The 9.2-inch Coast Defence Gun in Canadian Service

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Cover: Gun detachment taking post on a 9.2-inch Mk 10 gun on a Mk 5 mounting at Albert Head, BC (City of Vancouver Archives).

About the author:

Doug Knight is a retired Canadian Army officer with an ongoing interest in military history. His engineering degree and experience in the Royal Canadian Artillery and later in the Royal Canadian Electrical and Mechanical Engineers provide a solid background for his research into the history of equipment used by the Canadian army. As a gunner, he served in "Z" Battery, 3 RCHA, and both the 2nd and the 1st Surface-to-Surface Missile Batteries.

This book is dedicated to Roger Sarty, Ph.D.,
who is the expert on Canadian coast defence,
and who encouraged me to help tell its story.

Thank you, Roger.

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Introduction

Since the before the invention of gunpowder, sea-faring nations have fortified and protected their naval bases and major harbours. During the era of the smoothbore muzzleloading gun, defence was centred on a citadel, ringed with outlying works, each armed with a significant number of cannons. In 1826, Halifax had ten fortified batteries, equipped with more than 83 smoothbore guns. By the 1850s, the main coast defence guns fired a spherical 32-pound (~14.5 kilogram) shot to a maximum effective range of 1,500 yards (~1,370 metres).[1]

As time passed, technology changed, and rifled muzzleloading guns replaced the smoothbores. Spiral grooves (rifling) in the barrel gave the projectile a spin, which stabilized it during flight, increased the range, and improved accuracy. With the introduction of armoured warships, projectiles had to become larger and heavier to have the mass to smash though the armour. The spherical shot of the 32-pounder smoothbore gun was replaced by the cylindrical 250-pound (~113.4 kg) armour-piecing shot of the 9-inch (228-millimetre) rifled muzzleloader.

For almost a generation, the Royal Artillery refused to use breech-loading technology. However, as the weight of the large rifled muzzleloaders increased, change became imperative, and in the late 1800s, the British finally adopted breech-loaders. The rest of the empire had to follow along. Change was not instantaneous, and the development of the technology was not a smooth process but, by the turn of the twentieth century, major ports in the British Empire were protected by small calibre quick-firing guns, medium-sized close defence guns, and heavy, long-ranged guns to deter enemy battleships and other armoured warships.

By that time, in Canada, only Halifax, Nova Scotia, and Esquimalt, British Columbia, were defended with modern weapons. Both were Royal Navy bases, had a garrison of British troops, and Britain armed the ports with suitable coast defence artillery. At the top end, the heavyweights were the 9.2-inch (~234-mm) breech-loading guns that fired a 380 pound (~172 kg) shot to a maximum range of 15,000 yards (~13,700 m).

There were only a few of those guns in Canadian service. When Canada took over responsibility for the defence of Halifax and Esquimalt from the British in 1905, five 9.2-inch guns were in the country, but only three were mounted and ready for action. When they finally retired in 1954, there were eleven guns divided between three ports, supported by a few spare barrels.

For fifty years, and through two world wars, the 9.2-inch coast defence guns were the elite of the Canadian coast artillery. With them overlooking the harbour entrance, the ports they protected were never attacked by a major warship.

About This Book

Weights and Measures

Although Canada has officially used the Metric system for many years, most of the source material for this book is in British Imperial measurements. The guns went out of service long before the conversion to the metric system, so in this book, unless otherwise noted, the Imperial measure is authoritative.

For the modern reader, a conversion to metric units is included, and measurements will be listed in Imperial (metric) format. In many cases, the metric conversion has been rounded for readability, and also to avoid the impression of excess precision. For example, a maximum range quoted as 1,000 yards converts mathematically to 914.4 metres. However, the range of 1,000 yards is relatively imprecise because there are ballistic factors that come into play that can affect the exact range, yet using 914.4 metres implies a very precise value. Therefore, the metric conversion has been rounded to 915 metres and a tilde (~) added to indicate “approximately”. For example, 15,000 yards (~13,700 m). Unless high precision is necessary, this principle applies to all conversions.

