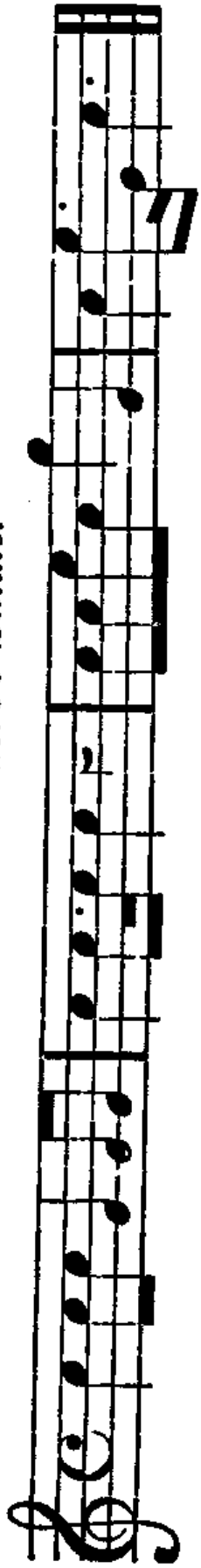
XI. *Advance.*



XII. *Admiral's Salute.*

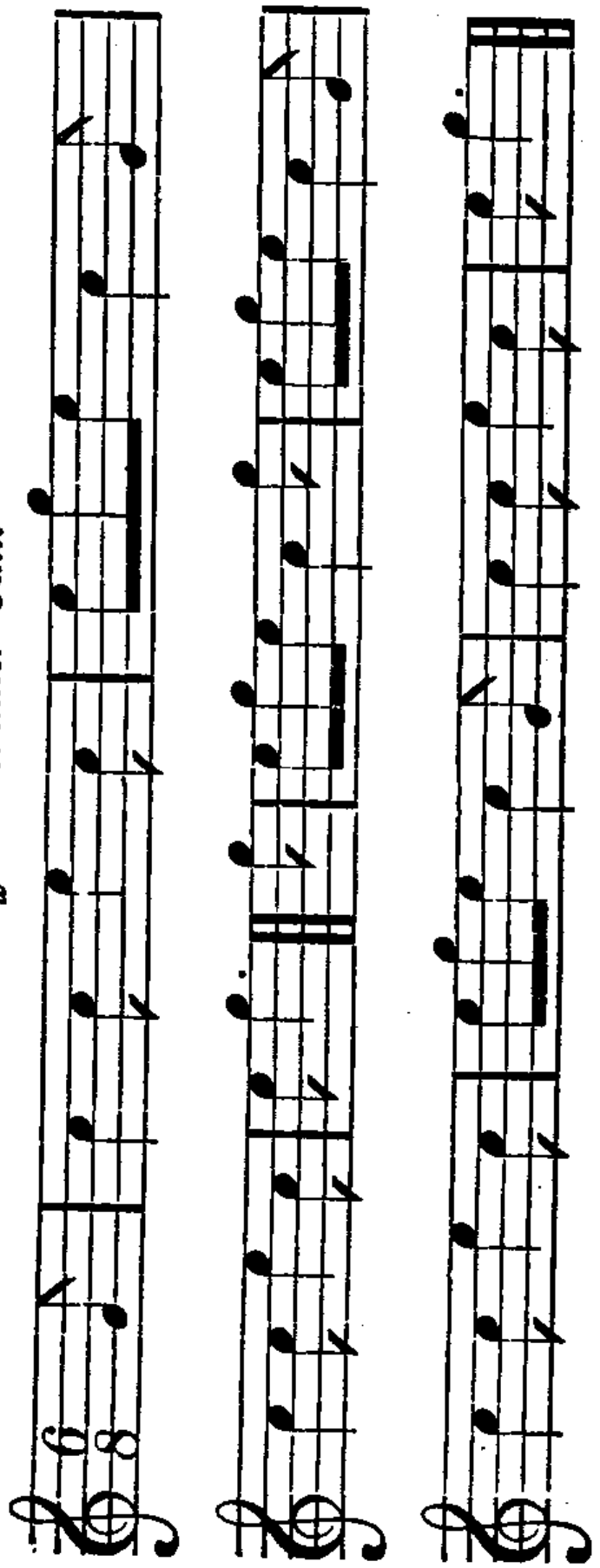


XIII. *Commodore's Salute.*

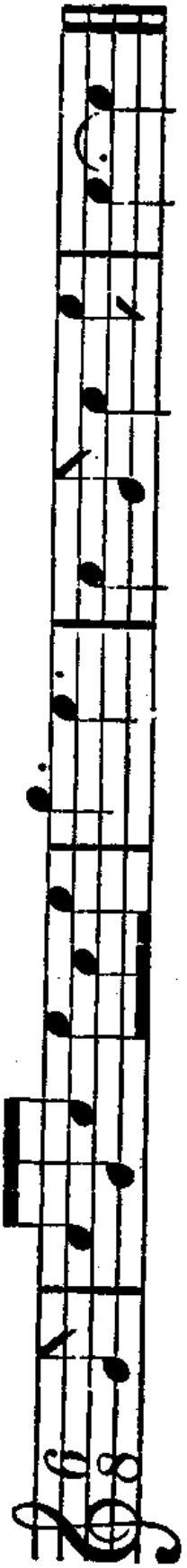


XIV. *Officers' Call.*

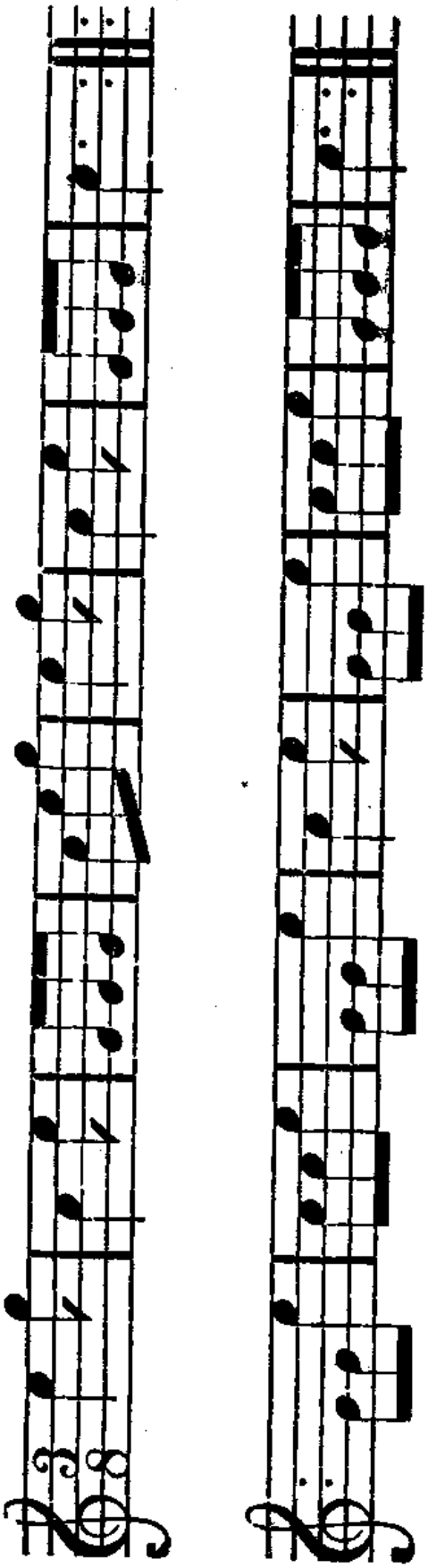
XV. *Officers' Dinner Call.*



XVI. *Cooks of Messes.*

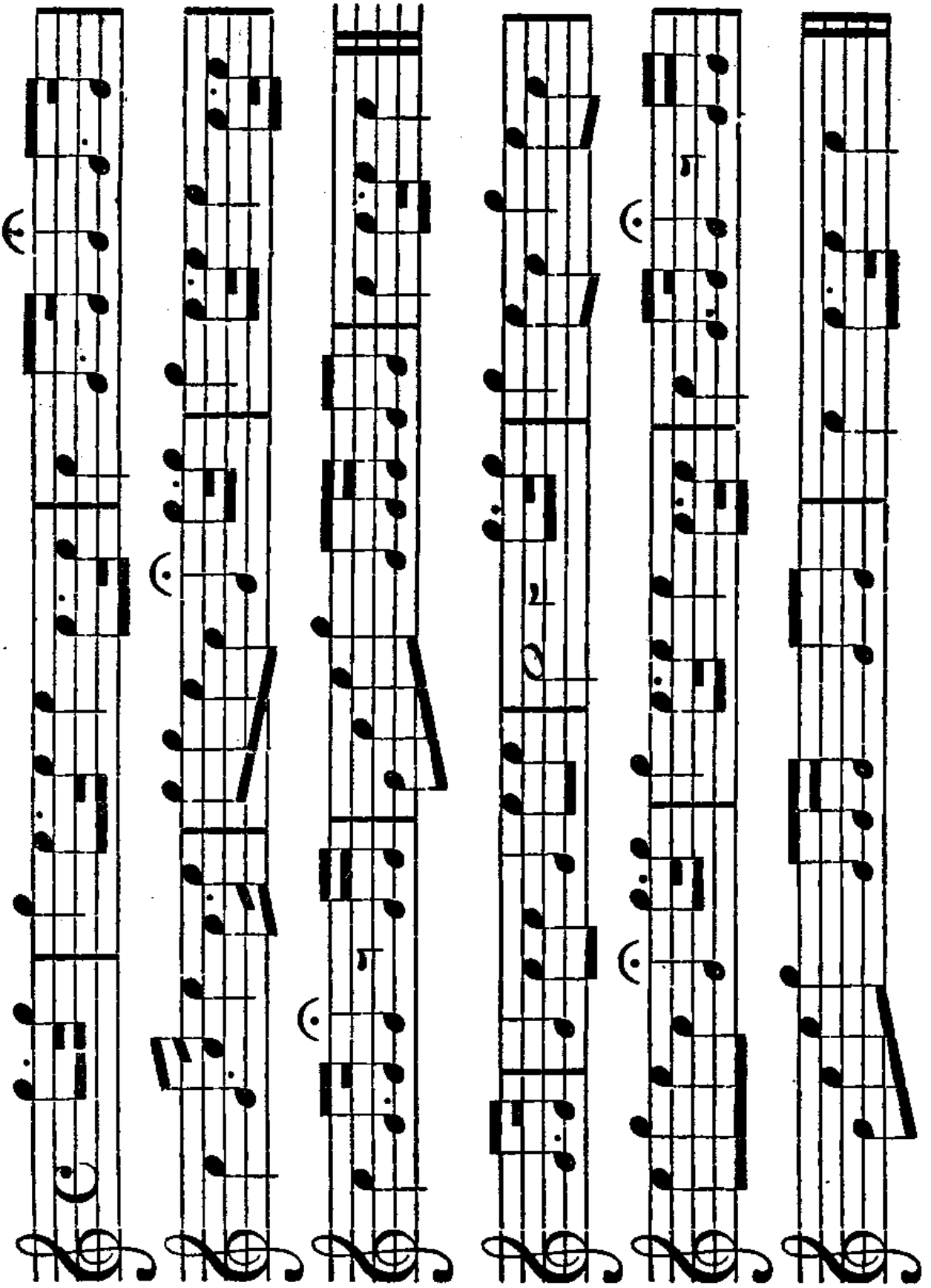


XVII. *Daylight.*



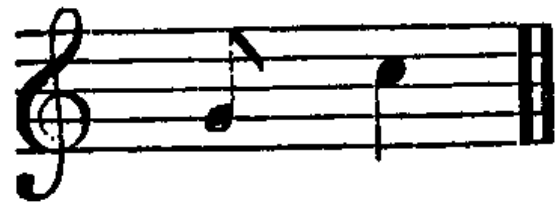
Presto.

XVIII. *Sunset.*



XIX. *Still.*

XX. *Carry on.*



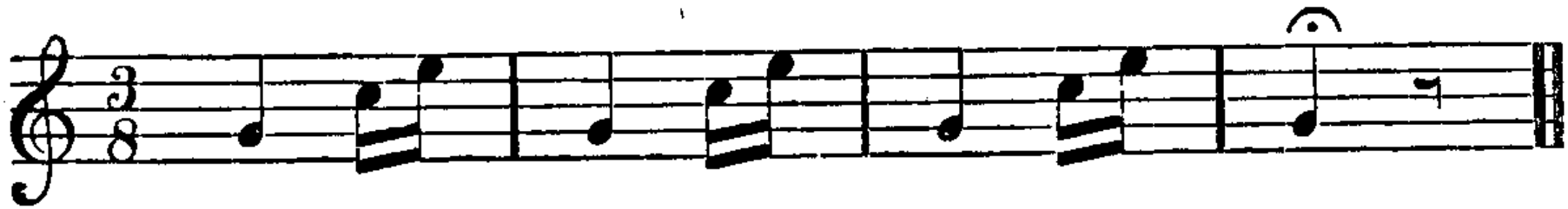
The following Bugle Calls preceded and followed by one "G" refer to the Upper Deck Quarters, or First Division of Boarders.

When preceded and followed by two "G's" they refer to the Port Battery, or Second Division.

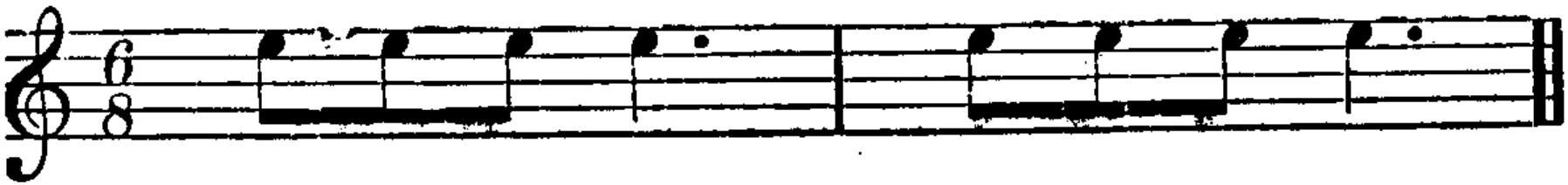
When preceded and followed by three "G's" they refer to the Starboard Battery, or Third Division.

When sounded without "G's" they are general.

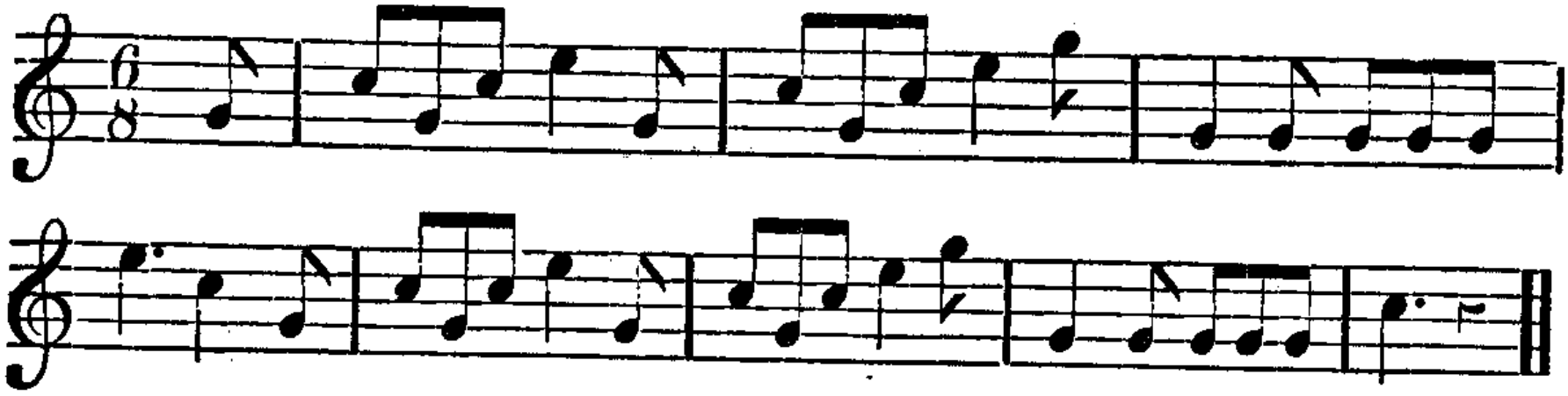
I. *Commence Firing.*



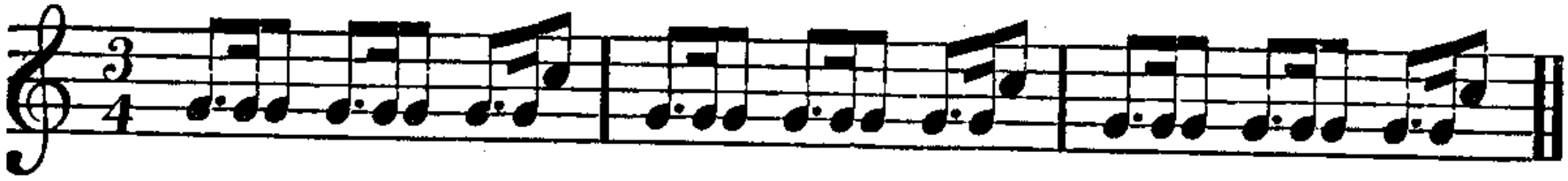
II. *Cease Firing.*



III. *Boarders.*



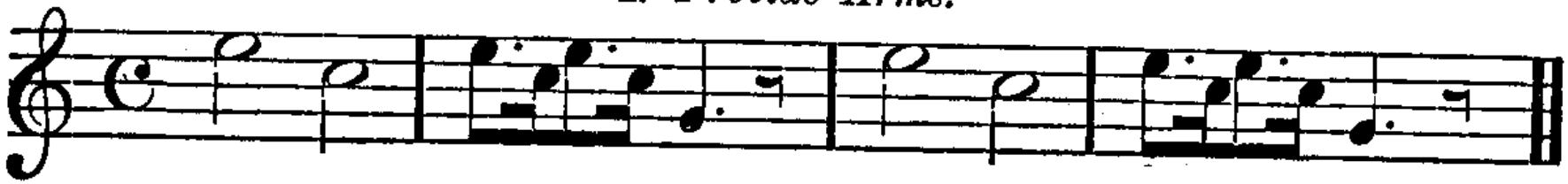
IV. *Boarders return to their Quarters.*



CLOSE WATERTIGHT DOORS.

A succession of "G's" on the Bugle, or short notes on the Foghorn, to be sounded along the decks.

I. *Provide Arms.*



PROJECTILES AND CHARGES.

Guns.	Weight.	Length.	Nature of Powder.	Charges.		Shell.								Shot.			
						Palliser.		Common.		Shrapnel.		Segment.		Palliser.		Case.	
				Battering.	Full.	Weight.	Burster.	Weight.	Burster.	Weight.	Burster.	Weight.	Burster.	Weight.	Burster.	Weight.	Balls.
	tons.	ft. in.		lb.	lb.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	No.
10-inch M.L.R.	18	15 0	Pebble	70	44	..	..	..	..	..	..	..	..	..	..	..	..
			R.L.G.	60	40	391 14	6 14	377 12	20 4	404 9	1 9	..	..	400 0	4 0	143 0	193
10-inch B.L.R.	25	27 10	Pris-matic	215	..	..	..	..	..	..	..	..	..	..	..	..	..
			Pebble	..	150	444 8	5 8	379 1	20 4	400 0	1 9	393 0	7 6	..	..	378 0	486
8-inch B.L.R.	12	19 3	Pris-matic	100	..	..	..	..	..	..	..	..	..	..	..	..	..
			Pebble	..	65	177 0	3 0	168 0	12 0	180 0	0 10	177 0	3 0	..	..	180 0	432
6-inch B.L.R.	4	14 7	Pris-matic	42	..	..	..	..	..	..	..	..	..	..	..	..	..
			Pebble	..	30	78 7	1 9	75 0	5 0	80 0	0 5	77 0	3 0	..	..	70 0	320
	cwt.				lb. oz.												
13-pr. B.L.R.	8	7 7	R.L.G.	..	3 12	..	..	12 8	0 7	12 8	0 1	12 8	0 4	..	..	12 8	150
9-pr. B.L.R.	5	7 0	R.L G. ..	..	2 8	..	..	8 11	0 4¾	9 0	0 1	8 15	0 1	..	..	9 0	108

The battering and full charges for the 10-inch and 8-inch B.L.R. Guns are in two half-charges.

STATIONS FOR "FIRE" AND TORPEDO ATTACKS.

"Cerberus."

After Bell is Rung.—Bugle will sound "Still," and word will be passed where the fire is.

After Turret's Crew, and after shell-room and magazine men, man the after 7-inch and 9-inch pumps in steerage, each watch working their own side.

Fore Turret's Crew.—The same forward with their magazine and shell-room party. Should pumps not be able to be worked below, then hands would rig them on upper deck.

Machine-guns' Crews and riggers, with quartermaster, cover hatches, and place armour covers, if not already placed. Put in deck-plates, then fall in on quarter-deck ready to man pump as required.

Fire Brigade.—Pass steam-hose along and attend it.