The term “ton” is especially messy. The British ton had 2,240 pounds (20 hundredweights, each of 112 pounds); the American (and later Canadian) ton was 2,000 pounds (although when Canada actually moved from the Imperial to the American ton is a bit vague), and the metric tonne is 1,000 kilograms or 2,204.6 pounds (rounded). The handbooks are of British origin, so the term is traceable to the UK, but the the files are not always completely clear on which version they are using. In this book, unless otherwise noted, the term “ton” is the British 2,240-pound ton, which converts to 1.016 tonnes (rounded). To avoid the problem, whenever possible, I have used pounds (kg). If there is no conversion to metric, the value is considered sufficiently generic that ton and tonne are equivalent (for example, a 4,000-ton ship).

Range is another value that can be overly precise. The maximum range of a gun is calculated from firing data that is obtained from test firings. This is then corrected for non-standard meteorological conditions and published in a firing table. Most authors just quote the maximum figure in the table and leave it at that. However, the actual range depends on many ballistic variables, such as meteorological conditions (air speed and direction, air pressure, rain, etc.), minor differences in the weight of the shell, the actual propellant weight in the bag charge, the wear in the gun, and many other factors. I have witnessed two shots fired at the same bearing and elevation less than an hour apart, but with a major weather front passing through between the two shots. The nominal range of the first shell was about 10,000 metres; after the front went through, the second shell landed about 1,000 metres further away. The ranges used in the text are quoted from the source material. They are nominal values, and are also subject to the metric conversion rounding noted above.

Nomenclature and Terminology

During most of this period, British (and therefore Canadian) practice designated different versions of a piece of equipment by using the term “Mark” (Mk), followed by a Roman numeral. For example, Mark V, Mk IX, etc. On 23 June 1944, the numbering system was changed to use Arabic numerals (Mk 5, etc). For a modern reader, the use of Roman numerals has largely fallen out of use. Therefore, although the 9.2-inch guns were designated using Roman numerals for most of their existence, this book will use Arabic numerals throughout. For example, Mk 10 gun, Mk 5 mounting, etc. As noted, this is not strictly correct, but it should increase clarity.

Official British artillery terminology tended to be fairly precise. A gun barrel (the “ordnance”) can be mounted on different types of carriages, so British practice designated the barrel and carriage separately. For example, the official designation in 1906 was the 9.2-inch Breech-loading Gun Mark 10 on the Carriage, Garrison, Barbette, Mark 5, Land Service. The gun and carriage combination was referred to as the “equipment”, which could also include the tools and spare parts needed for its operation.

The “ordnance” (occasionally called the “piece”) included the gun barrel, breech block, breech screw and obturator (that sealed the breech from escaping gas on firing) , breech opening mechanism, firing lock and firing mechanism, and some minor fittings. Ordnance was sub-divided into categories: guns, howitzers, and mortars. A gun had a longer barrel, used a fixed size of propellant charge, and its shell had a long, flat trajectory. A howitzer had a shorter barrel, and used a variable-sized propellant charge in order to vary the the range and trajectory of the shell to be able to fire over hills and uneven ground. A mortar could only fire in a very high trajectory to lob shells over walls or other obstacles. Most coast artillery ordnance were guns.

Guns were further divided into “quick-firing” (Q.F.) and “breech-loading” (B.L.) types. By the 1890s, both were loaded from the breech end, but the propellant for a Q.F. gun was contained in a brass cartridge case, whereas the charge for a B.L. gun was packed in a tightly-bound cloth bag. Q.F. guns tended to be smaller than B.L. guns.

In 1906, the supporting structure for the ordnance was the “carriage”. The term “carriage” was used until about 1934, when it was changed to “mounting” for the static coast defence guns. Carriage continued in use for the mobile guns in the field artillery, and for a sub-structure in the mounting. The mounting included the complete support structure for the ordnance, including the mechanisms to elevate, depress, and traverse the gun, and absorb the recoil energy when the gun fired. The mounting also supported the sights, armoured shields and the loading mechanism.

The mounting was installed in an “emplacement”. By 1900, this was a concrete structure surrounded by earth, with only a small parapet visible above the ground level. Space was provided in the emplacement so that the gun detachment could operate the gun with some degree of protection. An underground magazine was connected to the emplacement and stored the ammunition. Later, as mountings became more complex, emplacements included rooms for power and hydraulic equipment, and were connected to the rest of the battery by covered tunnels.