Stokers close watertight doors as required. Cooks and stewards to fall in with them on shield-deck with buckets, and wait orders.

Engineer attends with flooding-keys of magazine.

Captain, 2nd Captain, and *No. 1 of turrets* attend branch-pipes and hoses.

Closing Watertight Doors.

An Engineer will be in charge of fire brigade and all water-tight doors.

A succession of G's on the Bugle is the signal.

Stokers are stationed to close doors; men in magazines and shell-rooms close magazines and shell-rooms, and get out smartly.

Stations "Fire" in Action.

The Stokers, stationed in each compartment with a bucket of water, will put out any small fire occurring.

If a fire occurs either forward or aft the magazine, that part and shell-rooms are to be closed.

Stokers will close watertight doors as requisite.

Engineer in charge of fire brigade will get steam-hose down.

Fire Brigade, and shell-room and magazine men in that part of ship, man 7-inch pump and get hoses along, Petty Officers attending branch-pipes.

Should fire require more assistance, one gun's crew of the turrets of part of ship will be ordered to "Cease Fire," and be sent to man pumps.

Fire Brigade will consist of *watch of stokers* not on fires. These will close *watertight doors* as well.

MAN AND ARM SHIP, REPEL TORPEDO ATTACK.

Inside turret Nos. load with case. Turrets trained in direction required. Outside numbers, riggers, and fire brigade take rifles and post themselves under cover on flying and shield decks. Machine-guns' crews man their guns.

"Victoria."

MAN AND ARM SHIP, REPEL TORPEDO BOATS' ATTACK.

The hands, if not already at quarters, will at once repair to them. Clear away and load their guns with full charge and case shot; open the ports and run out; then all Nos., except 2 and 6 at the 10-inch gun, and 1 and 2 at 12½-prs. and Nordenfelts, will provide their arms and station themselves on whichever side of the ship the attack is expected on.

"FIRE" STATIONS.

Starboard Watch.—Rig and man the fire-engine; provide suction hose, delivery hose, branch pipe, spanners, pump and handle.

Port Watch.—Man force-pump and pass water in buckets to the fire. Remainder of watch, man fire buckets from bridge, mount the rail near the fire, and draw water.

Firemen, assisted by , rig and man donkey pump.

"Albert."

MAN AND ARM SHIP, REPEL TORPEDO ATTACK.

The hands, if not already at their quarters, will at once repair to them, clear away, and load their guns with full charge and case shot.

The machine-guns' crews prepare for action.

When the guns are loaded, all Nos., except 1, 2, and 6, at 8-inch gun, and Nos. 1 and 2 of the 6-inch and 9-pr. guns, provide their arms, and will post themselves, under cover, on whatever side of the ship the attack is expected on.

"FIRE" STATIONS.

On the fire-bell being rung, the hands will repair to the following stations:—

Starboard Watch, as follows:—Rig and man the fire-engine; provide suction hose, delivery hose, branch pipe, spanners, pump and handle.

Port Watch.—Man force pump, and pass water in buckets to the fire.

Firemen, assisted by , rig and man donkey pump.

USEFUL RULES AND TABLES.

The Metric Tables are all arranged in rows.

To find the Metric equivalent of any given number, or *vice versâ*, look in the left vertical row for the first figures of the number, and along the top horizontal row for the last figure; the equivalent will be found at the intersection of these two rows.

For example: at page 197, find the equivalent in English inches of 45 millimètres.

Having found the figure 4 in the left vertical row, look along it for its intersection with the row under the figure 5 in the top horizontal row, and find the number 1·77169, which is equivalent in English inches to 45 millimètres.

It is evident that the equivalent of all Metric multiples of 45 will be found merely by shifting the decimal point in the number 1·77169; thus the equivalent of 450 millimètres is 17·7169 inches, and of 4,500 millimètres 177·169 inches, and so on.

As 1 centimètre equals 10 millimètres, and 1 décimètre equals 100 millimètres, the table for the conversion of millimètres into inches is applicable to the conversion of either centimètres or décimètres into inches. Thus 15 centimètres equal 150 millimètres, or 5·906 inches, and 20 décimètres equal 2,000 millimètres, or 78·742 inches.

The Metric measures of length are—

1	millimètre	= 0·039370788 English inches.
10	millimètres	= 1 centimètre.
100	,,	= 1 décimètre.
1,000	,,	= 1 mètre.
10	mètres	= 1 décamètre.
100	,,	= 1 hectomètre.
1,000	,,	= 1 kilomètre.
10,000	,,	= 1 myriamètre.

MILLIMETRES TO INCHES.

EXAMPLES.

(1.) Find the equivalent number of inches in 0·03, 0·36, 0·97, 1, 20, 36, 360, 3,660, and 7,000 millimètres.

Answer.

0·0012, 0·0142, 0·0382, 0·03937, 0·78742, 1·41735, 14·173, 144·10, and 275·59 inches.

(2.) Find the number of inches in 78·67 millimètres.

Answer.

78	millimètres	= 3·0709	inches.
·67	,,	= 0·0264	,,
78·67	,,	= 3·0973	,,

(3.) The 17-centimètre German gun has a cabibre of 172·6 millimètres, and a length of bore of 3·784 millimètres; what are the equivalents in English inches?

Answer.

172	millimètres	= 6·771	inches.
·6	,,	= 0·024	,,
172·6	,,	= 6·795	,,

3,700	millimetrès	= 145·67	inches.
84	,,	= 3·31	,,
3,784	,,	= 148·98	,,

MILLIMÈTRES TO INCHES.

1 millimètre = 0·0393708 inch.

Millimetres	0	1	2	3	4	5	6	7	8	9
0·0	0·0000	0·0004	0·0008	0·0012	0·0016	0·0020	0·0024	0·0028	0·0032	0·0035
0·1	0·0039	0·0043	0·0047	0·0051	0·0055	0·0059	0·0063	0·0067	0·0071	0·0075
0·2	0·0079	0·0083	0·0087	0·0091	0·0095	0·0098	0·0102	0·0106	0·0110	0·0114
0·3	0·0118	0·0122	0·0126	0·0130	0·0134	0·0138	0·0142	0·0146	0·0150	0·0154
0·4	0·0158	0·0161	0·0165	0·0169	0·0173	0·0177	0·0181	0·0185	0·0189	0·0193
0·5	0·0197	0·0201	0·0205	0·0209	0·0213	0·0217	0·0221	0·0224	0·0228	0·0232
0·6	0·0236	0·0240	0·0244	0·0248	0·0252	0·0256	0·0260	0·0264	0·0268	0·0272
0·7	0·0276	0·0280	0·0284	0·0287	0·0291	0·0295	0·0299	0·0303	0·0307	0·0311
0·8	0·0315	0·0319	0·0323	0·0327	0·0331	0·0335	0·0339	0·0343	0·0347	0·0350
0·9	0·0354	0·0358	0·0362	0·0366	0·0370	0·0374	0·0378	0·0382	0·0386	0·0389
—	—	0·03937	0·07874	0·11811	0·15748	0·19685	0·23622	0·27559	0·31497	0·35434
1	0·39371	0·43308	0·47245	0·51182	0·55119	0·59056	0·62993	0·66930	0·70868	0·74805
2	0·78742	0·82679	0·86616	0·90553	0·94490	0·98427	1·02364	1·06301	1·10239	1·14176
3	1·18112	1·22054	1·25987	1·29924	1·33861	1·37798	1·41735	1·45672	1·49610	1·53547
4	1·57483	1·61421	1·65358	1·69295	1·73232	1·77169	1·81106	1·85043	1·88981	1·92918
5	1·96854	2·00792	2·04729	2·08666	2·12603	2·16540	2·20477	2·24414	2·28352	2·32289
6	2·36225	2·40163	2·44100	2·48037	2·51974	2·56911	2·59848	2·63785	2·67723	2·71660
7	2·75595	2·79534	2·83471	2·87408	2·91345	2·95282	2·99219	3·03156	3·07094	3·11031
8	3·14966	3·18905	3·22842	3·26779	3·30716	3·35653	3·38590	3·42527	3·46465	3·50402
9	3·54337	3·58276	3·62213	3·66150	3·70087	3·74024	3·77961	3·81898	3·85836	3·89773
10	3·93708	3·976	4·016	4·055	4·095	4·134	4·173	4·213	4·252	4·291
11	4·331	4·370	4·409	4·449	4·488	4·528	4·567	4·606	4·646	4·685
12	4·724	4·764	4·803	4·843	4·882	4·921	4·961	5·000	5·039	5·079
13	5·118	5·158	5·197	5·236	5·276	5·315	5·354	5·394	5·433	5·472
14	5·512	5·551	5·591	5·630	5·669	5·709	5·748	5·787	5·827	5·866
15	5·906	5·945	5·984	6·024	6·063	6·102	6·142	6·181	6·221	6·260
16	6·299	6·339	6·378	6·417	6·457	6·496	6·535	6·575	6·614	6·654
17	6·693	6·732	6·771	6·811	6·850	6·890	6·929	6·969	7·008	7·047
18	7·087	7·126	7·165	7·205	7·244	7·284	7·323	7·362	7·402	7·441
19	7·480	7·520	7·559	7·599	7·638	7·677	7·717	7·756	7·795	7·835
20	7·874	7·913	7·953	7·992	8·032	8·071	8·110	8·150	8·189	8·228
21	8·268	8·307	8·347	8·386	8·425	8·465	8·504	8·543	8·583	8·622
22	8·661	8·701	8·740	8·780	8·819	8·858	8·898	8·937	8·976	9·016
23	9·055	9·095	9·134	9·173	9·213	9·252	9·291	9·331	9·370	9·410
24	9·449	9·488	9·528	9·567	9·606	9·646	9·685	9·725	9·764	9·803
25	9·843	9·882	9·921	9·961	10·000	10·039	10·079	10·118	10·158	10·197
26	10·236	10·276	10·315	10·354	10·394	10·433	10·473	10·512	10·551	10·591
27	10·630	10·669	10·709	10·748	10·788	10·827	10·866	10·906	10·945	10·984
28	11·024	11·063	11·103	11·142	11·181	11·221	11·260	11·299	11·339	11·378

MILLIMÈTRES TO INCHES—*continued.*

Millimetres.	0	1	2	3	4	5	6	7	8	9
29	11·417	11·457	11·496	11·536	11·575	11·614	11·654	11·693	11·732	11·772
30	11·811	11·851	11·890	11·929	11·969	12·008	12·047	12·087	12·126	12·166
31	12·205	12·244	12·284	12·323	12·362	12·402	12·441	12·480	12·520	12·559
32	12·599	12·638	12·677	12·717	12·756	12·795	12·835	12·874	12·914	12·953
33	12·992	13·032	13·071	13·110	13·150	13·189	13·229	13·268	13·307	13·347
34	13·386	13·425	13·465	13·504	13·543	13·583	13·622	13·662	13·701	13·740
35	13·780	13·819	13·858	13·898	13·937	13·977	14·016	14·055	14·095	14·134
36	14·173	14·213	14·251	14·292	14·331	14·370	14·410	14·449	14·488	14·528
37	14·567	14·607	14·646	14·685	14·725	14·764	14·803	14·843	14·882	14·921
38	14·961	15·000	15·040	15·079	15·118	15·158	15·197	15·236	15·276	15·315
39	15·355	15·394	15·433	15·473	15·512	15·551	15·591	15·630	15·670	15·709
40	15·748	15·788	15·827	15·866	15·906	15·945	15·984	16·024	16·063	16·103
41	16·142	16·181	16·221	16·260	16·299	16·339	16·378	16·418	16·457	16·496
42	16·536	16·575	16·614	16·654	16·693	16·733	16·772	16·811	16·851	16·890
43	16·929	16·969	17·008	17·047	17·087	17·126	17·166	17·205	17·244	17·284
44	17·323	17·362	17·402	17·441	17·481	17·520	17·559	17·599	17·638	17·677
45	17·717	17·756	17·796	17·835	17·874	17·914	17·953	17·992	18·032	18·071
46	18·111	18·150	18·189	18·229	18·268	18·307	18·347	18·386	18·425	18·465
47	18·504	18·544	18·583	18·622	18·662	18·701	18·740	18·780	18·819	18·859
48	18·898	18·937	18·977	19·016	19·055	19·095	19·134	19·173	19·213	19·252
49	19·292	19·331	19·370	19·410	19·449	19·488	19·528	19·567	19·607	19·646
50	19·685									

The foregoing table will also serve for the conversion of mètres to inches, as 1 metre = 1,000 millimètres:—

EXAMPLE.

Find the number of inches in 0·02, 0·36, 3·66 mètres.

Answer.

0·787, 14·17, and 144·10 inches.

DÉCIMÈTRES TO INCHES.

1 décimètre = 3·937079 inches.

	0	1	2	3	4	5	6	7	8	9
0·1	0·394	0·433	0·472	0·512	0·551	0·591	0·630	0·669	0·709	0·748
0·2	0·787	0·827	0·866	0·906	0·945	0·984	1·024	1·063	1·102	1·142
0·3	1·181	1·220	1·260	1·299	1·339	1·378	1·417	1·457	1·496	1·535
0·4	1·575	1·614	1·654	1·693	1·732	1·772	1·811	1·850	1·890	1·929
0·5	1·968	2·008	2·047	2·087	2·126	2·165	2·205	2·244	2·283	2·323
0·6	2·362	2·402	2·441	2·480	2·520	2·559	2·598	2·638	2·677	2·717
0·7	2·756	2·795	2·835	2·874	2·913	2·953	2·992	3·031	3·071	3·110
0·8	3·150	3·189	3·228	3·268	3·307	3·346	3·386	3·425	3·465	3·504
0·9	3·543	3·583	3·622	3·662	3·701	3·740	3·780	3·819	3·858	3·898
—	—	3·937	7·874	11·811	15·748	19·685	23·622	27·559	31·497	35·434
1	39·371	43·308	47·245	51·182	55·119	59·056	62·993	66·930	70·867	74·804
2	78·742	82·679	86·616	90·553	94·490	98·427	102·364	106·301	110·239	114·176
3	118·113	122·050	125·987	129·924	133·861	137·798	141·735	145·672	149·610	153·547
4	157·484	161·421	165·358	169·295	173·232	177·169	181·106	185·043	188·981	192·918
5	196·855	200·792	204·729	208·666	212·603	216·540	220·477	224·414	228·352	232·289
6	236·226	240·163	244·100	248·037	251·974	255·911	259·848	263·785	267·723	271·660
7	275·597	279·534	283·471	287·408	291·345	295·282	299·219	303·156	307·094	311·031
8	314·968	318·905	322·842	326·779	330·716	334·653	338·590	342·527	346·465	350·402
9	354·339	358·276	362·213	366·150	370·087	374·024	377·961	381·898	385·836	389·773
10	393·708									

EXAMPLES.

(1.) Find the number of inches in 0·22, 1, 6, and 64 décimètres.

Answer.

0·866, 3·937, 23·622, and 251·974.

(2.) The total length of the Russian 24-centimètre gun is 3,367 millimetres; what is this in inches?

Answer.

3,367 millimètres = 33·67 décimètres.

33 décimètres = 129·924 inches.

·67 ,, = 2·638 ,,

33·67 ,, = 132·562 ,,

MÈTRES TO FEET.

EXAMPLES.

(1.) Find the number of feet in 0·05, 0·76, 1, 24, 500, and 550 mètres.

Answer.

0·164, 2·493, 3·281, 78·741, 1,640·45, and 1,804·5 feet.

(2.) Find the number of feet in 68·97 mètres.

Answer.

68	mètres	=	223·101 feet.
·97	,,	=	3·182 ,,
68·97	,,	=	226·283 ,,

(3.) The muzzle velocity with the 15-centimètre German gun is 475 mètres; what is the equivalent in English feet?

Answer.

1,558·43 feet.

MÈTRES TO FEET.

1 mètre = 3·2808992 feet.

Met.	0	1	2	3	4	5	6	7	8	9
0·0	0·000	0·033	0·066	0·098	0·131	0·164	0·197	0·230	0·262	0 295
0·1	0·328	0·361	0·394	0·426	0·459	0·492	0·525	0·558	0·590	0·62
0·2	0·656	0·689	0·722	0·754	0·787	0·820	0·853	0·886	0·918	0·951
0·3	0·984	1·017	1·050	1·082	1·115	1·148	1·181	1·214	1·246	1·279
0·4	1·312	1·345	1·378	1·410	1·443	1·476	1·509	1·542	1·574	1·607
0·5	1·640	1·673	1·706	1·738	1·771	1·804	1·837	1·870	1·902	1·935
0·6	1·968	2·001	2·034	2·067	2·100	2·132	2·165	2·198	2 230	2·263
0·7	2·296	2·329	2·362	2·394	2·427	2·460	2 493	2·526	2·558	2·591
0·8	2·624	2·657	2·690	2·722	2·755	2·788	2·821	2·854	2·886	2·919
0·9	2·952	2·985	3 018	3·050	3·083	3·116	3·149	3·182	3·214	3·247
—	—	3·281	6·562	9·843	13·124	16·405	19 685	22·966	26·247	29·528

METRES TO FEET—*continued.*

Met.	0	1	2	3	4	5	6	7	8	9
1	32·809	36·090	39·371	42·652	45·933	49·213	52·494	55·775	59·056	62·337
2	65·618	68·899	72·180	75·461	78·741	82·022	85·304	88·584	91·865	95·146
3	98·427	101·708	104·989	108·270	111·550	114·831	118·112	121·393	124·674	127·955
4	131·236	134·517	137·798	141·079	144·360	147·640	150·921	154 202	157·483	160·764
5	164·045	167·326	170·607	173·888	177·169	180·449	183·730	187·011	190·292	193·573
6	196·854	200·135	203·416	206·697	209·978	213·258	216·539	219·820	223 101	226·382
7	229·663	232·944	236·225	239·506	242·787	246·067	249·349	252·629	255·910	259·191
8	262·472	265·753	269·034	272·315	275·595	278·876	282·157	285·438	288·719	292·000
9	295·281	298·562	301·843	305·124	308·405	311·685	314·966	318·247	321·528	324·809
10	320·09	331·37	334·65	337·93	341·21	344·49	347·78	351·06	354·34	357·62
11	360·90	364·18	367·46	370·74	374·02	377·30	380·58	383·87	387·15	390·43
12	393·71	396·99	400·27	403·55	406·83	410·11	413·39	416·67	419·96	423·24
13	426·52	429·80	433·08	436·36	439·64	442·92	446·20	449·48	452·76	456·04
14	459·33	462·61	465·89	469·17	472·45	475·73	479·01	482·29	485·57	488·85
15	492·13	495·42	498·70	501·98	505·26	508·54	511 82	515·10	518·38	521·66
16	524·94	528·22	531·50	534·79	538·07	541·35	544·63	547·91	551·19	554·47
17	557·75	561·03	564·31	567·60	570·88	574·16	577·44	580·72	584·00	587·28
18	590·56	593·84	597·12	600·40	603·69	606·97	610·25	613·53	616·81	620·09
19	623·37	626·65	629·93	633·21	636·49	639·78	643·06	646·34	649·62	652·90
20	656·18	659·46	662·74	666·02	669·30	672·58	675·87	679·15	682·43	685·71
21	688·99	692·27	695·55	698·83	702·11	705·39	708·67	711·96	715·24	718·52
22	721·80	725·08	728·36	731·64	734·92	738·20	741·48	744·76	748·05	751 33
23	754·61	757·89	761·17	764·45	767·73	771·01	774·29	777·57	780·85	784·14
24	787·42	790·70	793·98	797·26	800·54	803·82	807·10	810·38	813·66	816·94
25	820·22	823·51	826·79	830·07	833·35	836·63	839·91	843·19	846·47	849·75
26	853·03	856 32	859 60	862·88	866·16	869·44	872 72	876·00	879·28	882·56
27	885·84	889·12	892·41	895·69	898·97	902·25	905·53	908·81	912·09	915·37
28	918·65	921·93	925·21	928·49	931·78	935·06	938·34	941·62	944·90	948·18
29	951·46	954·74	958·02	961·30	964·58	967·87	971·15	974·43	977·71	980·99
30	984·27	987 55	990·83	994 11	997·39	1000 67	1003·96	1007·24	1010·52	1013·80
31	1017·08	1020·36	1023·64	1026·92	1030·20	1033·48	1036·76	1040·05	1043·33	1046·61
32	1049·89	1053·17	1056·45	1059·73	1063·01	1066·29	1069·57	1072·85	1076·14	1079·42
33	1082·70	1085·98	1089·26	1092·54	1095·82	1099·10	1102·38	1105·66	1108·94	1112·22
34	1115·50	1118·79	1122·07	1125·35	1128·63	1131·91	1135·19	1138·47	1141·75	1145·03
35	1148·31	1151·60	1154·88	1158·16	1161·44	1164·72	1168·00	1171·28	1174·56	1177·84
36	1181·12	1184·40	1187·69	1190·97	1193·25	1196·53	1199·81	1203·09	1206·37	1209·65
37	1213·93	1217·21	1220·49	1223·78	1227·06	1230·34	1233·62	1236·90	1240·18	1243·46
38	1246·74	1250·02	1253·30	1256·58	1259·87	1263·15	1266·43	1269·71	1272·99	1276·27
39	1279·55	1282·83	1286·11	1289·39	1292·67	1295·96	1299·24	1302·52	1305·80	1309·08
40	1312·36	1315·64	1318·92	1322·20	1325·48	1328·76	1332·04	1335·33	1338·61	1341·89
41	1345·17	1348·45	1351·73	1355·01	1358·29	1361·57	1364·85	1368·13	1371·42	1374·70
42	1377·98	1381·26	1384·54	1387·82	1391·10	1394·38	1397·66	1400·94	1404·22	1407·50

MÈTRES TO FEET—*continued.*

Met.	0	1	2	3	4	5	6	7	8	9
43	1410·79	1414·07	1417·35	1420·63	1423·91	1427·19	1430·47	1433·75	1437·03	1440·31
44	1443·60	1446·88	1450·16	1453·44	1456·72	1460·00	1463·28	1466·56	1469 84	1473·12
45	1476·40	1479·69	1482·97	1486 25	1489·53	1492·81	1496·09	1499·37	1502·65	1505·93
46	1509·21	1512·49	1515·78	1519·06	1522·34	1525·62	1528·90	1532·18	1535·46	1538·74
47	1542·02	1545·30	1548·58	1551·87	1555·15	1558·43	1561·71	1564·99	1568 27	1571·55
48	1574·83	1578·11	1581·39	1584·67	1587·96	1591·24	1594·52	1597·80	1601·08	1604·36
49	1607·64	1610·92	1614·20	1617·48	1620·76	1624 04	1627·33	1630·61	1633·89	1637·17
50	1640·45	1643·73	1647·01	1650·29	1653·57	1656·85	1660·13	1663·42	1666·70	1669·98
51	1673·26	1676·54	1679·82	1683·10	1686·38	1689·66	1692·94	1695·22	1699·50	1702·79
52	1706·07	1709·35	1712·63	1715·91	1719·19	1722·47	1725·75	1729·03	1732·31	1735·60
53	1738·88	1742·16	1745·44	1748·72	1752·00	1755·28	1758·56	1761·84	1765·12	1768·40
54	1771·69	1774·97	1778·25	1781·53	1784·81	1788·09	1791·37	1794·65	1797·93	1801·21
55	1804·49	1807·78	1811·06	1814·34	1817·62	1820·90	1824·18	1827·46	1830·74	1834·02
56	1837·30	1840·58	1843·87	1847·15	1850·43	1853·71	1856·99	1860·27	1863·55	1866·83
57	1870·11	1873·39	1876·67	1879·96	1883·24	1886·52	1889·80	1893·08	1896·36	1899·64
58	1902·92	1906·20	1909·48	1912·76	1916·04	1919·33	1922·61	1925·89	1929·17	1932·45
59	1935·73	1939·01	1942·29	1945·57	1948·85	1952·13	1955·42	1958·70	1961·98	1965·26
60	1968·54	1971·82	1975·10	1978·38	1981·66	1984·94	1988·22	1991·50	1994·79	1998·07
61	2001·35	2004·63	2007·91	2011·19	2014·47	2017·75	2021·03	2024·31	2027·60	2030·88
62	2034·16	2037·44	2040·72	2044·00	2047·28	2050·56	2053·84	2057·12	2060·40	2063·69
63	2066·97	2070·25	2073·53	2076·81	2080·09	2083·37	2086·65	2089·93	2093·21	2096·49
64	2099·78	2103·06	2106·34	2109·62	2112·90	2116·18	2119·46	2122·74	2126·02	2129·30
65	2132·58	2135·87	2139·15	2142·43	2145 71	2148·99	2152·27	2155·55	2158·83	2162·11
66	2165·39	2168·67	2171·96	2175·24	2178·52	2181·80	2185·08	2188·36	2191·64	2194·92
67	2198·20	2201·48	2204·76	2208·04	2211·33	2214 61	2217·89	2221·17	2224·45	2227·73
68	2231·01	2234·29	2237·57	2240·85	2244·13	2247·42	2250·70	2253·98	2257·26	2260·54
69	2263·82	2267·10	2270·38	2273·66	2276·94	2280·22	2283 50	2286·79	2290·07	2293·35
70	2296·63	2299·91	2303·19	2306·47	2309·75	2313·03	2316·31	2319·60	2322·88	2326·16
71	2329·44	2332·72	2336·00	2339·28	2342·56	2345·84	2349·12	2352·40	2355·69	2358·97
72	2362·25	2365·53	2368·81	2372·09	2375·37	2378·65	2381·93	2385·21	2388·49	2391·78
73	2395·06	2398 34	2401·62	2403·90	2407·18	2410·46	2413·74	2417·02	2420·30	2423·58
74	2427·86	2431·15	2434·43	2437·71	2440·99	2444·27	2447·55	2450·83	2454·11	2457·39
75	2460·67	2463·96	2467·24	2470·52	2473·80	2477·08	2480·36	2483·64	2486·92	2490·20
76	2493·49	2496·76	2500·04	2503·33	2506·61	2509·89	2513·17	2516·45	2519·73	2523·01
77	2526·29	2529·57	2532·85	2536·13	2539·42	2542·70	2545·98	2549·26	2552·54	2555·82
78	2559·10	2562·38	2565·66	2568·94	2572·22	2575·50	2578·79	2582·07	2585·35	2588·63
79	2591·91	2595·19	2598·47	2601·75	2605·03	2608·31	2611·60	2614·88	2618·16	2621·44
80	2624·72	2628·00	2631·28	2634·56	2637·84	2641·12	2644·40	2647·69	2650·97	2654·25

MÈTRES TO YARDS.

1 mètre = 1·0936331 yard.

Metres.	0	1	2	3	4	5	6	7	8	9
0·0	0·000	0·011	0·022	0·033	0·044	0·055	0·066	0·077	0·087	0·098
0·1	0·109	0·120	0·131	0·142	0·153	0·164	0·175	0·186	0·197	0·208
0·2	0·219	0·230	0·241	0·252	0·262	0·273	0·284	0·295	0·306	0·317
0·3	0·328	0·339	0·350	0·361	0·372	0·383	0·394	0·405	0·416	0·427
0·4	0·437	0·448	0·459	0·470	0·481	0·492	0·503	0·514	0·525	0·536
0·5	0·547	0·558	0·569	0·580	0·591	0·602	0 612	0·623	0·634	0·645
0·6	0·656	0·667	0·678	0·689	0·700	0·711	0·722	0·733	0·744	0·755
0·7	0·766	0·776	0·787	0·798	0·809	0·820	0·831	0·842	0·853	0·864
0·8	0·875	0·886	0·897	0·908	0·919	0·930	0·941	0·951	0·962	0·973
0·9	0·984	0·995	1·006	1·017	1·028	1·039	1·050	1·061	1·072	1·083
—	--	1·094	2·187	3·281	4·374	5·468	6 562	7·655	8·749	9·843
1	10·9363	12·0300	13·1236	14·2172	15·3109	16·4045	17·4981	18·5918	19·6854	20·7790
2	21·8727	22·9663	24·0599	25·1536	26·2472	27·3408	28·4345	29·5281	30·6217	31·7154
3	32·8090	33·9026	34·9963	36·0899	37·1835	38·2772	39·3708	40·4644	41·5581	42·6517
4	43·7453	44·8389	45·9326	47·0262	48·1198	49 2135	50·3071	51·4007	52·4944	53·5880
5	54·6816	55·7753	56·8689	57·9625	59 0562	60·1498	61·2434	62·3371	63·4307	64·5243
6	65·6180	66·7116	67·8052	68·8989	69 9925	71·0861	72·1798	73·2734	74·3670	75·4607
7	76·5543	77·6479	78·7416	79·8352	80·9288	82·0225	83·1161	84·2097	85·3034	86·3970
8	87·4906	88·5843	89·6779	90·7715	91·8652	92 9588	94·0524	95·1461	96·2397	97·3333
9	98·4270	99·5206	100·614	101·708	102 802	103·895	104·989	106·082	107·176	108·270
10	109·363									

EXAMPLES.

(1.) Find the number of yards in 0·05, 0·46, 1, 6, 55, 550, and 6,400 mètres.

Answer.

0·055, 0·503, 1·094, 6·562, 60·15, 601·50, and 6,999·25 yards.

(2.) The mean range, mean error in range, and mean error in direction of projectiles fired at 3° elevation from the 15-centimètre German gun are 2,285, 14·66, and 0·85 mètres; what are the equivalents in yards?

Answer.

2,200	mètres	= 2,405·99	yards.	14	mètres	= 15·31	yards.
85	,,	= 92 96	,,	·66	,,	= 72	,,
2,285	,,	= 2,498·95	,,	14·66	,,	= 16·03	

0·85 mètre = 0·93 yard.

The British measures of length are—

12 inches = 1 foot.
3 feet = 1 yard.
5½ yards = 1 pole or rod.
40 poles = 1 furlong.
8 furlongs = 1 mile.

The following tables will facilitate the conversion of British measures of length into corresponding Metric measures.

INCHES TO MILLIMÈTRES.

1 inch = 25·3995411 millimètres.

Inches.	0	1	2	3	4	5	6	7	8	9
0·0	0·000	0·254	0·508	0·762	1·016	1·270	1·524	1·778	2·032	2·286
0·1	2·540	2·794	3·048	3·302	3·556	3·810	4·064	4·318	4·572	4·826
0·2	5·080	5·334	5·588	5·842	6·096	6·350	6·604	6·858	7·112	7·366
0·3	7·620	7·874	8·128	8·382	8·636	8·890	9·144	9·398	9·652	9·906
0·4	10·160	10·414	10·668	10·922	11·176	11·430	11·684	11·938	12·192	12·446
0·5	12·700	12·954	13·208	13·462	13·716	13·970	14·224	14·478	14·732	14·986
0·6	15·240	15·494	15·748	16·002	16·256	16·510	16·764	17·018	17·272	17·526
0·7	17·780	18·034	18·288	18·542	18·796	19·050	19·304	19·558	19·812	20·066
0·8	20·320	20·574	20·828	21·082	21·336	21·590	21·844	22·098	22·352	22·606
0·9	22·860	23·114	23·368	23·622	23·876	25·130	24·384	24·638	24·892	25·146
—	—	25·400	50·800	76·199	101·599	127·000	152·399	177·798	203·198	228·598
1	254·0	279·4	304·8	330·2	355·6	381·0	406·4	431·8	457·2	482·6
2	508·0	533·4	558·8	584·2	609·6	635·0	660·4	685·8	711·2	736·6
3	762·0	787·4	812·8	838·2	863·6	889·0	914·4	939·8	965·2	990·6
4	1016·0	1041·4	1066·8	1092·2	1117·6	1143·0	1168·4	1193·8	1219·2	1244·6
5	1272 0	1295·4	1320·8	1346·2	1371·6	1397·0	1422·4	1447·8	1473·2	1498·6
6	1524·0	1549·4	1574·8	1600·2	1625·6	1651·0	1676·4	1701·8	1727·2	1752·6
7	1778·0	1803·4	1828·8	1854·2	1879·6	1905·0	1930·4	1955·8	1981·2	2006·6
8	2032·0	2057·4	2082·8	2108·2	2133·6	2159·0	2184·4	2209·8	2235·2	2260·6
9	2286·0	2311·4	2336·8	2362·2	2387·6	2413·0	2438·4	2463·8	2489·2	2514·6

INCHES TO MILLIMÈTRES.

EXAMPLES.

(1.) Find the number of millimètres in 0·36, 0·97, 1, 12, and 43 inches.

Answer.

9·144, 24·638, 25·400, 304·80, and 1,092·2 millimètres.

(2.) Find the number of millimètres in 3·1 inches.

Answer.

3	inches	=	76·199	millimètres.
·1	,,	=	2·540	,,
3·1	,,	=	78·739	,,

(3.) The British 64-pr. gun has a calibre of 6·3 inches, and a length of bore 97·5 inches; what are the equivalents of these numbers in millimètres?

Answer.

6	inches	=	152·399	millimètres.
·3	,,	=	7·620	,,
6·3	,,	=	160·019	,,

97	inches	=	2,463·8	millimètres.
·5	,,	=	12·7	,,
97·5	,,	=	2,476·5	,,

FEET TO MÈTRES.

1 foot = 0·3047945 mètre.

Feet.	0	1	2	3	4	5	6	7	8	9
0·0	0·000	0·003	0·006	0·009	0·012	0·015	0·018	0·021	0·024	0·027
0·1	0·030	0·034	0·037	0·040	0·043	0·046	0·049	0·052	0·055	0·058
0·2	0·061	0·064	0·067	0·070	0·073	0·076	0·079	0·082	0·085	0·088
0·3	0·091	0·094	0·097	0·100	0·104	0·107	0·110	0·113	0·116	0·119
0·4	0·122	0·125	0·128	0·131	0·134	0·137	0·140	0·143	0·146	0·149
0·5	0·152	0·155	0·158	0·161	0·164	0·168	0·171	0·174	0·177	0·180
0·6	0·183	0·186	0·189	0·192	0·195	0·198	0·201	0·204	0·207	0·210
0·7	0·213	0·216	0·219	0·222	0·226	0·229	0·232	0·235	0·238	0·241
0·8	0·244	0·247	0·250	0·253	0·256	0·259	0·262	0·265	0·268	0·271
0·9	0·274	0·277	0·280	0·283	0·286	0·289	0·293	0·296	0·299	0·302
—	—	0·305	0·610	0·914	1·219	1·524	1·829	2·134	2·438	2·743
1	3·048	3·353	3·657	3·962	4·267	4·572	4·877	5·181	5·486	5·791
2	6·096	6·401	6·705	7·010	7·315	7·620	7·925	8·229	8·534	8·839
3	9·144	9·449	9·753	10·058	10·363	10·668	10·973	11·277	11·582	11·887
4	12·192	12·497	12·801	13·106	13·411	13·716	14·020	14·325	14·630	14·835
5	15·240	15·544	15·849	16·154	16·459	16·764	17·068	17·373	17·678	17·983
6	18·288	18·592	18·897	19·202	19·507	19·812	20·116	20·421	20·726	21·031
7	21·336	21·640	21·945	22·250	22·555	22·860	23·164	23·469	23·774	24·079
8	24·384	24·688	24·993	25·298	25·603	25·907	26·212	26·517	26·822	27·127
9	27·431	27·736	28·041	28·346	28·651	28·955	29·260	29·565	29·870	30·175
10	30·479									
20	60·959									
30	91·438									
40	121·918									
50	152·397									
60	182·877									
70	213·356									
80	243·836									
90	274·315									
100	304·79									
200	609·59									
300	914·38									
400	1219·18									
500	1523·97									
600	1828·77									
700	2133·56									
800	2438·36									
900	2743·15									
000	3047·94									

FOR CONVERTING FEET TO MÈTRES.

EXAMPLES.

(1.) Find the number of mètres in 0·08, 0·36, 1, 39, and 78 feet.

Answer.

0·024, 0·110, 0·305, 11·887, and 23·774 mètres.

(2.) Find the number of mètres in 57·62 feet.

Answer.

57	feet	=	17·373	mètres.
·62	,,	=	0·189	,,
57·62	,,	=	17·562	,,

(3.) The muzzle velocity with the British 7-inch M.L. gun is 1,561 feet; what is the equivalent in mètres?

Answer.

1,000	feet	=	304·79	mètres.
500	,,	=	152·397	,,
61	,,	=	18·592	,,
1,561	,,	=	475·779	

YARDS TO MÈTRES.—1 yard = 0·9143834 mètre.

Yds.	0	1	2	3	4	5	6	7	8	9
0·0	0·000	0·009	0·018	0·027	0·037	0·046	0·055	0·064	0·073	0·082
0·1	0·091	0·101	0·110	0·119	0·128	0·137	0·146	0·155	0·164	0·174
0·2	0·138	0·192	0·201	0·210	0·219	0·229	0·238	0·247	0·256	0·265
0·3	0·274	0·283	0·293	0·302	0·311	0·320	0·329	0·338	0·347	0·357
0·4	0·366	0·375	0·384	0·393	0·402	0·411	0·420	0·430	0·439	0·448
0·5	0·457	0·466	0·475	0·485	0·494	0·503	0·512	0·521	0·530	0·539
0·6	0·549	0·558	0·567	0·576	0·585	0·594	0·603	0·613	0·622	0·631
0·7	0·640	0·649	0·658	0·668	0·677	0·686	0·695	0·704	0·713	0·722
0·8	0·732	0·741	0·750	0·759	0·768	0·777	0·786	0·796	0·805	0·814
0·9	0·823	0·832	0·841	0·850	0·860	0·869	0·878	0·887	0·896	0·905
—	—	0·914	1·829	2·743	3·657	4·572	5·486	6·401	7·315	8·229
1	9·144	10·058	10·973	11·887	12·801	13·716	14·630	15·544	16·459	17·373
2	18·288	19·202	20·116	21·031	21·945	22·860	23·774	24·688	25·603	26·517
3	27·431	28·346	29·260	30·175	31·089	32·003	32·918	33·832	34·747	35·661
4	36·575	37·490	38·404	39·318	40·233	41·147	42·062	42·976	43·890	44·805
5	45·719	46·634	47·548	48·462	49·377	50·291	51·205	52·120	53·034	53·949
6	54·863	55·777	56·692	57·606	58·520	59·435	60·349	61·264	62·178	63·092
7	64·007	64·920	65·836	66·750	67·664	68·579	69·493	70·407	71·322	72·236
8	73·151	74·065	74·979	75·894	76·808	77·723	78·637	79·551	80·466	81·380
9	82·294	83·209	84·123	85·038	85·952	86·866	87·781	88·695	89·610	90·524
10	91·438									
20	182·88									
30	274·32									
40	365·75									
50	457·19									
60	548·63									
70	640·07									
80	731·51									
90	822·95									
100	914·38									
200	1828·77									
300	2743·15									
400	3657·53									
500	4571·92									
600	5486·30									
700	6400·68									
800	7315·07									
900	8229·45									
1000	9143·84									
2000	18287·67									
2500	22859·59									
3000	27431·50									
3500	32003·43									
4000	36575·34									
5000	45719·17									

RANGE TABLES.

10-INCH R.M.L. GUN.

Charge: 70 lbs. P. Projectile: Palliser Shell, with Gas-check, Mark II., 410 lbs. Muzzle Velocity, 1,379 f. s.

Range.	Elevation.	To hit an object 10 ft. high, Range must be known within—	Time of Flight.	Fuze Scale. Fifteen Seconds Wood M.L., based on practice of various dates (Proof of Fuzes.)	
Yards.	° ′	Yards.	Seconds.	Yards.	Tenths.
0					
100	0 3	636	0·22	245	1·0
200	0 12	318	0·44	330	1·5
300	0 21	212	0·66	415	2·0
400	0 30	156	0·89	500	2·5
500	0 39	122	1·12	585	3·0
600	0 48	101	1·35	670	3·5
700	0 58	84	1·58	755	4·0
800	1 8	73	1·82	840	4·5
900	1 18	64	2·06	920	5·0
1,000	1 28	56	2·30	1,005	5·5
1,100	1 38	50	2·54	1,085	6·0
1,200	1 48	45	2·78	1,170	6·5
1,300	1 58	41	3·03	1,250	7·0
1,400	2 9	38	3·28	1,335	7·5
1,500	2 20	35	3·53	1,415	8·0
1,600	2 31	32	3·78	1,500	8·5
1,700	2 42	30	4·04	1,580	9·0
1,800	2 53	28	4·30	1,665	9·5
1,900	3 4	26	4·56	1,745	10·0
2,000	3 15	25	4·82	1,830	10·5
2,100	3 27	24	5·09	1,910	11·0
2,200	3 39	22	5·36	1,990	11·5
2,300	3 51	21	5·63	2,070	12·0
2,400	4 3	20	5·90	2,150	12·5
2,500	4 15	19	6·18	2,225	13·0
2,600	4 27	18	6·46	2,300	13·5
2,700	4 40	17	6·74	2,370	14·0

10-Inch R.M.L. Gun—*continued.*

Charge: 70 lbs. Palliser Shell, 410 lbs. M.V.: 1,379 f.s.

Range.	Elevation.	To hit an object 10 ft. high, Range must be known within—	Time of Flight.	Fuze Scale. Fifteen Seconds Wood M.L., based on practice of various dates (Proof of Fuzes).	
Yards.	° ′	Yards.	Seconds.	Yards.	Tenths.
2,800	4 53	16	7·02	2,440	14·5
2,900	5 6	15	7·30	2,510	15·0
3,000	5 19	15	7·59	2,580	15·5
3,100	5 32	14	7·88	2,650	16·0
3,200	5 45	13	8·17	2,720	16·5
3,300	5 59	13	8·46	2,790	17·0
3,400	6 13	12	8·75	2,860	17·5
3,500	6 27	12	9·04	2,935	18·0
3,600	6 41	11	9·34	3,005	18·5
3,700	6 55	11	9·64	3,075	19·0
3,800	7 9	11	9·94	3,150	19·5
3,900	7 24	10	10·24	3,220	20·0
4,000	7 39	10	10·54	3,290	20·5
4,100	7 54	10	10·84	3,360	21·0
4,200	8 9	9	11·14	3.430	21·5
4,300	8 24	9	13·45	3,500	22·0
4,400	8 40	9	11·76	3,570	22·5
4,500	8 56	8	12·07	3,635	23·0
4,600	9 12	8	12·4	3.705	23·5
4,700	9 28	8	12·7	3,770	24·0
4,800	9 44	8	13·0	3,840	24·5
4,900	10 0	7	13·3	3,905	25·0
5,000	10 17	7	13·7	3,970	25·5
5,100	10 34	7	14·0	4,035	26·0
5,200	10 51	7	14·3	4,105	26·5
5,300	11 8	7	14·7	4,170	27·0
5,400	11 26	6	15·0	4,235	27·5
5,500	11 43	6	15·3	4,300	28·0
5,600	12 0	6	15·6	4,370	28·5
5,700	12 18	6	16·0	4,435	29·0
5,800	12 36	6	16·3	4,500	29·5
5,900	12 54	5	16·6	4,565	30·0
6,000	13 12	5	17·0		

RANGE TABLES.

10-INCH R.M.L. GUN.

Charge: 44 lbs. P. Projectile: Common Shell, with Gas-check Mark II., weight 410 lbs. Muzzle Velocity: 1,028 f.s.

Range.	Elevation.	To hit an Object 10 ft. high, Range must be known within—	Time of Flight.	Fuse Scale, 15 Seconds. M.L. Wood Time Fuze.	
Yards.	° ′	Yards.	Seconds.	Yards.	Tenths.
0				240	1·0
				320	1·5
100	0 13	355	0·29	390	2·0
				455	2·5
200	0 29	179	0·58	520	3·0
300	0 45	117	0·88	585	3·5
400	1 1	87	1·18	650	4·0
				720	4·5
500	1 17	70	1·48	790	5·0
600	1 33	58	1·77	855	5·5
				920	6·0
700	1 49	49	2·08	985	6·5
800	2 6	43	2·39	1,050	7·0
900	2 23	38	2·70	1,115	7·5
				1,180	8·0
1,000	2 40	33	3·01	1,250	8·5
				1,315	9·0
1,100	2 57	30	3·32	1,385	9·5
1,200	3 14	28	3·63	1,450	10·0
				1,515	10·5
1,300	3 31	25	3·95	1,580	11·0
1,400	3 48	23	4·27	1,645	11·5
1,500	4 6	22	4·59	1,710	12·0
				1,775	12·5
1,600	4 24	20	4·91	1,840	13·0
1,700	4 42	19	5·23	1,905	13·5
1,800	5 0	18	5·56	1,970	14·0
				2,035	14·5
1,900	5 18	17	5·89	2,100	15·0

10-Inch R.M.L. Gun—*continued.*

Charge: 44 lbs. Common Shell, 410 lbs. M. V.: 1,028 f.s.

Range.	Elevation.	To hit an object 10 ft. high, Range must be known within—	Time of Flight.	Fuze Scale, 15 seconds M.L. Wood Time Fuze.	
Yards.	° ′	Yards.	Seconds.	Yards.	Tenths.
2,000	5 36	16	6·22	2,165	15·5
				2,225	16·0
2,100	5 54	15	6·55	2,290	16·5
				2,355	17·0
2,200	6 12	14	6·88	2,420	17·5
2,300	6 31	13	7·22	2,480	18·0
2,400	6 50	13	7·56	2,545	18·5
2,500	7 9	12	7·90	2,605	19·0
				2,670	19·5
2,600	7 28	12	8·24	2,730	20·0
2,700	7 47	11	8·58	2,795	20·5
2,800	8 6	11	8·93	2,855	21·0
				2,920	21·5
2,900	8 25	10	9·28	2,980	22·0
3,000	8 45	10	9·63	3,040	22·5
				3,100	23·0
				3,165	23·5
3,100	9 5	9	10·0	3,225	24·0
3,200	9 25	9	10·3	3,290	24·5
3,300	9 45	9	10·7	3,335	25·0
3,400	10 5	8	11·1	3,420	25·5
				3,480	26·0
3,500	10 25	8	11·4	3,545	26·5
3,600	10 46	8	11·8	3,605	27·0
3,700	11 7	7	12·2	3,670	27·5
				3,730	28·0
3,800	11 28	7	12·5	3,795	28·5
3,900	11 49	7	12·9	3,850	29·0
4,000	12 10	7	13·2	3,910	29·5
				3,970	30·0

RANGE TABLES.

10-INCH R.M.L. GUN OF 18 TONS.

Full Charge: 70 lbs. P. Powder. Projectile: Common Shell, without Gas-check.

Range.	Elevation.	Fuze Scale.	Range.	Elevation.	Fuze Scale.
Yards.	° ′		Yards.	° ′	
170	0 15	1	2,570	4 42	16
260	0 23	1·5	2,640	4 52	16·5
340	0 31	2	2,710	5 2	17
430	0 39	2·5	2,780	5 12	17·5
510	0 47	3	2,850	5 22	18
600	0 55	3·5	2,920	5 32	18·5
680	1 3	4	2,990	5 42	19
770	1 12	4·5	3,060	5 52	19·5
850	1 21	5	3,130	6 2	20
940	1 30	5·5	3,200	6 12	20·5
1,020	1 39	6	3,260	6 22	21
1,110	1 48	6·5	3,330	6 32	21·5
1,190	1 57	7	3,400	6 42	22
1,270	2 6	7·5	3,460	6 51	22·5
1,350	2 15	8	3,530	7 1	23
1,430	2 24	8·5	3,590	7 10	23·5
1,510	2 33	9	3,660	7 21	24
1,590	2 42	9·5	3,720	7 31	24·5
1,670	2 52	10	3,780	7 41	25
1,750	3 2	10·5	3,850	7 52	25·5
1,820	3 11	11	3,910	8 1	26
1,900	3 20	11·5	3,970	8 11	26·5
1,970	3 29	12	4,030	8 20	27
2,050	3 38	12·5	4,090	8 30	27·5
2,120	3 47	13	4,150	8 40	28
2,200	3 56	13·5	4,210	8 50	28·5
2,270	4 5	14	4,270	9 0	29
2,350	4 14	14·5	4,330	9 10	29·5
2,420	4 23	15	4,380	9 18	30
2,500	4 32	15 5			

10-INCH R.M.L. GUN OF 18 TONS.

Charge: 44 lbs. P. Powder. Projectile: Common Shell, without Gas-check.

Range.	Elevation.	Fuze Scale.	Range.	Elevation.	Fuze Scale.
Yards.	° ′		Yards.	° ′	
160	0 19	1	2,330	5 36	16
240	0 28	1·5	2,400	5 47	16·5
320	0 38	2	2,460	5 58	17
400	0 48	2·5	2,530	6 10	17·5
480	0 58	3	2,590	6 21	18
560	1 8	3·5	2,660	6 34	18·5
630	1 18	4	2,720	6 46	19
710	1 28	4·5	2,790	6 59	19·5
780	1 38	5	2,850	7 11	20
860	1 49	5·5	2,910	7 23	20·5
930	1 59	6	2,970	7 35	21
1,000	2 9	6·5	3,030	7 47	21·5
1,080	2 20	7	3,090	7 59	22
1,150	2 30	7·5	3,150	8 11	22·5
1,220	2 40	8	3,210	8 23	23
1,300	2 51	8·5	3,270	8 35	23·5
1,370	3 1	9	3,330	8 48	24
1,440	3 12	9·5	3,390	9 0	24·5
1,510	3 22	10	3,440	9 12	25
1,580	3 33	10·5	3,500	9 25	25·5
1,650	3 43	11	3,570	9 38	26
1,720	3 54	11·5	3,620	9 51	26·5
1,790	4 5	12	3,670	10 2	27
1,860	4 16	12·5	3,730	10 15	27·5
1,930	4 27	13	3,798	10 29	28
2,000	4 39	13·5	3,840	10 42	28·5
2,070	4 50	14	3,900	10 56	29
2,140	5 2	14·5	3,950	11 8	29·5
2,200	5 13	15	4,010	11 23	30
2,270	5 25	15·5			

10-INCH B.L. GUN.

Full Charge: 215 lbs. Prismatic. Projectile: 450 lbs.

Range.	Elevation.	Time of Flight.	Length of Fuze.	Range.	Elevation.	Time of Flight.	Length of Fuze.
Yards.	° ′	″	Inches.	Yards.	° ′	″	Inches.
100	0 4	·16	·00	3,800	3 50	7·15	2·88
200	0 8	·32	·00	3,900	3 59	7·37	2·97
300	0 12	·48	·00	4,000	4 8	7·60	3·07
400	0 16	·64	·00	4,100	4 17	7·83	3·16
500	0 20	·80	·00	4,200	4 26	8·06	3·25
600	0 24	·96	·00	4,300	4 35	8·29	3·34
700	0 28	1·13	·43	4,400	4 44	8·52	3·43
800	0 32	1·30	·50	4,500	4 53	8·76	3·53
900	0 37	1·47	·56	4,600	5 3	9·00	3·62
1,000	0 42	1·64	·63	4,700	5 13	9·24	3·72
1,100	0 47	1·81	·69	4,800	5 23	9·48	3·81
1,200	0 52	1·98	·76	4,900	5 33	9·72	3·91
1,300	0 57	2·16	·84	5,000	5 43	9·97	4·01
1,400	1 2	2·34	·91	5,100	5 53	10·22	4·11
1,500	1 7	2·52	·97	5,200	6 3	10·47	4·21
1,600	1 13	2·70	1·05	5,300	6 13	10·72	4·31
1,700	1 19	2·89	1·12	5,400	6 23	10·98	4·41
1,800	1 25	3·07	1·18	5,500	6 34	11·24	4·51
1,900	1 31	3·26	1·26	5,600	6 45	11·50	4·62
2,000	1 37	3·45	1·34	5,700	6 56	11·76	4·72
2,100	1 43	3·64	1·42	5,800	7 7	12·02	4·82
2,200	1 50	3·83	1·49	5,900	7 18	12·28	4·92
2,300	1 57	4·02	1·56	6,000	7 29	12·55	5·02
2,400	2 4	4·22	1·65	6,100	7 40	12·82	5·12
2,500	2 11	4·42	1·72	6,200	7 51	13·09	5·22
2,600	2 18	4·62	1·80	6,300	8 3	13·36	5·33
2,700	2 25	4·82	1·88	6,400	8 15	13·63	5·44
2,800	2 32	5·02	1·96	6,500	8 27	13·90	5·55
2,900	2 39	5·22	2·04	6,600	8 39	14·18	5·65
3,000	2 46	5·43	2·12	6,700	8 51	14·46	5·76
3,100	2 54	5·64	2·21	6,800	9 3	14·74	
3,200	3 2	5·85	2·29	6,900	9 15	15·03	
3,300	3 10	6·06	2·37	7,000	9 27	15·32	
3,400	3 18	6·27	2·54	7,100	9 40	15·61	
3,500	3 26	6·49	2·62	7,200	9 53	15·91	
600	3 34	6·71	2·71	7,300	10 6	16·20	
3,700	3 42	6·93	2·80	7,400	10 19	16·50	

10-Inch B.L. Gun—*continued.*

Full Charge : 215 lbs. Prismatic. Projectile : 450 lbs.

Range.	Elevation.	Time of Flight.	Length of Fuze.	Range.	Elevation.	Time of Flight.	Length of Fuze.
Yards.	° ′	″	Inches.	Yards.	° ′	″	Inches.
7,500	10 32	16·80		8,500	12 50	20·01	
7,600	10 45	17·10		8,600	13 5	20·35	
7,700	10 58	17·41		8,700	13 20	20·69	
7,800	11 11	17·72		8,800	13 35	21·04	
7,900	11 25	18·04		8,900	13 50	21·39	
8,000	11 39	18·36		9,000	14 6	21·75	
8,100	11 53	18·68		9,100	14 22	22·11	
8,200	12 7	19·00		9,200	14 38	22·48	
8,300	12 1	19·33		9,300	14 55	22·85	
8,400	12 35	19·67		9,400	15 12	23·23	

10-INCH B.L. GUN.

Reduced Charge: 150 lbs. Pebble Powder. Projectile: 400 lbs.

Range.	Elevation.	Time of Flight.	Length of Fuze.	Range.	Elevation.	Time of Flight.	Length of Fuze.
Yards.	° ′	″	Inches.	Yards.	° ′	″	Inches.
100	0 5	·18	·00	1,200	1 4	2·18	·85
200	0 9	·35	·00	1,300	1 11	2·37	·92
300	0 14	·52	·00	1,400	1 18	2·57	1·00
400	0 19	·70	·00	1,500	1 25	2·77	1·08
500	0 24	·88	·00	1,600	1 32	2·97	1·16
600	0 29	1·06	·41	1,700	1 39	3·18	1·24
700	0 34	1·24	·47	1,800	1 47	3·39	1·32
800	0 40	1·42	·55	1,900	1 55	3·60	1·40
900	0 46	1·61	·62	2,000	2 3	3·81	1·48
1,000	0 52	1·80	·70	2,100	2 11	4·02	1·56
1,100	0 58	1·99	·77	2,200	2 19	4·24	1·65

10-Inch B.L. Gun—*continued.*

Reduced Charge: 150 lbs. Pebble Powder. Projectile: 400 lbs

Range.	Elevation.	Time of Flight.	Length of Fuze.	Range.	Elevation.	Time of Flight.	Length of Fuze.
Yards.	° ′	″	Inches.	Yards.	° ′	″	Inches.
2,300	2 27	4·46	1·74	5,400	7 58	12·41	4·86
2,400	2 35	4·68	1·83	5,500	8 11	12·70	4·97
2,500	2 43	4·90	1·92	5,600	8 24	12·99	5·08
2,600	2 52	5·13	2·00	5,700	8 37	13·28	5·19
2,700	3 1	5·36	2·09	5,800	8 50	13·57	5·30
2,800	3 10	5·59	2·18	5,900	9 3	13·86	5·42
2,900	3 19	5·82	2·28	6,000	9 17	14·16	5·54
3,000	3 28	6·05	2·37	6,100	9 31	14·46	5·65
3,100	3 38	6·29	2·47	6,200	9 45	14·76	5·76
3,200	3 48	6·53	2·57	6,300	9 59	15·07	
3,300	3 58	6·77	2·66	6,400	10 13	15·38	
3,400	4 8	7·02	2·76	6,500	10 27	15·69	
3,500	4 18	7·27	2·86	6,600	10 41	16·00	
3,600	4 28	7·52	2·96	6,700	10 55	16·31	
3,700	4 38	7·77	3·06	6,800	11 9	16·62	
3,800	4 48	8·02	3·15	6,900	11 24	16·93	
3,900	4 59	8·28	3·25	7,000	11 39	17·24	
4,000	5 10	8·54	3·35	7,100	11 54	17·56	
4,100	5 21	8·80	3·46	7,200	12 9	17·88	
4,200	5 32	9·06	3·56	7,300	12 24	18·20	
4,300	5 43	9·33	3·66	7,400	12 39	18·52	
4,400	5 55	9·60	3·77	7,500	12 55	18·85	
4,500	6 7	9·87	3·87	7,600	13 11	19·18	
4,600	6 19	10·14	3·98	7,700	13 27	19·51	
4,700	6 31	10·42	4·09	7,800	13 43	19·84	
4,800	6 43	10·70	4·20	7,900	13 59	20·18	
4,900	6 55	10·98	4·31	8,000	14 15	20·52	
5,000	7 7	11·26	4·42	8,100	14 32	20·86	
5,100	7 19	11·54	4·53	8,200	14 49	21·21	
5,200	7 32	11·83	4·64	8,300	15 6	21·56	
5,300	7 45	12·12	4·75	8,400	15 23	21·91	

8-INCH B.L. GUN.

Full charge: 100 lbs. Projectile: 180 lbs.

Range.	Elevation.		Time of Flight.	Length of Fuze.	Range.	Elevation.		Time of Flight.	Length of Fuze.
Yards.	°	′	″	Inches.	Yards.	°	′	″	Inches.
100	0	1	·08	·01	4,000	4	16	8·11	3·21
200	0	3	·18	·07	4,100	4	26	8·38	3·31
300	0	5	·33	·14	4,200	4	36	8·65	3·41
400	0	7	·50	·21	4,300	4	46	8·93	3·51
500	0	9	·68	·28	4,400	4	56	9·21	3·61
600	0	12	·88	·35	4,500	5	6	9·49	3·71
700	0	15	1·06	·42	4,600	5	17	9·77	3·81
800	0	19	1·24	·50	4,700	5	28	10·06	3·92
900	0	23	1·42	·57	4,800	5	39	10·35	4·03
1,000	0	27	1·61	·65	4,900	5	50	10·65	4·14
1,100	0	32	1·79	·73	5,000	6	1	10·95	4·25
1,200	0	37	1·97	·80	5,100	6	13	11·26	4·36
1,300	0	42	2·15	·87	5,200	6	25	11·57	4·47
1,400	0	48	2·34	·95	5,300	6	37	11·88	4·58
1,500	0	54	2·53	1·02	5,400	6	49	12·19	4·69
1,600	1	0	2·72	1·10	5,500	7	1	12·50	4·80
1,700	1	6	2·91	1·17	5,600	7	13	12·81	4·91
1,800	1	13	3·10	1·25	5,700	7	26	13·13	5·02
1,900	1	20	3·30	1·33	5,800	7	39	13·46	5·13
2,000	1	27	3·50	1·41	5,900	7	52	13·79	5·25
2,100	1	33	3·70	1·49	6,000	8	5	14·12	5·37
2,200	1	40	3·90	1·57	6,100	8	18	14·45	5·49
2,300	1	47	4·11	1·66	6,200	8	31	14·78	5·61
2,400	1	54	4·32	1·75	6,300	8	45	15·11	5·73
2,500	2	2	4·54	1·84	6,400	8	59	15·44	5·85
2,600	2	10	4·76	1·92	6,500	9	13	15·77	
2,700	2	18	4·98	2·00	6,600	9	27	16 10	
2,800	2	26	5·20	2·09	6,700	9	41	16·43	
2,900	2	34	5·42	2·18	6,800	9	55	16·77	
3,000	2	42	5·65	2·27	6,900	10	9	17·11	
3,100	2	51	5·88	2·37	7,000	10	23	17·45	
3,200	3	0	6·11	2·46	7,100	10	37	17·79	
3,300	3	9	6·35	2·55	7,200	10	51	18·13	
3,400	3	18	6·59	2·64	7,300	11	5	18·47	
3,500	3	27	6·84	2·73	7,400	11	19	18·81	
3,600	3	36	7·09	2·83	7,500	11	33	19·15	
3,700	3	46	7·34	2·92	7,600	11	47	19·49	
3,800	3	56	7·59	3·02	7,700	12	1	19·83	
3,900	4	6	7·85	3·11					

8-INCH B.L. GUN.

Reduced Charge: 65 lbs. Projectile: 180 lbs.

Range.	Elevation.	Time of Flight.	Length of Fuze.	Range.	Elevation.	Time of Flight.	Length of Fuze.
Yards.	° ′	″	Inches.	Yards.	° ′	″	Inches.
100	0 1	·12	·04	3,600	5 22	8·51	3·36
200	0 3	·27	·10	3,700	5 35	8·80	3·46
300	0 6	·45	·18	3,800	5 48	9·09	3·57
400	0 9	·65	·26	3,900	6 1	9·39	3·68
500	0 12	·86	·34	4,000	6 14	9·69	3·79
600	0 16	1·07	·42	4,100	6 27	10·00	3·89
700	0 21	1·29	·51	4,200	6 41	10·31	4·00
800	0 27	1·51	·60	4,300	6 55	10·62	4·11
900	0 34	1·73	·69	4,400	7 9	10·93	4·22
1,000	0 41	1·95	·78	4,500	7 23	11·25	4·34
1,100	0 48	2·17	·87	4,600	7 37	11·57	4·46
1,200	0 55	2·39	·96	4,700	7 51	11·90	4·58
1,300	1 3	2·61	1·05	4,800	8 5	12·23	4·70
1,400	1 11	2·83	1·14	4,900	8 19	12·56	4·82
1,500	1 20	3·05	1·23	5,000	8 33	12·89	4·94
1,600	1 29	3·27	1·32	5,100	8 47	13·22	5·05
1,700	1 39	3·49	1·42	5,200	9 1	13·55	5·17
1,800	1 49	3·72	1·51	5,300	9 15	13·88	5·29
1,900	1 59	3·96	1·61	5,400	9 30	14·22	5·41
2,000	2 9	4·21	1·71	5,500	9 45	14·57	5·53
2,100	2 20	4·46	1·80	5,600	10 0	14·92	5·65
2,200	2 31	4·71	1·90	5,700	10 15	15·27	5·77
2,300	2 42	4·96	2·00	5,800	10 29	15·62	5·89
2,400	2 53	5·22	2·10	5,900	10 44	15·97	
2,500	3 4	5·48	2·20	6,000	10 58	16·32	
2,600	3 16	5·74	2·30	6,100	11 13	16·67	
2,700	3 28	6·01	2·40	6,200	11 27	17·03	
2,800	3 40	6·28	2·51	6,300	11 42	17·39	
2,900	3 52	6·55	2·62	6,400	11 57	17·75	
3,000	4 4	6·82	2·73	6,500	12 12	18·12	
3,100	4 17	7·09	2·83	6,600	12 28	18·50	
3,200	4 30	7·37	2·93	6,700	12 44	18·88	
3,300	4 43	7·65	3·03	6,800	13 0	19·26	
3,400	4 56	7·93	3·14	6,900	13 16	19·64	
3,500	5 9	8·22	3·25	7,000	13 32	20·02	

6-INCH B.L. GUN.

Full charge : 42 lbs. Projectile : 80 lbs.

Range.	Elevation.		Time of Flight.	Length of Fuze.	Range.	Elevation.		Time of Flight.	Length of Fuze.
Yards.	°	′	″	Inches.	Yards.	°	′	″	Inches.
100	0	0	·03	·00	3,700	4	29	8·16	3·23
200	0	1	·07	·02	3,800	4	41	8·44	3·34
300	0	2	·14	·04	3,900	4	53	8·72	3·44
400	0	3	·24	·08	4,000	5	5	9·00	3·54
500	0	5	·38	·14	4,100	5	17	9·28	3·64
600	0	8	·54	·21	4,200	5	30	9·56	3·74
700	0	12	·72	·28	4,300	5	43	9·86	3·84
800	0	17	·90	·35	4,400	5	56	10·16	3·95
900	0	23	1·12	·44	4,500	6	10	10·46	4·06
1,000	0	30	1·34	·53	4,600	6	24	10·76	4·17
1,100	0	37	1·58	·62	4,700	6	38	11·06	4·28
1,200	0	44	1·82	·72	4,800	6	52	11·36	4·39
1,300	0	52	2·06	·82	4,900	7	6	11·66	4·50
1,400	1	0	2 30	·92	5,000	7	20	11·96	4·61
1,500	1	8	2·54	1·02	5,100	7	35	12·27	4·71
1,600	1	16	2·78	1·12	5,200	7	50	12·57	4·82
1,700	1	24	3·02	1·22	5,300	8	5	12·88	4·93
1,800	1	32	3·26	1·32	5,400	8	20	13·18	5·04
1,900	1	40	3·50	1·42	5,500	8	35	13·49	5·15
2,000	1	48	3·74	1·52	5,600	8	50	13·80	5·26
2,100	1	56	3·98	1·62	5,700	9	5	14·10	5·37
2,200	2	4	4·22	1·72	5,800	9	20	14·41	5·48
2,300	2	12	4·46	1·82	5,900	9	35	14·71	5·59
2,400	2	21	4·72	1·92	6,000	9	50	15·02	5·70
2,500	2	30	4·98	2·02	6,100	10	5	15·34	
2,600	2	39	5·24	2·12	6,200	10	20	15·66	
2,700	2	48	5·50	2·23	6,300	10	35	16·00	
2,800	2	57	5·76	2·33	6,400	10	51	16·30	
2,900	3	6	6·02	2·43	6,500	11	7	16·62	
3,000	3	16	6·28	2·53	6,600	11	23	16·94	
3,100	3	26	6·54	2·63	6,700	11	40	17·26	
3,200	3	36	6·80	2·73	6,800	11	57	17·58	
3,300	3	46	7·06	2·83	6,900	12	14	17·90	
3,400	3	56	7·32	2·93	7,000	12	31	18·23	
3,500	4	7	7·60	3·03	7,100	12	48	18·56	
3,600	4	18	7·88	3·13	7,200	13	5	18·89	

6-INCH B.L. GUN.

Reduced charge: 30 lbs. Projectile: 80 lbs.

Range.	Elevation.	Time of Flight.	Length of Fuze.	Range.	Elevation.	Time of Flight.	Length of Fuze.
Yards.	° ′	″	Inches.	Yards.	° ′	″	Inches.
100	0 0	·14	·05	3,100	5 11	7·90	3·14
200	0 1	·28	·10	3,200	5 26	8·20	3·25
300	0 3	·43	·16	3,300	5 41	8·50	3·36
400	0 6	·59	·22	3,400	5 57	8·82	3·47
500	0 11	·77	·30	3,500	6 13	9·14	3·59
600	0 17	·97	·38	3,600	6 29	9·46	3·70
700	0 24	1·19	·47	3,700	6 45	9·78	3·82
800	0 32	1·42	·56	3,800	7 1	10·10	3·93
900	0 41	1·66	·66	3,900	7 17	10·43	4·05
1,000	0 51	1·90	·76	4,000	7 33	10·76	4·17
1,100	1 2	2·16	·86	4,100	7 59	11·09	4·29
1,200	1 13	2·42	·97	4,200	8 5	11·42	4·41
1,300	1 24	2·68	1·08	4,300	8 21	11·75	4·52
1,400	1 35	2·94	1·19	4,400	8 38	12·08	4·64
1,500	1 46	3·20	1·29	4,500	8 55	12·42	4·76
1,600	1 57	3·48	1·41	4,600	9 12	12·75	4·88
1,700	2 8	3·76	1·53	4,700	9 29	13·10	5·00
1,800	2 19	4·04	1·64	4,800	9 46	13·44	5·12
1,900	2 31	4·42	1·76	4,900	10 4	13·78	5·25
2,000	2 43	4·60	1·88	5,000	10 22	14·12	5·37
2,100	2 55	4·90	2·00	5,100	10 40	14·46	5·50
2,200	3 8	5·20	2·11	5,200	10 58	14·80	5·62
2,300	3 21	5·50	2·22	5,300	11 16	15·14	5·75
2,400	3 34	5·80	2·33	5,400	11 34	15·48	
2,500	3 47	6·10	2·44	5,500	11 51	15·82	
2,600	4 0	6·40	2·56	5,600	12 8	16·16	
2,700	4 14	6·70	2·68	5,700	12 25	16·50	
2,800	4 28	7·00	2·80	5,800	12 42	16·83	
2,900	4 42	7·30	2·92	5,900	12 59	17·16	
3,000	4 56	7 60	3·03	6,000	13 17	17·48	

6-INCH B.L. GUNS, VAVASSEUR.

Reduced Charge: 30 lbs. Projectile: 80 lbs.

Range	Elevation.	Time of Flight.	Length of Fuze.		Range.	Elevation.	Time of Flight.	Length of Fuze.	
			Large.	Small.				Large.	
Yards.	° ′	″	In.	In.	Yards.	° ′	″	In.	
100	0 0	·14			3,100	5 11	7·90	3·14	
200	0 1	·28			3,200	5 26	8·20	3·25	
300	0 3	·43			3,300	5 41	8·50	3·36	
400	0 6	·59			3,400	5 57	8·82	3·47	
500	0 11	·77	..	0·36	3,500	6 13	9·14	3·59	
600	0 17	·97	0·38	0·48	3,600	6 29	9·46	3·70	
700	0 24	1·19	0·47	0·61	3,700	6 45	9·78	3·82	
800	0 32	1·42	0·56	0·75	3,800	7 1	10·10	3·93	
900	0 41	1·66	0·66	0·90	3,900	7 17	10·43	4·05	
1,000	0 51	1·90	0·76	1·05	4,000	7 33	10·76	4·17	
1,100	1 2	2·16	0·86	1·20	4,100	7 59	11·09	4·29	
1,200	1 13	2·42	0·97	1·35	4,200	8 5	11·42	4·41	
1,300	1 24	2·68	1·08	1·50	4,300	8 21	11·75	4·52	
1,400	1 35	2·94	1·19	1·65	4,400	8 38	12·08	4·64	
1,500	1 46	3·20	1·29	1·80	4,500	8 55	12·42	4·76	
1,600	1 57	3·48	1·41	1·95	4,600	9 12	12·75	4·88	
1,700	2 8	3·76	1·53	2·10	4,700	9 29	13·10	5·00	
1,800	2 19	4·04	1·64	2·25	4,800	9 46	13·44	5·12	
1,900	2 31	4·32	1·76	2·40	4,900	10 4	13·78	5·25	
2,000	2 43	4·60	1·88	2·55	5,000	10 22	14·12	5·37	
2,100	2 55	4·90	2·00	2·70	5,100	10 40	14·46	5·50	
2,200	3 8	5·20	2·11	2·85	5,200	10 58	14·80	5·62	
2,300	3 21	5·50	2·22	3·00	5,300	11 16	15·14	5·75	
2,400	3 34	5·80	2·33	3·14	5,400	11 34	15·48		
2,500	3 47	6·10	2·44	3·28	5,500	11 51	15·82		
2,600	4 0	6·40	2·56	3·42	5,600	12 8	16·16		
2,700	4 14	6·70	2·68	3·56	5,700	12 25	16·50		
2,800	4 28	7·00	2·80	3·70	5,800	12 42	16·83		
2,900	4 42	7·30	2·92	3·85	5,900	12 59	17·16		
3,000	4 56	7·60	3·03	4·00	6,000	13 17	17·48		

Small Fuze used up to 3,000 yards.

6-INCH B.L. GUNS, VAVASSEUR.

Full Charge: 42 lbs. Projectile: 80 lbs.

Range	Elevation.		Time of Flight	Length of Fuze.		Range.	Elevation.		Time of Flight.	Length of Fuze.
				Large.	Small.					Large.
Yards.	°	′	″	In.	In.	Yards.	°	′	″	In.
100	0	3	·16			3,800	4	33	8·63	3·38
200	0	7	·32			3,900	4	44	8·93	3·50
300	0	11	·48			4,000	4	56	9·24	3·62
400	0	15	·64			4,100	5	8	9·55	3·74
500	0	19	·81	..	·37	4,200	5	20	9·86	3·86
600	0	23	·98	37	·48	4,300	5	32	10·17	3·99
700	0	28	1·16	·44	·59	4,400	5	44	10·49	4·12
800	0	33	1·34	·51	·70	4,500	5	57	10·81	4·24
900	0	38	1·53	·58	·82	4,600	6	10	11·14	4·37
1,000	0	43	1·72	·66	·94	4,700	6	23	11·47	4·50
1,100	0	48	1·91	·73	1·06	4,800	6	36	11·80	4·63
1,200	0	54	2·11	·81	1·18	4,900	6	50	12·13	4·75
1,300	1	0	2·32	·89	1·30	5,000	7	4	12·47	4·88
1,400	1	6	2·53	·97	1·42	5,100	7	18	12·81	5·01
1,500	1	12	2·74	1·06	1·54	5,200	7	32	13·15	5·14
1,600	1	18	2·95	1·15	1·66	5,300	7	46	13·50	5·27
1,700	1	25	3·17	1·23	1·79	5,400	8	1	13·85	5 41
1,800	1	32	3·29	1·32	1·91	5,500	8	16	14·21	5·55
1,900	1	39	3·61	1·41	2 04	5,600	8	31	14·57	5·69
2,000	1	46	3·84	1·50	2·16	5,700	8	46	14·93	
2,100	1	53	4·08	1·59	2·29	5,800	9	1	15·30	
2,200	2	1	4·32	1·68	2·41	5,900	9	16	15·67	
2,300	2	9	4·56	1·77	2·53	6,000	9	31	16·04	
2,400	2	17	4·80	1·87	2·65	6,100	9	47	16·42	
2,500	2	25	5·05	1·97	2·78	6,200	10	3	16·80	
2,600	2	34	5·30	2·07	2·90	6,300	10	19	17·19	
2,700	2	43	5·56	2·17	3·02	6,400	10	35	17·58	
2,800	2	52	5·82	2·27	3·13	6,500	10	51	17·97	
2,900	3	1	6·08	2·38	3·26	6,600	11	8	18·37	
3,000	3	10	6·35	2·49	3·39	6,700	11	25	18·77	
3,100	3	20	6·62	2·60	3·51	6,800	11	42	19·18	
3,200	3	30	6·90	2·71	3·64	6,900	11	59	19·59	
3,300	3	40	7·18	2·82	3·78	7,000	12	17	20·00	
3,400	3	50	7·47	2·93	3·92	7,100	12	35	20·42	
3,500	4	0	7·76	3·04	4·06	7,200	12	53	20·84	
3,600	4	11	8·05	3·15		7,300	13	11	21·26	
3,700	4	22	8·34	3·26		7,400	13	29	21·68	

Small Fuze used up to 3,500 yards.

12-PR. B.L. GUNS.

Charge : $3\frac{3}{4}$ lbs. R.L.G^2. Projectile: 12 lbs.

Initial Velocity: 1,650 f.s.

Range	Elevation.	Time.	Length of Fuze.		Range.	Elevation.	Time.	Length of Fuze.
			Small.	Medium.				Medium.
Yards.	° ′	″	In.	In.	Yards.	° ′	″	In.
100	0 0	·18	·08	·00	3,100	6 2	9·19	3·93
200	0 0	·37	·15	·01	2,200	6 21	9·61	4·13
300	0 4	·78	·37	·04	3,300	6 40	10·03	4·33
400	0 10	1·03	·54	·08	3,400	6 59	10·45	4·53
500	0 16	1·28	·71	·12	3,500	7 19	10·87	4·73
600	0 23	1·53	·90	·17	3,600	7 39	11·30	4·94
700	0 31	1·78	1·06	·22	3,700	7 59	11·75	
800	0 40	2·04	1·21	·29	3,800	8 20	12·20	
900	0 50	2·30	1·36	·37	3,900	8 41	12·65	
1,000	1 0	2·56	1·50	·46	4,000	9 2	13·10	
1,100	1 10	2 82	1·64	·56	4,100	9 23	13·55	
1,200	1 21	3 08	1 77	·68	4,200	9 45	14·00	
1,300	1 32	3·34	1·88	·80	4,300	10 7	14·45	
1,400	1 43	3·60	2·01	·95	4,400	10 29	14·90	
1,500	1 55	3·87	2·14	1·12	4,500	10 52	15·40	
1,600	2 7	4·14	2·27	1·30	4,600	11 15	15·90	
1,700	2 20	4·42	2·41	1·50	4,700	11 40	16·40	
1,800	2 33	4·71	2·55	1·69	4,800	12 6	16·90	
1,900	2 47	5·00	2·70	1·87	4,900	12 33	17·40	
2,000	3 1	5·30	2 85	2·04	5,000	13 1	17·92	
2,100	3 15	5·60	3·00	2·20	5,100	13 30	18·44	
2,200	3 30	5·91	3·15	2·34	5,200	14 0	18·96	
2,300	3 45	6·23	3·31	2·50	5,300	14 31	19·50	
2,400	4 1	6·56	3·48	2·67	5,400	15 3	20·04	
2,500	4 17	6·90	3 65	2·84	5,500	15 36	20·60	
2,600	4 34	7·25	3·83	3·01	5,600	16 12	21·16	
2,700	4 51	7 61	4·01	3·18	5,700	16 51	21·76	
2,800	5 8	7·99	4·20	3·36	5,800	17 33	22·36	
2,900	5 26	8·38	..	3·55	5,900	18 18	23·00	
3,000	5 44	8·78	..	3·74	6,000	19 6	23·70	

Small Fuze used up to 2,900 yards.

9-PR. B.L. GUNS.

Charge: 2·5 lbs. Projectile: 9 lbs.

Range	Elevation.	Time.	Length of Fuze.		Range.	Elevation.	Time.	Length of Fuze.	
			Medium.	Short.				Medium.	
Yards.	° ′	″	In.	In.	Yards.	° ′	″	In.	
100	0 4	·25	·00	·10	2,900	5 45	8·26	3·50	
200	0 8	·46	·02	·18	3,000	6 2	8·64	3·68	
300	0 13	68	·03	·31	3,100	6 21	9·02	3·86	
400	0 19	·89	·06	·45	3,200	6 40	9·40	4·04	
500	0 26	1·11	·09	·61	3,300	7 0	9·80	4·24	
600	0 33	1·35	·13	·78	3,400	7 20	10·20	4·43	
700	0 41	1·60	·18	·96	3,500	7 40	10·60	4·63	
800	0 49	1·86	·24	1·13	3,600	8 0	11·04	4·84	
900	0 58	2·12	·30	1·29	3,700	8 20	11·48	5·04	
1,000	1 7	2·38	·39	1·44	3,800	8 42	11·92		
1,100	1 16	2 66	·49	1·58	3,900	9 4	12·36		
1,200	1 26	2·94	·61	1·70	4,000	9 26	12·08		
1,300	1 38	3·22	·73	1·83	4,100	9 50	13·24		
1,400	1 50	3 50	·89	1·97	4,200	10 14	13·70		
1,500	2 4	3·78	1·06	2·11	4,300	10 38	14·16		
1,600	2 18	4·08	1·27	2·25	4,400	11 3	14·64		
1,700	2 32	4·38	1·48	2·40	4,500	11 28	15·12		
1,800	2 46	4·68	1·68	2·54	4,600	11 54	15·60		
1,900	3 0	4·98	1·88	2·69	4,700	12 20	16·08		
2,000	3 16	5·28	2·05	2 84	4,800	12 47	16·56		
2,100	3 32	5·58	2 19	2·99	4,900	13 15	17·04		
2,200	3 48	5·90	2·35	3·15	5,000	13 44	17·52		
2,300	4 4	6·22	2·50	3·31	5,100	14 14	18·00		
2,400	4 20	6·54	2·65	3·47	5,200	14 45	18·50		
2,500	4 37	6·86	2·80	3·63	5,300	15 17	19·00		
2,600	4 54	7·20	2·97	3·80	5,400	15 50	19·50		
2,700	5 11	7·54	3·14	3·97	5,500	16 28	20·00		
2,800	5 28	7·90	3·33		5,600	17 10	20·50		

Small Fuze used up to 2,800 yards.

PART IV.

DIRECTIONS FOR LOCAL NAVIGATION.

DESCRIPTION OF LIGHTS ON THE VICTORIAN COAST.

All bearings are from seaward, and magnetic.

Name.	Description of Light, &c.	Visible in Clear Weather.
Cape Nelson.	*Fixed White Light*, of the dioptric order, elevated 250 feet above sea-level. A *White Light* will be seen from seaward over an arc of 189 degrees; a ray of *Red Light* will be shown to the eastward over the Laurence Rock; and a ray of *Red Light*, also to the westward, over the southernmost point of Cape Bridgewater, and one mile to seaward of such point. The bearings (magnetic) on which the light will be seen from seaward are as follows:— *Red*, from W.S.W. to W. ½ S. *White*, from W. ½ S. round northerly to E. ½ S. *Red*, from E. ½ S. to E. by S.	19 miles.

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Cape Nelson —*continued.*	The Lighthouse is 79 feet high, constructed of stone, and painted *White.* Position: Latitude, 38° 25′ 45″ S. Longitude, 141° 32′ 55″ E.	
Portland Bay.	*Fixed White* and *Green Light*, dioptric, of the fourth order, elevated 116 feet above sea-level. The light shows *Green* from S. by E. round westerly to N.W., and *White* over the anchorage between S. by E. and the end of the jetty. The lighthouse is built of stone, and coloured *White.* Position: Latitude, 38° 22′ S. Longitude, 141° 39′ E.	12 miles.
Portland Jetty.	*Red.* Fixed.	3 to 4 miles.
Belfast, Port Fairy.	*Fixed* and *Flashing Light*, dioptric, of the fourth order, coloured *Red*, showing a *bright flash* every three minutes. At a distance of six miles and upwards it will appear as a *steady light* for a space of 1 minute and 40 seconds, be suddenly *eclipsed* 34 seconds, then exhibit a *bright flash* for 12 seconds, and be again	9 miles.

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Belfast, Port Fairy—*continued.*	*eclipsed* for 34 seconds, when the *steady light* will re-appear. Within three miles of the light the eclipses will be scarcely observable, a continued fixed light being at that distance, in clear weather, visible between the intervals of the bright flashes. The light is elevated 41 feet above sea-level, visible from S. by E. ½ E. round by west and north to N. E. by E. ½ E. The lighthouse is circular, built of stone, and coloured *Red.* Position: Latitude, 38° 24′ S. Longitude, 142° 20′ E. A *White Light* is exhibited from one of the lower windows in the above tower. The light is cut to mark the black buoy, moored in 18 feet off the northern extremity of the reef, and to point out the best anchorage for vessels making the port after dark.	
Look-out Hill.	*Fixed Green Light* is placed on Look-out Hill, visible between S.W. by W. and S.	3 miles (about).
	NOTE.—Mariners are particularly cautioned to note the distinctive features of the Port Fairy and Cape Otway Lights, the latter being *White*, and attaining its greatest brilliancy once every minute.	

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Warrnambool Lights.	*Two fixed Lights*, upper and lower. Upper Light: *Fixed White Light*, dioptric, of the fourth order, 109 feet above sea-level; visible from seaward from about E. round northerly to N.W.	14 miles.
	Lower Light: *Fixed Red Light*, 87 feet above sea-level; visible between the bearings N. ¼ E. and N.W. ½ N.	5 miles.
Warrnambool Jetty.	*Fixed Green Light.*	3 miles.
Cape Otway.	*Revolving White Light*, catoptric, of the first order, *showing a bright flash of four seconds duration every minute;* elevated 300 feet above sea-level; visible from E. by S. round northerly to W. ½ S. The Lighthouse is built of stone, and coloured *White.* In addition to the revolving light, a *Red* danger light is exhibited at the base of Lighthouse, 48 feet below the revolving light. (See Sailing Directions.) Position: Latitude, 38° 51′ 45″ S. Longitude, 143° 31′ E. NOTE.—Mariners are particularly requested to note the distinction between the Otway and Schanck Lights.	24 milts.

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Cape Otway —*continued.*	The Otway shows a bright flash *once every minute.* The Schanck shows a bright flash *once every two minutes.*	
Point Lonsdale.	*Fixed Red* and *Green Light*, dioptric, elevated 80 feet above sea-level. The Lighthouse is built of wood, and painted in alternate bands of *Red* and *Black*, commencing red at top. *Green Light* visible bearing N. by W. to N.W. ½ W. *Red Light* visible bearing N.W. ½ W. to W. by S.	8 to 10 miles.
Point Nepean Jetty Light.	*Fixed Green Light*, exhibited from end of Sanitary Station Jetty, Point Nepean.	2 to 3 miles.
Queenscliff Lights.*	High Lighthouse: *Fixed White Light* catodioptric, of the second order, elevated 130 feet above sea-level, visible on any bearing between E. by N. and N. When close in with Lonsdale land, it will only be seen between N.E. by E. and N. Within Port Phillip Heads, the light will be visible from N.E. by E. round by north and west to S.W. by W.	17 miles.

NOTE.—See Caution in Sailing Directions.

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Queenscliff Lights*—*continued.*	The Lighthouse is built of *Blue* stone, and retains its natural colour.	
	Low Lighthouse: *Fixed Red and White Light*, dioptric, of the third order. Elevated 90 feet above sea-level.	*White Lt.*, 14 miles. *Red Light* 10 miles.
	The *White Light* is visible from N.E. by E. to N.E.	
	The *Red Light* is visible from N.E. to N.N.E.	

* NOTE TO QUEENSCLIFF LIGHTS.

The following notice has been published in reference to alteration in these lights:-

"On and after the 1st November, 1886, the low leading light to the entrance to Port Phillip will be altered by exhibiting the *White Light* of the western sector four degrees further to the eastward, thereby bringing the eastern edge of the Lonsdale Rock within the range of such *White* sector.

"The *Low Light*, therefore, on and after the date mentioned, will be seen from approaching vessels on the following bearings:—

"*Western White Sector*, from N.E. by E. to N.E. ½ N.
"*Leading Red Sector*, from N.E. ½ N. to N.N.E.
"*Eastern White Sector*, from N.N.E. round northerly to W. by N.

"CAUTION.

"Vessels entering between Port Phillip Heads should keep the *Red Light* visible, and in line with the high *White Light*. The change of colour from *Red* to *White* will be an indication that the vessel is either approaching the Lonsdale Rock on the west or the Nepean Reef on the east side of the fairway entrance."

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Queenscliff Lights*—*continued*	The *White Light* again from N.N.E. round by N. to W. by N. NOTE.—See cautions in Sailing Directions.	
Swan Spit Lightship.	*Two fixed Red Lights*, one from mainmast, and one from foremast. Lightship painted *Red.* NOTE.—This Lightship temporarily replaces a Pile Lighthouse, which was destroyed by collision. A gong is sounded from the Lightship every ten minutes in thick or foggy weather.	8 miles.
West Channel Pile Light.	*Fixed Red and White*, elevated 38 feet above low water. The light shows *Red* between N.E. by N. and S. by E. ½ E. The light shows *White* between N.E. by N. round westerly to S. by E. ¼ E.	11 miles.
South Channel Lights.	The "Eastern Light" (immediately under Arthur's Seat) is a *Fixed White and Red Light*, dioptric, of the third class, elevated 100 feet above high-water level.	13 miles.
	The "South Channel Pile Light," *Fixed Red and White*, dioptric, of the fourth class, elevated 27 feet above high-water.	10 miles.

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
South Channel Lights—*continued.*	The "Eastern Light" shows *Red* between S. by W. ½ W. and S.E. ¼ E. *White* between S.E. ¼ E. and E. by N. ½ N. The "South Channel Pile Light" shows *Red* from W. ½ S. round northerly to N.E. ¼ N. *White* N.E. ¼ N. and S.S.E. NOTE.—Between the bearings of S.S.E. to W. ½ S. this light is obscured.	
Gellibrand's Point Lightship.	*Revolving White Light*, showing a *bright flash* every 30 seconds, elevated 40 feet above sea-level. The Lightship is painted *Red.* NOTE.—A horn is sounded alternately with a gong every ten minutes in foggy weather.	10 miles.
Geelong Lightship	*Fixed White Light*, elevated 27 feet above sea-level. The Lightship is painted *Red.* NOTE.—A gong is sounded every ten minutes in foggy weather.	9 miles.
South Channel Geelong Lights.	On and after 1st October, 1886, lights will be exhibited from two beacons erected on the North Bank, at the Eastern and Western entrance to the South Channel, Geelong. The lights will be of the ordinary jetty type, elevated 21 feet above the mean level of the sea, and will be visible in clear weather about 6 miles.	

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
South Channel Geelong Lights—*continued.*	From the Eastern entrance a *Red Light* will be shown towards Point Henry and the Bird Rock, with a sector of *White Light* marking a clear passage off the Point Wilson and Wilson Spit Buoys. The Light from the Western Entrance will be *Green.*	
Schnapper Point.	*Fixed White Light*, dioptric, of the fifth order, elevated 50 feet above sea-level, visible all round to seaward. Lighthouse painted *White.*	10 miles.
Schnapper Point Jetty Light.	*Fixed Red.*	3 miles.
Portarlington Harbour Light.	*Fixed Red Light*, dioptric, elevated 50 feet above sea-level, visible between the bearings W.S.W. and S.E. by E. Lighthouse built of wood, skeleton frame, and painted *White.*	7 miles.
Portarlington Jetty Light.	*Fixed Green Light*, visible from any point seaward.	2 to 3 miles.
Cape Schanck Coast Light.	*Fixed and Flashing White Lights*, catodioptric, of the first order, showing a *bright flash* every two minutes. The Light at a distance of eight	23 miles.

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Cape Schanck Coast Light —*continued.*	miles and upwards, according to the state of the atmosphere, will appear as a *Steady Light* for the space of 1 minute, be suddenly eclipsed for 25 seconds, then exhibit a *bright flash* for about 10 seconds, and be again eclipsed for 35 seconds, when the *Steady Light* will re-appear. When a vessel is about six miles from the Light, the eclipses will be scarcely observable, a continued faint light being at that distance, in clear weather, visible between the intervals of the bright flashes. The Light is elevated 328 feet above sea-level, and is visible between the bearings W. $\frac{1}{4}$ N. and S.E. $\frac{3}{4}$ E. The Light tower is built of stone, and coloured *White.*	
Flinders Jetty Light, Western Port.	*Fixed Red and White Light.* NOTE.—See Caution in Sailing Directions.	4 to 5 miles.
Queensferry Jetty Light, Western Port.	*Fixed Red Light.*	3 miles.

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Griffith Point, east entrance Western Port.	*Fixed Green Light.*	2 to 3 miles.
Waratah Bay Harbour Light.	*Fixed Red Light*, elevated about 120 feet above sea-level. Position : Latitude, 38° 52′, S. Longitude, 146°, E.	3 miles.
Wilson's Promontory. Coast Light.	*Fixed White Light*, catoptric of the first order, elevated 342 feet above sea-level. The Light is seen between the bearings of N.E. by E. ½ E. and S.S.W., and is again visible between the islands of the Anser Group on an E.N.E. bearing. The Lighthouse is built of stone, and coloured *White*.	24 miles.
Cliffy Island Lighthouse.	*Flashing Red Light*, dioptric, of the fourth order. The Light gives *five flashes and eclipses alternately* in every minute. visible in clear weather all round the horizon. The Light is elevated 180 feet above sea-level. The Lighthouse is constructed of stone.	15 miles.

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Cliffy Island Lighthouse —*continued.*	Position (approximate): Latitude, 38° 58′ 10″ S. Longitude, 146° 42′ 24″ E.	
Clonmel Island, east entrance to Port Albert.	*Fixed and Flashing Red Light*, dioptric, of the fourth order, showing a *bright flash* every three minutes at a distance of six miles and upwards. It will appear as a *Steady Red Light* for a space of one minute forty seconds, be suddenly eclipsed thirty-four seconds, then exhibit a *bright Red flash* for twelve seconds, and be again eclipsed for thirty-four seconds, when the *Steady Red Light* will re-appear. When within about three miles of the light, the eclipses will be scarcely observable, a continued *Fixed Red Light* being at that distance visible between the intervals of the *bright flashes.* The light is elevated 52 feet above sea-level, and is visible between the bearings of N.E. and W. and S. The Lighthouse tower is built of wood, and coloured *White.* Position (approximate): Latitude, 38° 45′ 10″ S. Longitude, 146° 37′ 50″ E.	11 miles.

DESCRIPTION OF LIGHTS—*continued.*

Name.	Description of Light, &c.	Visible in Clear Weather.
Gabo Island Light.	*Fixed White Light*, catodioptric, of the first order. Elevated 179 feet above sea-level. The Light is visible from seaward between the bearings E. ½ N. round northerly to S.W. by S. The Lighthouse is built of *Red* granite, and retains its natural colour. Position: Latitude, 37° 34′ 15″ S. Longitude, 149° 55′ 10″ E.	20 miles

BEACON AND DOLPHIN LIGHTS.

Beacon or Dolphin Lights are exhibited at the undermentioned places:—

I.—ENTRANCE TO RIVER YARRA.

One *Red Light* at outer Black Dolphin.
One *Green Light* at the Elbow Beacon.
One *Red Light* on the Williamstown Beach.

II.—ENTRANCE TO GEELONG HARBOUR.

One *White Light* placed on first Red Dolphin, and inshore of the Geelong Lightship.
One *Red Light* placed on the westernmost Red Dolphin on the north side of the Channel.

PIER-HEAD LIGHTS.

Pier-head Lights are exhibited at the undermentioned jetties:—

Green Lights, visible two to three miles:

Belfast, Warrnambool, Queenscliff, Portarlington, Sandridge Railway Pier, Frankston, Dromana; Ann-street Pier, Williamstown; Griffith Point.

Red Lights, visible three to four miles:

Portland, Williamstown Breakwater, Williamstown Town Pier, Sandridge Town Pier, Schnapper Point Jetty, New Pier (Brighton), Railway Pier (Geelong).

White Lights, visible about five miles:

Hastings Jetty, Cowes, Yarra-street Jetty (Geelong), Drysdale Jetty.

Red and White Light, visible four to five miles:

Flinders Jetty, Western Port.

SAILING DIRECTIONS FOR PORT PHILLIP.

In passing within signalling distance of Cape Otway, vessels, whether bound to Port Phillip or not, are recommended to show their numbers, and communicate any public intelligence they may be in possession of.

A sunken reef lies off Cape Otway, about one and a half miles in a S.E. to S.S.W. direction. The screw steamer *Blackbird*, drawing 13 feet, struck upon this reef. It is advisable to round the Cape at a distance of not less than four miles, and when the Lighthouse bears W. by N. ½ N. 6 miles steer N.E. 56 miles to Port Phillip entrance.

Keep an Offing until Daylight.—Strangers, if when abreast of Split Point find there is not sufficient daylight to take them to Pilot waters, should bring the ship under easy sail, and stand off and on shore until daylight, not shoaling their water to less than 20 fathoms.

Henty Reef.—In running for Port Phillip, be careful to avoid a sunken rock, with not more than 18 feet over it, which lies about two miles off shore, near Apollo Bay, and 13 miles off Cape Otway. Four beacons on the main land mark the position of this rock; two on Cape Bunbury, bearing from each other S.E. ½ S. and N.W. ½ N., the inner one painted *White*, the outer *Red;* two on Point Hayley, situated about nine miles N.E. from Cape Otway, bearing from each other E. ¼ N. and W. ¼ S., the inner one painted *White*, the outer *Black*. The position of the rock is marked by the intersection of two lines drawn through these beacons. This danger is known as Henty's Reef, is steep to, having 10 fathoms all round within a cable's length of the shoalest part. As the sea only breaks on the reef in bad weather, vessels should give it a good berth in passing.

Caution not to heave to.—On no account should a vessel be hove to when waiting for daylight near the Heads. Several vessels that have done so have drifted into danger—two (the *Sacramento* and the *Earl of Charlemont*) were lost, one on Point Lonsdale, the other on Point Flinders, from this cause, combined with inattention to the lead and the state of the tide.

Current.—Should Cape Otway be rounded early in the evening, with a fresh southerly breeze, it is necessary to be aware of over-running the distance, as the current, after a prevalence of westerly or southerly gales, is often found to set strongly along the land to the N.E.

Approaching the Entrance from the South-West.

If the weather be at all clear after passing Split Point, high land will be seen opening out on the Starboard bow; this is Arthur's Seat, rising inland over the waters of Port Phillip with a steep declivity to the N.W., but sloping gradually with an even outline to the S.E. Proceeding onward, the land about Cape Schanck will be seen more to the eastward, making at first like a long low island, and also trending to the S.E.; and as you near the entrance, Flinders Point will open out on the Port bow, which is an isolated, saddle-shaped, scrubby hill, about 150 feet high, and is an excellent mark for the Port, there being no land at this part of the coast like it. Care should be taken in thick or hazy weather not to mistake Flinders Point for Port Phillip Heads, which, in several instances, has led to vessels going ashore.

Approaching the Harbour from the Eastward.

Vessels steering for the Heads from the southward and eastward usually make the land about Cape Schanck, which cannot be mistaken, from the bold precipitous character of the coast; the opening into Western Port to the N.E., and the unbroken trending of the coast in a N.W. direction, thence to Port Phillip Heads. The extremity of Cape Schanck is distinguished by a marked isolated basaltic rock, called the

Pulpit; it, and a small reef awash, lies off the Cape three cables length in a S.E. direction. There is a fixed and flashing *White Light* upon the highest part of the Cape, the tower of which is painted *White*. Vessels having passed Cape Schanck should keep a good offing, running down towards the entrance until they open out the Shortland's Bluff Lighthouses, which are not seen before bearing N. ¾ E. owing to the high land of Point Nepean intervening, nor when near the Heads bring the Point Lonsdale Lighthouse to the westward of N.W. before opening out the high Lighthouse to the west of the obelisk.

Pilot Waters.

Pilots.—The pilot vessels cruise from three to twelve miles outside the Heads, borrowing on either shore according to the weather.

Pilot Flag.—Pilot vessels carry by day a red and white flag in horizontal stripes, white uppermost, at the mainmast-head, and between sunset and sunrise exhibit a bright light at the foremast-head, and show in the waist a flash light every quarter of an hour.

Tidal Signals.

(See Table of Tidal Signals.)

Entrance to Port Phillip.

The entrance to Port Phillip is between Points Lonsdale and Nepean, bounded by reefs off each point, and an outlying danger, the Lonsdale Rock, on the west side of the fairway—(the Lightning Rocks are now removed)—leaving a clear navigable channel of half-a-mile between them, with five fathoms close to the Lonsdale Rock, and from seven to nine fathoms in mid-channel, and close over to the late site of the Lightning Rocks, but ships of heavy draught should endeavour to keep in mid-channel, as the strong tide ripple causes them to plunge several feet below the level of the water.

Point Lonsdale.

Forms the western side of the entrance to Port Phillip, and bears from Flinders Point E. ¾ N. six miles, and W. two miles from Point Nepean. It is neither so high nor so well marked in outline as the latter, but can now easily be distinguished by a Light and Look-out House, Telegraph Station, and Tidal Flagstaff near its south extremity.

Lonsdale Light.

(See Table of Lights.)

Caution.—Vessels having the *Green Light* in sight will be outside and the *Red Light* in sight will be inside the Lonsdale Rock, which bears S.E. ½ E., distant nearly two-thirds of a mile from the light. The blending of the two colours, when seen from a vessel, will show she is in the vicinity of, or in a line with, this danger. Great caution will, therefore, be necessary before these colours begin to blend.

During the day-time, a line N.W. ½ W., passing through the Lighthouse and Tidal Flagstaff, leads over the Lonsdale Rock.

Lonsdale Reef.

Lonsdale Reef extends S.E. from the Point three cables' length, and is about one cable's length broad. The greater part is dry at low water.

Lonsdale Rock.

Lonsdale Rock lies S. 56° E. six cables' length from the Tidal Flagstaff; it is a small pinnacle rock, having only 18 feet over it, with four and five fathoms close to. There is a navigable channel, 150 fathoms wide, between the end of the reef and the rock, for vessels in day-light drawing under 14 feet.

Point Nepean.

Point Nepean terminates the Peninsula, which slopes gradually W.N.W. from Arthur's Seat. It forms the eastern part of the entrance, is higher than Point Lonsdale, and consists of a series of sandy hummocks, slightly covered with low bushes.

Jetty Light.

(See Table of Lights.)

Point Nepean Jetty.

Mooring Buoy. There is a *Red Cask* Mooring Buoy placed 75 fathoms E.N.E. off the end of the jetty, in 15 feet low water.

Nepean Reef and Rock.

Nepean Reef projects west nearly two cables' length from Nepean Point to Nepean Rock, a small islet, on which is a *Red cone-shaped Beacon;* from thence a continuation of the reef, and several pinnacle rocks outside it, extends three and a half cables' length further westward to Corsair Rock, at 150 feet to the N.N.E., off which is a small detached rock, with 10 feet of water on it. Nepean Reef is dry at low water out to the islet, but the remainder of the reef is covered with 1 to 3 feet water.

The northern edge of the rocky ledge along Nepean Reef trends from Corsair Rock, E. by N., to one cable's length northward of Nepean Point. The coast outside Nepean Point is bounded by a continuation of this reef and numerous rocks; but they do not extend more than *one* to *one and a half cables* from the shore, which may be approached to a quarter of a mile in five fathoms.

Corsair Rock.

The Corsair Rock may be considered as the outer end of Nepean Reef. It is 20 feet in diameter, having 8 feet water over it. The chart mark is the cone-shaped *Red Beacon* on the rocky islet on with Port Nepean *White Beacon.*

Leading Beacons for Deep-water Channel.

The beacons—the outer *Red,* and the inner *White*—are situated in Lonsdale Bight, nearly one and two-tenth miles from Point Lonsdale, and one and six-tenth miles from Queenscliff low Lighthouse, and kept in line bearing N.N.W. ¼ W.; lead in with not less than 42 feet at low water.

Victory Shoal.

Victory shoal lies near midway between the low Light-house and Point Lonsdale, about half a mile off shore, in a line with the Shortland's Bluff and Tidal Flagstaffs. It is a rocky patch, about a cable's length in extent, with 10 feet water over it, and three and four fathoms a little outside. But the whole of Lonsdale Bight is shallow, foul ground, and should be avoided by all vessels.

Shortland's Bluff.

Is situated inside the Heads, about two and a quarter miles N.E. ½ E. from Point Lonsdale. It is well marked by two Lighthouses (Queenscliff Lights), an obelisk, telegraph station and flagstaff. The Lighthouses are 1,056 feet apart, and bear from each other S. 33° W., and N. 33° E. The obelisk stands a little to the eastward of the low Lighthouse; it is 50 feet high, coloured lower half *White*, upper half *Red*, and was the leading mark to clear the Lightning Rocks, which are now removed.

Queenscliff Lights.

(See Table of Lights.)

Alteration of Low Light.—Officers in charge of vessels are particularly requested to notice the alteration in Queenscliff low Light. The alteration takes place on and after 1st November, 1886, and is described in "Note to Queenscliff Light," in Table of Lights.

Caution.—Vessels entering between Port Phillip Heads should keep the *Red Light* in sight, and steer with it bearing N.E. by N., in line with high *White Light.*

The change of colour from *Red* to *White* at the low Light indicates approach to Lonsdale Reef on the west and to Nepean Reef on the east side of entrance.

These bearings, it will be observed, show the low Light to be *White* from Point Lonsdale to a safe berth clear of the Reef; thence *Red*, to a safe berth clear of the Corsair Rock; thence *White* to a line passing from the Lighthouse through the South Channel to the southward of the Pope's-eye and

black buoys, and to the northward of the white buoys, so that vessels caught after dark with light winds or adverse tides in the South Channel will be aided in their passage through by a bearing of the light. The change of colour from *Red* to *White* is intended to warn vessels approaching Point Lonsdale and Nepean Reefs to haul to the eastward or westward, as the case may be, to get into the stream of *Red Light*, which will lead them clear of both reefs. The two lights in one is the safest course for vessels of heavy draught entering between the Heads. See Alteration of Lights.

Swan Spit Lightship.

(See Table of Lights.)

Cautions in Approaching Swan Spit Lightship.

After passing Royal George Sand (see further on) care must be exercised to avoid several sandy knolls to the southward and eastward of the Lightship, two outside the Lightship, with not more than 12 feet of water over them, bearing from Lightship E.N.E. and S.E. by E., each distant about a cable's length on bearings named.

A sandy knoll to the southward of the Lightship. It is about one cable in length, trending S.E. ½ S. towards No. 4 buoy. The shoalest part is at its S.E., where there are only 14½ feet at low water. There are 17 feet over the northern part of it.

A *checkered* buoy is placed over the shoalest part. There is a passage with from 18 to 20 feet between the knoll and the Lightship.

At night, an additional sector of *Red Light* will be shown from Shortland Bluff low Lighthouse, Queenscliff, visible between the bearings of about S.W. by W. ‡ W., and S.W. by W. ¾ W., or from black buoy No. 1 to perch buoy No. 2, at the entrance to the West Channel. After passing No. 2 perch buoy, this sector will indicate approach to above knoll.

Vessels must not approach the Lightship nearer than 100 fathoms, outside of which distance there is a clear channel of nearly one-third of a mile, with three, four, and five fathoms water.

Swan Spit.

A shoal is forming off the Swan Spit Lightship; at present the depth, at a distance of 1¼ cables from the Light, is 12 feet.

A black buoy will be placed on the shoal to the northward of the Swan Spit Lightship until it is removed.

Vessels are cautioned not to approach within 100 fathoms of the Lightship, which will keep ships clear of this recently formed shoal.

Queenscliff Bight.

Great changes have taken place since 1864. Six banks, with three and four feet of water, have been formed, and four of the six are each nearly a cable in extent. The outer of these two banks is in a line between Queenscliff high Light and Swan Spit Lightship, the south-west one being nine cables from the Queenscliff high Light, and the other nine cables from the Lightship, the two being distant from each other four cables.

The recently formed banks in the Queenscliff Bight being out of the navigable channel, the old clearing marks, viz., Lonsdale Lighthouse open of Shortland's Bluff, will clear the edge of the bank referred to.

Inside the Heads.

Inside the Heads, for the first two and a half miles, the Bay is free from other dangers; above that distance it widens to the north and east, and for ten miles is covered with sand banks, through which there are several channels, three only being buoyed, namely, the South, West, and Coles' Channels; the others are narrow and intricate.

Royal George Sand.

Royal George Sand lies on the eastern side of the entrance to the West Channel; its western end is about a mile S.W. by W. from the Swan Spit Lightship, and a mile east from the upper Lighthouse. The eastern end is separated from Symons' Spit by a 17 feet channel, two cables wide. The knoll is marked by two *White* buoys, bearing from each

other W. by S. and E. by N.; least water 11 feet, about midway between the buoys, which lie in 16 feet.

This bank has shoaled one foot, and moved 400 feet, outwards towards the Heads.

Pope's-Eye Bank.

This shoal of sand is about a mile long and two cables in width, having two feet water on the northern and three fathoms on the southern end, which lies a mile and a half S. ¾ W. from Swan Spit Lightship, and nearly the same distance S.E. by E. from the upper Lighthouse. The S.W. end of the Pope's eye is marked by a *Red* buoy, the Royal George buoy about S.S.W.

Nicholson's Knoll.

Nicholson's Knoll is a small sand ridge off the Quarantine Ground, with three fathoms water over it, and five, six, and seven fathoms close to. This ridge is of recent formation, and lies in a north and south direction, and is about a cable's length in extent; it is marked by checkered *Black* and *White* buoys, moored on the north and south ends of it. The flagstaff on the eastern end of the Quarantine Ground, bearing S. by W. ¾ W., and the upper Lighthouse, bearing N.W. by W. ½ W., places you on the ridge.

Marks to Clear the Dangers at the Entrance and Shoals inside the Heads.

To clear the Lonsdale Reef.—Vessels drawing under 14 feet may, in the day time, pass between Lonsdale Reef and the rock by keeping Swan Point a little open east of Shortland's Bluff; and pass to the eastward of these dangers, keep Swan Point Beacon open east of Shortland's Bluff until the Lighthouse on Point Lonsdale opens well and clear of the Tidal Flagstaff.

To clear the Corsair Rocks and adjacent dangers.—Keep the Lighthouse in line with east end of keeper's quarters until you open the *White Beacon* on Point Nepean well out to the northward of the *Red Beacon* when bound inwards, and well out to the southward when bound outwards.

To clear Victory Shoal.—Keep Swan Spit Lightship open east to Shortland's Bluff.

To clear Royal George Knoll.—Keep Swan Spit Lightship to the eastward of N.E. by E. until the out end of Queenscliff Jetty bears W. by S.

To clear Pope's-eye Bank.—To pass to the westward of the southernmost end of the Pope's-eye, do not bring Swan Spit Lightship to the northward of N. by E. ½ E.

To clear the Bank between Shortland's Bluff and Swan Spit Lightship.—Keep the Lonsdale Lighthouse open of Shortland's Bluff.

To clear Nicholson's Knoll.—To pass to the northward, keep the rocky islet a little open of Point Nepean; to pass to the southward, shut in the rocky islet with Point Nepean. When the eastern flagstaff of the Quarantine Ground bears S.W. by S. you are above the knoll.

South Channel.

The South Channel is nine miles long, free from dangers, varying from one to a quarter of a mile in breadth; soundings very irregular, varying in the centre from seven fathoms at the western end to twelve and twenty fathoms off Point King, and decreasing to four and five fathoms at the eastern end, shoaling gradually from the middle to three fathoms at the sides, then suddenly to two fathoms and less. It is marked by three leading lights (the two eastern, immediately under Arthur's Seat, from heights of 80 and 46 feet above high-water level, and the western, shown at an elevation of 27 feet from a Pile Lighthouse erected on the position formerly occupied by No. 10 buoy), and twelve buoys, eight *Black* on the Port hand, and four *White* on Starboard, the former marked with odd, the latter with even, numbers, commencing from seaward. The first and last *Black* buoys are each surmounted by a staff and ball.

West Channel.

The West Channel is five miles long and about half-a-mile broad, free from dangers, with an even bottom, having from

three to four fathoms through it, shoaling suddenly towards both sides. The channel is mostly used, and marked by two lights and fourteen buoys, the light at the lower entrance being exhibited from a Lightship on the Swan Spit. The Lighthouse at the upper end of the channel is built on piles, on the north-eastern edge of the west bank, in 15 feet of water; is 38 feet above low water, and is visible in clear weather at a distance of eleven miles. The Light is fixed, and shows *Red* between N.E. by N. and S. by E. ½ E., and *White* between N.E. by N. round westerly to S. by E. ¼ E. The *Red* Light is cut to mark the black buoy off Prince George Bank, and No. 5 buoy in the West Channel. Vessels passing should keep half a cable's length to the eastward of the Light.

There are five *Black* buoys on the Port hand, with odd numbers, and eight *White* buoys on the Starboard hand, with even numbers. The first *White* buoy on the Royal George Bank, and the large cone buoy (No. 12) on the N.W. elbow of the bank which forms the east side of the channel, are surmounted by a staff and ball. The draught of water for ships navigating the West Channel should be limited to 17 feet.

Cole's Channel.

Cole's Channel is the westernmost, is three miles long, and about one quarter of a mile broad, with 13 feet in the fairway, shoaling gradually to the shore, but suddenly towards the bank which separates it from the West Channel. The entrance to this channel is above Swan Island; it is but little used.

There are two *Red* buoys on the Starboard hand.

Directions for Entering between the Heads.

Waiting the Turn of the Tide.—It is advisable for vessels waiting the turn of the tide outside the Heads to keep point Lonsdale shore aboard, where the tide runs fairer, and, in bad weather, small vessels incur less danger from the tide ripple, and will have smoother water.

Proper Time to Enter the Heads.—Should a pilot not have been taken on board outside the Heads, and the last-quarter ebb signal be up, or it be flood tide, steer within three leagues

of the entrance, to bring the high Lighthouse on Shortland's Bluff to bear N.E. by N., upon which line of bearing, as you approach the Heads, the low Lighthouse will be seen to seaward of the upper one, when steer as follows:—

Fair Wind and Flood Tide.—With a fresh fair wind and flood tide, keep the two Lighthouses in one until you bring the rocky islet off point Nepean open to the westward of that Point, when you are in clear of reefs.

Scant Wind and Flood Tide.—With a scant or light wind (easterly) and flood tide, do not shut Swan Point Beacon in with Shortland's Bluff.

Directions for West Channel.

Entering against Ebb Tide.—Entering the Heads with ebb tide, steer when within two miles of the Heads to get the low Lighthouse about a point open E. of the high one until you draw near Point Lonsdale, when haul as close round the reef as practicable, taking care, however, if your draught is over 14 feet, not to shut Swan Island Beacon in with Shortland's Bluff, nor on any account to shut in Swan Point with the Bluff until you are clear of the reefs and have the rocky islet off Point Nepean open to the westward of that point, when, if bound through the West Channel, steer N.E. ¼ E. for the white buoy which is surmounted by a staff and ball, and lies on the east side of the S.W. end of the West Channel, giving Shortland's Bluff a berth of two cables' length in order to avoid a ledge which runs about that distance S.E. of it. The *White* perch buoy and the *Red* buoy on the Pope's-eye Shoal are to be left on the Starboard hand, and when within a cable's length of the former haul a little to the northward to pass between it and the Swan Spit Lightship, taking care not to keep Point Lonsdale Lighthouse to the westward of Shortland's Bluff until you bring Swan Island Beacon on with the Swan Spit Lightship, to which give a berth three-quarters of a cable's length in passing—(See description of Shoal to the N.E. of Swan Spit Lightship)—then steer about N.N.E. keeping the upper Pile Lighthouse

a little on the starboard bow until past No. 12 *White* buoy, which has a staff and ball, then bring the Lighthouse on the Port bow, passing it to the eastward; and if bound to Hobson's Bay, steer N. by E. ¼ E. for Gellibrand's Point Lightship; if to Geelong, steer N. by W. for Prince George buoy, and follow the directions for that Port.

Vessels under 15 feet draught may enter the West Channel between the Royal George and Pope's-eye sands, by keeping about midway between the *White* perch buoy and the *Red* buoy until Swan Island Beacon comes on with the *White* cask buoy, bearing N.W. by N., when steer for the Swan Spit Lightship leaving the cask buoy on the Port hand.

With a Scant Wind against Ebb Tide.—Vessels with a scant wind proceeding up channel against the ebb must not stand too close over towards the east bank, as they are liable to be horsed on it, especially at the north end of the channel.

Vessels working in between the Heads, standing to the westward, must keep Swan Island Beacon open of Shortland's Bluff until Point Lonsdale Lighthouse is well open of the Tidal Flagstaff, when vessels of light draught may stand more in shore, keeping Swan Point a little open of Shortland's Bluff, making due allowance, however, for the set of the flood tide; and above the Bluff, standing to the westward, do not shut in the Lonsdale Lighthouse with the low Lighthouse until you are a cable's length above the Lightship, when do not stand inside the line of buoys.

South Channel Lights.

(For description of South Channel Lights, see Table of Lights.)

The colour of the *Red Light* at Point Lonsdale is deepened to a darker red than formerly shown, between the bearings of W. by S. and W. by N.

The deepening of colour is made to prevent the possibility of mariners navigating the eastern entrance of the South Channel mistaking these lights for the Pile Light in the South Channel.

Vessels entering the South Channel from seaward should steer in with these two lights (*White*) in one bearing E. ¾ S., but in approaching to within quarter of a mile of the South Channel Pile Light, in vessels of heavy draught of water, care must be taken to bring the Eastern Light under Arthur's Seat well to the northward of the Pile Light, in order to avoid shoal soundings in 20, 21, and 22 feet, recently obtained by Captain Stanley whilst re-surveying this channel.

After passing the Pile Lighthouse, steer about east, taking care to get sight of the Light again (*Red*) before getting into the vicinity of No. 13 buoy. When the eastern Light under Arthur's Seat shows *Red*, the vessel will be clear of the east end of the "Middle Ground," when a course may be shaped for either Melbourne or Geelong. Vessels leaving for sea by South Channel, having made the eastern Light under Arthur's Seat (*Red*), should steer for it until the Pile Light opens out (*Red*) upon a W. ½ S. bearing, when a course may be shaped so as to pass it on the north side, and then steer W. ¾ N. through the channel.

Sailing vessels working down, and when to the northward and in the vicinity of the Middle Ground and Great Sand, will know when they are getting into danger when either the South Channel Pile Light or the eastern Light under Arthur's Seat shows *White*.

They will also know their proximity to the eastern shore when the eastern Light ceases to be visible.

Vessels may find safe anchorage anywhere in Capel Sound, with the South Channel Pile Light showing *Red*, the only danger being the "Hurricane" wreck, upon which a "wreck buoy" is placed.

South Channel Inwards.

If bound through the South Channel, after clearing the Heads, steer along the south side of the Bay, with Flinders Point just kept open of Point Lonsdale, in from nine to eleven fathoms, until Point King bears S. by E., leaving the *Red* buoy on Pope's-eye Shoal on the Port hand; and when the *White* buoy off Point King comes on with that Point, keep

the Flagstaff on Observatory Point a large sail's length open of the southward of a small knob on the top of the western ridge of Point Nepean, which marks lead up in mid-channel, until the *White* cliff bears S. by E., when bring the Flagstaff just open to the southward of the knob until the Pile Lighthouse comes on with a *White* tower on the top of Arthur's Seat, which will lead through the channel, leaving the Pile Lighthouse on the Starboard hand, and when to the eastward of it keep it open of Observatory Point Flagstaff astern until the easternmost *Black* buoy is on with Mount Martha, then steer E. by N. for the latter buoy, leaving it on the Port hand, when if bound to Hobson's Bay steer N. ¾ W. 27 miles, or if bound to Geelong N.W. ½ W. 14 miles for the *Black* buoy off Prince George Bank.

Beating up the South Channel.

Vessels beating through the South Channel must be guided by the lead, not standing into less than four fathoms on either side, nor within the line of buoys; and when past the Pile Lighthouse there is plenty of room between the Middle Ground and the shore, which may be approached within half-a-mile into five fathoms; and when clear of the Middle Ground and to the northward of Mount Martha you can stand to the westward until the northernmost land of Indented Head comes on with Station Peak.

A shoal has been found between Nos. 1 and 3 buoys. It bears S.E. by E. ¾ E. from No. 1 buoy, and nearly due W. from No. 3 buoy.

The shoal lays about due north and south, and is a cable in length and half a cable in breadth, with 21½ feet over it at low water.

The shallowest part is a cable and a half south of a line between Nos. 1 and 3 buoys, and two and a quarter (2¼) cables from the fairway up channel, viz., two lights in one E. ¾ S.

This shoal is supposed to be the same on which the *Great Britain* touched some years ago.

Tidal Signals at Pile Lighthouse, South Channel.

(See Table of Tidal Signals.)

Navigation at Night.

Directions for the Guidance of Vessels Navigating the Entrance to Port Phillip.

Vessels from the southward and eastward will see the high light (Fixed, *White*) on a N. ½ W. bearing, and the white low light (Fixed, *White* and *Red*) on a N. ½ E. bearing; as they proceed to the N.W. to bring the two lights in one, the low light will change its colour from *White* to *Red* on a N.N.E. ½ E. bearing.

Vessels from the southward and westward sighting the high light to the eastward of N.E. by E. should, to avoid the Barwon Bight, haul out to the eastward to open the low light, which will be first seen *White*, on a N.E. by E. bearing, and as they proceed to bring the two lights into one the low light will change its colour from *Red* to *White* on a N.E. ½ E. bearing.

A reference to the chart will show that, as hitherto, the best and safest course between the Heads is to keep the two Shortland's Bluff lights in one line, on a N.E. by N. and S.W. by S. bearing; but should the wind become scant, and the vessel compelled to make a tack when in the vicinity of the Corsair Rock or the Point Lonsdale Reef, these dangers will be avoided by vessels of light draught so long as the Shortland's Bluff low *Red Light* is kept in sight. Vessels so circumstanced must be careful to go about, or haul towards mid-channel, before the low light changes from *Red* to *White*.

Point Lonsdale Light.—The light (Fixed, *Red* and *Green*) on Point Lonsdale has been established to warn vessels entering or departing at night of the vicinity to, or when they are clear of, the Lonsdale Rocks. Vessels steering from sea to Port Phillip, and near the entrance, will first see the Point Lonsdale *Green Light* on a N.W. by N. ¼ N. bearing; and so long as they have it in full view they are to seaward of the Lonsdale Rock. When the two colours, *Red* and *Green*, begin

to blend, it indicates vicinity to the line which passes on a N.W. by W. bearing from the light on this danger.

When the Lonsdale *Red Light* opens out full, vessels are inside of them; and when they shut it in on a W. ½ N. bearing they are inside the Corsair Rock.

Vessels steering towards the West Channel will avoid the reef off Shortland's Bluff, and the bank between it and the Swan Spit, and also clear the Royal George Sand, when in their vicinity, by not opening the *Red* ray thrown from Queenscliff Low Lights. The two lights (*Red* and *White*) blended will clear these dangers. When above Royal George Sand, and when within three cables' length of Swan Spit Lightship, haul to the eastward, and open the *White Light* again (Queenscliff Low Light), and follow directions for West Channel.

Alteration of Queenscliff Low Light.—Officers in charge of vessels navigating the entrance to Port Phillip at night are particularly requested to pay attention to the alteration in Queenscliff Low Light. The alteration takes place on and after 1st November, 1886, and is described in "Note to Queenscliff Light" in Table of Lights.

Vessels navigating the South Channel are reminded that the low light on Shortland's Bluff now shows *White* from sea up the South Channel to the east end of Capel Sound.

Vessels below Capel Sound white perch buoy will be aided in their passage up or down the South Channel, and avoid the north side, by not shutting the light in, it being masked on a W. by N. bearing.

With a view to keeping the fairway to the West Channel clear, vessels of light draught are recommended, when anchoring off Shortland's Bluff, to bring up as close over towards the shore as possible, on the N.W. side of the fairway, indicated at night by the *Red* ray from Queenscliff Low Light; and by day the Swan Spit Lightship just open W. of No. 1 *Black* buoy.

Vessels of heavy draught should anchor on the S.E. side of the fairway, being careful not to open the *Red* ray referred to

above; and by day the Swan Spit Lightship just open W. of No. 2 *White* perch buoy.

Vessels about to anchor at night off Shortland's Bluff are requested to note that the low light shuts in on a W. by N. bearing.

After passing Upper Pile Lighthouse in West Channel, steer N. by E. ½ E. for the Lightship off Gellibrand's Point, which Point forms the western side of Hobson's Bay.

NOTE.—In the above directions, particular attention to the chart and lead is requested.

SHORT RULES FOR NAVIGATING THE WEST CHANNEL BY NIGHT.

Coming up the West Channel at Night.—After rounding Lightship, keep Pile Light on Starboard bow about a point until Lightship is on Starboard quarter, then Port your helm and bring Pile Light about half a point on Port bow.

NOTE.—Pile Light cuts *Red* and *White* over No. 5 black buoy in West Channel.

Going down West Channel at Night.—Port your helm, after passing Pile Light, till you bring Pile Light on Port quarter and Swan Spit Lightship on Port bow; keep them thus halfway through channel, and then bring Lightship on Starboard bow about a point; then keep close to Lightship until you are in *Red* ray from Queenscliff Low Light, and steer with it about a point on Starboard bow.

SAILING DIRECTIONS FOR GEELONG.

Inner Harbour of Geelong.

Point Wilson Shoal.—Ships bound to Geelong should steer from the West Channel Upper Lighthouse N. by W. six miles for the *Black* buoy, which lies in seven fathoms at the north end of Prince George Bank. When abreast of this buoy, and the extreme end of St. Leonard's Head (Indented Head) bearing S. ½ W., steer W. ½ S. until Point Richards bears S. by E., off which a shoal lies due north about three-quarters of a mile, with not more than 10 feet on its northern

end, which is marked by a *Black* buoy, bearing from Point Richards N. ½ E. in four and a half fathoms of water. When the latter is on with Point Richards, haul up S. by W. for the *White* perch buoy on the southern part of Point Wilson shoal, which may be passed on either side unless the vessel's draught of water exceeds 14 feet; in that case, round the buoy as close as practicable, leaving it on the Starboard hand. The course is then N.N.W. for the anchorage of Point Henry, about a mile off shore in four fathoms, with the middle of the town of Geelong just open clear of Point Henry; but if bound into the inner harbour, steer when you have the town open to bring the beacon on the Bird Rock to bear N.W. by N.; which will lead you down in three fathoms to the entrance of the Ship Channel, when the water gradually shoals to 16 feet within a few fathoms of the *White* buoy, which must be left on the Starboard hand. Then steer for the Lightship, keep it just on the Starboard bow until close to; pass her on the Port side, then haul up for the *Red* buoy, and bring it half a point on the Starboard bow, leaving it and all the *Red* dolphins on the Starboard hand, and *Black* buoy and *Black* dolphins on the Port hand. From there, a course may be steered S.W. by S. three and a half miles to the anchorage, at three cables' length to the northward of the wharves, in four fathoms water. This ground being soft mud, mixed with sand and clay, a long scope of chain is required in strong winds to prevent the ship driving.

Tidal Signals at Geelong.

(See Table of Tidal Signals.)

Sailing Directions for the New Channel into Corio Bay and Geelong Harbour.

The artificial channel across the extensive sand bank which fronts Corio Bay has been deepened to 18 feet at low water.

The channel is about one mile and two-tenths along in an E. by N. and W. by S. direction, and is 132 feet wide at the bottom, sloping to 165 feet at the surface at its narrowest part.

Entering from the sea, the edges of the channel are marked by *White* beacons on the Starboard hand, and *Black* beacons on the Port hand.

About half-a-mile from the east end the main channel is marked by *White* dolphins on the Starboard hand; and, about half-a-mile S.E. from the east end of the main channel, a passage 18 feet deep at low water, about a cable's length in a N.W. and S.E. direction, and half a cable wide, has been dredged across the neck of sand which forms the south-eastern side of the basin lying to the eastward of the bar. This passage is marked by four buoys—two *Black* on the Port side, and two *White* on the Starboard side.

The easternmost *White* buoy is cone shaped, and, as a distinguishing mark, is moored broad end down; it swims nearly upright, and is surmounted by a staff and ball. The other three are cask buoys.

The sailing directions for Geelong, included in the general sailing directions for Port Phillip, will be sufficient to guide navigators to the upright *White* cone buoy at the S.E. end of the outer cut; passing which, steer direct for the Bird Rock Beacon, taking care to keep it a little open to the westward of a gap in the trees N.W. of the rock until you begin to bring the line of *Black* beacons in one, which marks the new channel, when haul sharp up and pass through, keeping midway between the two lines of beacons.

As the tides, both flood and ebb, set across the entrance of the new channel, care must be taken that the vessel is kept under good command, and not horsed over on either bank.

Vessels drawing 20 feet can, by choosing a proper time of tide and employing steam, pass through this channel into Corio Bay close up to the Geelong wharves.

The height of water in the new channel can always be ascertained by adding eight feet to the height in the old channel, as indicated by the tidal signals hoisted on board the Lightship.

Vessels using the channel are especially cautioned to keep in remembrance its very limited width, and to use every

precaution to avoid collisions with other vessels, the buoys, or beacons.

To prevent accidents, although there is width enough for ordinary vessels to pass each other from opposite directions in this channel, yet it is advisable not to do so. Officers in charge of vessels are recommended, when they see another vessel entering the channel from an opposite direction, to wait outside either entrance until she has passed through.

Point Wilson Shoal.

A rocky bank, upwards of a mile in width, stretches due south from Point Wilson about three miles, with very irregular soundings, varying from ten feet to three fathoms. The *White* buoy on the southern end lies in four fathoms, with 16 feet within a ship's length to the northward of it.

Course between Hobson's Bay and Geelong.

Vessels bound to Geelong from Hobson's Bay, whose draught of water exceeds 14 feet, should steer S.W. ½ S. 24 miles from a fair berth off Gellibrand's Point Lightship for Point Wilson *White* buoy, bringing Point Henry to bear W. ½ S. before Station Peak bears N.W. by W.; then follow the directions already given above.

A fourth-class overend *Black* buoy has been placed four and a half (4½) cables off and due south of the end of the spit running off the north shore, midway between the Werribee and Little Rivers.

The buoy is one and a quarter (1¼) miles off shore, is in 15 feet at low water, and is six (6) cables' length inside a fairway course between Point Cook and the Point Wilson steamboat buoys.

Point Henry to Sea by West Channel.

Vessels leaving Point Henry for sea by the West Channel should steer E.S.E. for Point Wilson buoy, and from thence keep about a mile off shore until Point Richards bears S. by E., when haul up E. ½ N. for the *Black* buoy off Prince George Bank; a round hill, visible between the two highest hummock

of Station Peak, just kept open to the northward of the highest will carry you clear of the bank. After passing the buoy, steer S. by E. six miles for the Pile Light.

Point Henry to Sea by South Channel.

If bound to sea from Geelong by the South Channel, steer, after passing Prince George buoy, S.E, ½ E. 12 miles for the easternmost *Black* buoy, which is surmounted by a staff and ball; then follow the directions given for the South Channel outwards.

South Channel Outwards.

Vessels bound to sea from Hobson's Bay by the South Channel should steer from a fair berth off Gellibrand's Point S. ¾ E. 27 miles for the easternmost *Black* buoy off the Middle Ground, taking care to have the white cliffs bearing S.W. by W. before the top of Arthur's Seat bears S.S.E., and after passing the *Black* buoy on the Middle Ground haul up for the south white cliff until you bring the Pile Lighthouse open to the northward of the Observatory Point Flagstaff; then keep away from the Lighthouse, leaving it on your Port hand, when a W. ¾ N. course will take you down mid-channel, keeping the Pile Lighthouse on with the top of Arthur's Seat astern, and the knob on Point Nepean open to the northward of the Flagstaff on Observatory Point, leaving the *Black* buoys on the Starboard, and *White* on the Port hand, and when to the westward of Point King steer to pass midway between Observatory Point and Lighthouse, bringing the latter to bear N.E. by N., with which marks on, be guided by the state of tides in proceeding to sea.

Caution.—No vessel should anchor close to the Heads, except it be to save the vessel from going ashore.

Anchorage Inside the Heads.

The waters of Port Phillip spread over a surface of upwards of 800 square miles, three-quarters of which are available for anchorage. The depth nowhere inside the Lighthouse exceeds 15 fathoms; below them the bottom is rocky, and the

ground foul, with very irregular soundings. Off Point Nepean there are several deep holes, with 30, 40, and 55 fathoms water, and 8 and 10 fathoms close to.

Anchorage off the Lighthouse.

Vessels detained inside the Heads by contrary winds or tide may, during the northerly or westerly wind, anchor with the High Lighthouse bearing W. distant about a mile and a half, in from 6 to 7 fathoms. The bottom below the above bearings is rocky; at night, keep the Spit Light to the eastward of the West Channel Upper Pile Light.

Anchorage in Southerly Gales.

With a southerly gale, haul over under Point Nepean, abreast of the Quarantine Station, between Observatory Point and Point King, in about 10 to 14 fathoms, a mile off shore.

Not to Anchor in the Channels.

It is not advisable in bad weather to anchor in either the South or West Channels, on account of the tide and loose nature of the bottom; but in S.W. gales, small vessels will find good shelter under Swan Spit, in 3½ fathoms, the Upper Lighthouse just shut in with Swan Point, about half-a-mile off shore; and vessels bound up, and caught in the South Channel with a northerly or north-westerly gale, will find anchorage in Capel Sound by bringing the white cliff to bear S.W., and the top of Arthur's Seat E., in from 5 to 7 fathoms, sandy bottom; but, if daylight permits, it would be better to run back to the anchorage off the Lighthouses.

North End of the West Channel.

Ships detained with southerly gales at the north end of the West Channel will find good anchorage by bringing the Upper Pile Lighthouse, West Channel, to bear S. by W., just shutting in Station Peak with Indented Head.

Point Henry.

The best anchorage at Point Henry is with the hospital open clear of the Point, in 4 fathoms of stiff clay and mud, about three-fourths of a mile off shore.

Port Phillip Bay.

Vessels navigating the Bay above the Channels may, if necessary, ride with good ground-tackle in any part of it, there not being a greater depth than 15 fathoms all over the Bay, and the holding ground good; but the west side is preferable, as the wind usually veers from north round westerly to S.W., making it the weather shore.

Lead to be Always kept Going.

In these directions, it is taken for granted that, when a ship is under weigh in pilot waters, the lead will always be kept going. No officer can be held blameless who neglects so valuable a guide.

TIDES IN PORT PHILLIP BAY.

Time of High Water.

The tides are so much influenced by the prevailing winds, that only an approximate time of high water at full and change can be arrived at, which, with observations made at the undermentioned points, are as follows:—

High Water, Full and Change.		Vertical Rise and Fall.	
		Spring.	Nea
	H. M.	Feet.	Feet.
High water on the beach at Point Lonsdale	10 50	...	4
High water, mid-channel, between Point Lonsdale and Point Nepean	1 50	...	...
High water, Lightship, West Channel	2 10	4	3
High water, east end of South Channel	2 25	4	3
High water, Bird Rock, Geelong ...	2 30	3	2
High water, Point Gellibrand, and mouth of River Yarra	2 31	3	2

Flood Tides at the Heads.

Swan Point, West Channel, and South Channel.—The flood-tide comes from the southward and eastward, increasing in strength as it nears the Heads, setting right into the entrance across and through the opening in the reefs with great force, spreading towards Shortland's Bluff and Point King, and decreasing in strength as it enters the channels, setting towards Swan Point and through the West Channel in an oblique direction, trending towards the Duck Ponds and Indented Head, and above the upper Pile Light to the N.W.

across Prince George Bank, spreading from thence towards Geelong Bay, Point Cook, and Hobson's Bay. In the South Channel, the flood sets to the E.N.E. across the Middle Ground, through the Pinnace Channel, and spreads along the eastern shore towards Hobson's Bay.

Set of Tides, etc.

Set of Tides in the Bay: Set of Tide at the Heads: Rate of Tide at the Heads: Current at Hobson's Bay.—The ebb-tide sets out of Hobson's Bay towards the S.E. for a few miles, when it takes a more southerly direction towards Prince George Bank; thence trending through the various channels in any oblique direction, the stream from Symonds' Channel joining and turning that of the West Channel below the Royal George buoy, setting away towards the bight between Shortland's Bluff and Point Lonsdale; thence out between the Heads with great force, the body of the tide setting athwart the entrance towards Point Nepean, and away to the south-east, along the land and into the bight between Nepean Point and Cape Schanck, between two and three knots, and about a knot and a half in the Bay above the channels. In Hobson's Bay, during the winter months, there is always a surface current running out, owing to the freshes which run down the river; this current frequently sets along both sides of the Bay at the rate of two knots. The tide is weak in Geelong Bay, except in the ship Channel, where it sets two and a half knots across the bar, and becomes weaker as it spreads over Corio Bay.

Influence of the Wind upon the Tides.

The prevailing winds have a great effect upon the tides, both as regards their height and the time of high water.

A gale from the N.N.W., N., and N.E., will keep back the flood tide for an hour, or even an hour and a half, later than the time for calculation, and also decrease the height of the tide.

Winds from S. to S.S.W. considerably increase the height of the tides.

TABLE OF TIDAL SIGNALS.

POINT LONSDALE TIDAL FLAGSTAFF.

Flood Tide Signals.

A blue flag will be hoisted half-mast high when the tide begins to flow in the middle of the entrance between Point Lonsdale and Point Nepean; it will be kept flying all the first quarter of the Flood tide.

The second quarter—a blue flag at the masthead.
The third quarter—a red flag half-mast high.
The last quarter—a red flag at the masthead.

Ebb Tide Signals.

During the Ebb tide the signals are as follows :—

The first quarter—a blue flag half-mast high, with a ball underneath
The second quarter—a blue flag at the masthead, with a ball underneath.
The third quarter—a red flag half-mast high, with a ball underneath.
The last quarter—a red flag at the masthead, with a ball underneath.

PILE LIGHTHOUSE, SOUTH CHANNEL.

The following Tidal Signals are exhibited from the Pile Lighthouse, South Channel, indicating the depth of water in the deepest or northern side of the channel, in the vicinity of the Pile Lighthouse.

From Sunrise to Sunset.

	feet.
One blue flag	25
One ball	25½
One ball with blue flag over	26

	feet.
One ball with blue flag under	26½
Two balls	27
Two balls with red flag under	27½
Two flags with red flag over	28
Two balls with red flag between	28½
One red flag	29

FROM SUNSET TO SUNRISE.

	feet.
One green light	25
One white light	25½
One white light with green light over	26
One white light with green light under	26½
Two white lights	27
Two white lights with red under	27½
Two white lights with red over	28
Two white lights with red between	28½
One red light	29

GEELONG LIGHTSHIP.

The following Tidal Signals are exhibited on board Geelong Lightship to indicate depth of water on the bar :—

	feet.
One blue flag	10
One ball	10½
One ball blue flag over	11
One ball blue flag under	11½
Two balls	12
Two balls blue flag under	12
Two balls blue flag over	13
Two balls red flag under	13½
Two balls red flag over	14
Two balls red flag between	14½
One red flag	15

BEARINGS AND DISTANCES.

All bearings are magnetic.

—	Course.	Distance. Miles.
Gellibrand to Sea, by South Channel—		
Gellibrand to easternmost Black Buoy...	S. ¾ E.	27
Black Buoy to Pile Lighthouse ...	W. ½ S.	2¼
Pile Lighthouse to abreast of Shortland's Bluff	W. ¾ N.	9
Shortland's Bluff to Sea	S.W. ½ S.	
Gellibrand to Sea, by West Channel—		
Gellibrand to Pile Lighthouse	S. by W. ½ W.	20½
Pile Lighthouse to Swan Spit Lightship	S.S.W.	4½
Swan Spit Lightship to Sea	S.W. ¼ W.	
Gellibrand to Geelong—		
Gellibrand to Point Wilson Shoal White Buoy	S.W. ½ S.	24
Point Wilson Shoal White Buoy to Ship Channel	N.W. by W.	3¼
Ship Channel to New Cut	N.W.	½
New Cut to Anchorage at Geelong ...	S.W. by S.	3½
Geelong to Sea, by South Channel—		
Point Wilson Shoal to Point Richards	N.E. by N.	6½
Point Richards Black Buoy to Prince George Bank	E. ½ N.	5½
Prince George Bank Black Buoy to the easternmost Black Buoy	S.E. ½ E.	12

BEARINGS AND DISTANCES—*continued.*

	Course.	Distance. Miles.
To Sea, by West Channel—		
Prince George Bank to Pile Lighthouse (Directions as above through Channels.)	S. by E.	6
Point Lonsdale to Western Port—		
Point Lonsdale to Cape Schanck ...	S.E. ¾ E.	17½
Cape Schanck to abreast of West Head, 1½ miles off	E. by N.	8
West Head to abreast Red Rock ...	N.E. ¾ E.	7½
Red Rock to anchorage off Cowes ...	E. by N. ½ N.	
Point Lonsdale to Portland—		
Point Lonsdale to Cape Otway	S.W. ¼ W.	61
Cape Otway to Julia Percy Island ...	W. by N.	76
Julia Percy Island to anchorage at Portland Jetty, bearing W. by. S., distant ¾ of a mile	W. by N. ½ N.	19
Cape Otway, 3 miles off, to Warrnambool—		
Light Towers in one, North, leads into anchorage, two cables S.E. by E. ½ E. from end of Jetty	W. by N. ¾ N.	57
Cape Otway, 3 miles off, to Belfast—		
Anchorage, a cable's length N.W. of Black Buoy	W. by N. ¾ N.	67
End of Jetty about West two cables.		

APPROXIMATE DISTANCES INSIDE THE HEADS.

DIRECT DISTANCES.

From.	To.	Miles.
Gellibrand Lightship	Queenscliff, *viâ* Cole's Channel	26¾
,, ,,	,, ,, West ,,	26½
,, ,,	,, ,, South ,,	39
,, ,,	Capel Sound Buoy	27
,, ,,	Frankston	19
,, ,,	Schnapper Point	21
,, ,,	Dromana	27¼
,, ,,	Geelong, *viâ* New Cut ...	31
,, ,,	Queenscliff, *viâ* South Channel	21
Schnapper Point ...	,, ,, Symonds' ,,	17¾
,, ,, ...	,, ,, West Channel	19¼
,, ,, ...	,, ,, Cole's ,,	30
Geelong Wharf ...	,, ,, West ,,	30½
,, ,, ...	,, ,, South ,,	14¾
Dromana	Queenscliff Jetty	6¼
West Channel Upper Pile Light Queenscliff	Port Phillip Heads	3

INTERMEDIATE DISTANCES.

From.	To.	Miles.
Gellibrand Lightship	Point Wilson Outer Buoy ...	25½
,, ,,	,, Inner Buoy ...	22¾
,, ,,	Point Richards Buoy ...	19¼
,, ,,	Portarlington Jetty	19
,, ,,	Prince George Buoy	16¼
,, ,,	Upper Pile Light, West Channel	20½
Frankston	Schnapper Point	5¾
Schnapper Point ...	Upper White Buoy, West Channel	11½
,, ,, ...	Swan Spit, *vid* Symonds' Channel	16
,, ,, ...	Prince George Buoy	15½
,, ,, ...	Dromana	8¼
Dromana	Sorrento, *vid* Inside Channel	11
Sorrento	Portsea	1¾
Portsea	Queenscliff	4½
West Channel, Upper Pile Light	Capel Sound Buoy	11¾
West Channel, Upper Pile Light	Perch Buoy, West Channel	1½
Perch Buoy	Swan Spit	3
Swan Spit	Queenscliff Jetty	1¾
Prince George Buoy	Capel Sound Buoy	15¼
,, ,,	West Channel Upper Pile Light	5½
,, ,,	Point Richards Buoy ...	5½
Capel Sound Buoy ...	Pope's-eye Buoy	5½
Point Richards Buoy	Point Wilson, Outer Buoy ...	6¾
,, ,,	East Entrance, New Cut, over all	9¼
Pope's-eye Buoy ...	Queenscliff Jetty	1¾

INTERMEDIATE DISTANCES—*continued.*

From.	To.	Miles.
Point Wilson Outer Buoy	East Entrance, New Cut ...	3¾
Point Wilson Inner Buoy	,, ,, ,,	3½
Point Wilson Inner Buoy	Outer Buoy, Point Wilson ...	2½
Geelong, Length of New Cut	... ...	1¼
West end of New Cut	Geelong Wharf	3½
Hobson's Bay Railway Pier	Brighton Jetty	5¾
Hobson's Bay Railway Pier	Frankston	20½
Hobson's Bay Railway Pier	Schnapper Point	22
Brighton Jetty (old)	Frankston	14½
,, ,, ,,	Gellibrand Lightship ...	4⅔
,, ,, (new)	St. Kilda Jetty	3
,, ,, ,,	Sandridge Railway Pier ...	5
,, ,, ,,	Williamstown Town Pier ...	5

NOTICE TO MARINERS.

The following Notices to Mariners are published for general information:—

W. F. WALKER,
Commissioner of Trade and Customs.

Department of Trade and Customs,
Melbourne, Aug. 8, 1887.

Port Phillip Bay.

The attention of masters of vessels, pilots, and others is directed to the following alterations in connexion with the Lights and Fog Signal Stations in Port Phillip Bay, and which will take effect from the respective dates mentioned:—

New Swan Spit Light Vessel.

Referring to notice dated the 5th January, 1882, it is now notified that on and after the 12th day of September, 1887, the present Swan Spit Light Ship, exhibiting two red lights, will be removed, and will be replaced by a new iron circular light vessel, which will be moored in the same position, and from which will be exhibited one light.

The hull of the new vessel is 36 ft. in diameter, painted red, and is surmounted by a round iron tower painted white.

The light will be a fourth order fixed red light, with a dioptric illuminating apparatus, elevated 38 feet above the sea-level, and will be visible all round in clear weather at a distance of eight (8) nautical miles.

Fog Signals.—During thick and foggy weather warning signals will be given therefrom every five minutes, *i.e.*, by alternately sounding a gong with a bell.

South Channel Pile Light.

Adverting to notice dated the 13th of May, 1874, it is hereby notified that on and after the 8th day of September, 1887, a ray of white light will be exhibited from the South Channel Pile Lighthouse, and the centre of such ray will show over No. 15 Buoy, situate at the eastern entrance to the South Channel.

The existing red and white cuttings of the pile light remain unaltered, but the additional white sector will be visible when approaching thereto, on the following bearings, viz., W. by S. ¼ S. to W. ½ S. (magnetic), and is established for the purpose of enabling pilots and masters of vessels when nearing the eastern entrance to the South Channel from Melbourne or Geelong to ascertain the position of the pile lighthouse earlier than heretofore, and consequently to proceed with greater confidence towards the eastern or shore light until the red sector of the pile light is sighted.

The sailing directions for the South Channel remain unaltered.

GELLIBRAND POINT LIGHTSHIP—FOG SIGNALS.

Referring to Notice to Mariners dated the 22nd June, 1878, notice is hereby given that on and after the 3rd September, 1887, a system of fog signals will be established on board the Gellibrand lightship in lieu of those now authorized.

During thick and foggy weather warning signals will be given therefrom at intervals of five minutes, by alternately exploding one rocket and sounding the present Aurora foghorn.

WARNING.

The rockets explode at a height of about 600ft. above the sea-level, producing at the same time a sharp report, which should be heard, under favorable atmospheric conditions, at a distance of from five to six miles; but circumstances may arise to prevent even the most powerful sound signal from being heard two miles distant; therefore when the rocket signal is heard, it should be assumed that the source of the sound is not more than from 1 to 1½ miles distant, and the necessary precautions taken accordingly.

ALEXR. WILSON,
Engineer in Charge Ports and Harbours.

Department of Ports and Harbours,
Melbourne, August, 1887.

By Authority: ROBT. S. BRAIN, Government Printer, Melbourne.