This book is for a general audience and I will keep things simple, if not completely official. Unless otherwise noted, “gun” means the complete barrel and mounting. “Gun barrel” or “barrel” refers to the ordnance, and includes the breech, etc., as defined above. “Mounting” and “carriage” are considered equivalent, unless noted otherwise (mainly in Chapter 12), and include the entire support structure. “Emplacement” refers to the concrete and earth structure in which the gun was placed.

At different times during its life, the 9.2-inch gun was referred to as a medium or a heavy gun. These are relative terms. To the British, who had 12-inch (heavy) and 15-inch (super heavy) guns in service, it was officially a medium gun. In Canada, it was the top of the line, and was often referred to as a heavy gun. This is a Canadian story, and I will refer to it as a heavy gun.

Sources

This book is intended to be a reasonably readable account for a general audience, and not a heavy tome for historians. Endnotes have been added on occasion, usually to indicate a general source file for a section or chapter, but their use has been minimized for readability. A list of sources is provided at the end, including a location where the source may be found. Most of the information is based on files in the Library and Archives of Canada (LAC), or in the relevant equipment handbook. Handbooks were republished occasionally during the 50-year service of the gun, and specifications changed as the equipment was updated. Do not be surprised if different versions of the handbook quote different numbers for the same characteristic, especially concerning weights and ranges.

Chapter 1 - Coast Defence in the Late 19th Century

Until the end of the Second World War, the official Canadian defence policy was to to use British doctrine and equipment. To the extent possible, the equipment was manufactured in Canada, but this was not feasible for heavy artillery, which needed special tools and expertise. After Confederation in 1867, and for the rest of the nineteenth century, the British Royal Navy retained the responsibility for the seaward defence of the country beyond the three-mile limit, and the heavy guns inside the limit were designed and manufactured in Britain. Canada had little input into either process.

The Threat

The role of coast artillery is to defend a harbour against enemy warships, so it is not surprising that most coast defence guns are either a ship's gun on a land-based mounting, or a gun that has been developed from a naval gun. In 1856, a battleship was a wooden vessel of about 4,000 tons with a full set of masts, yards, and sails, and sometimes an engine capable of driving the ship at a speed of about ten knots. These ships were vulnerable to the heated shot (solid iron balls that had been heated in a furnace) and explosive shells that could be fired from a contemporary smoothbore cannon. However, in 1858, France produced the first ironclad warship (the frigate *La Gloire*), which was countered quickly by the British HMS *Warrior*. Spherical shot and shell had little effect on the hull of an ironclad warship, and this forced the development of the rifled breech-loading gun with its pointed and hardened armour-piercing projectiles. Under the contemporary British definition, a "shot" was a solid metal projectile and did not explode, whereas a "shell" contained a fuze and explosive. An armour-piecing projectile could be solid, or could have a small explosive charge that would be triggered after the armour was [theoretically] penetrated. Today, "shell" is used much more generically.

Warships increased in size and power and, by 1891, the modern British battleship HMS *Barfleur* displaced 10,500 tons. Its armour was twelve inches (305 mm) thick. Masts and sails had disappeared, and its coal-fired engines could drive the ship at a speed of eighteen knots (~33 kilometres/hour). Its main armament consisted of four 10-inch (25-cm) breech-loading (B.L.) guns, supported by ten 4.7-inch (120-mm) quick-firing (Q.F.) guns. In British terminology, a breech-loading gun uses a cloth bag propellant charge, and the breech is sealed on firing by the breech screw. In a quick-firing gun, the propellant is contained in a brass cartridge case, which expands and seals the breech on firing. In the smaller Q.F. guns, the projectile and case were often crimped together and loaded as a single unit. This significantly increased the rate of fire.

Another development in the late 1800s was the fast torpedo boat. A relatively light vessel displacing about 150 tons, it had a maximum speed of about 21 knots (~39 kilometres per hour), and carried several torpedo tubes and light guns. The torpedoes were a threat to any ship and, with the speed and agility of these small craft, warships in defended harbours were no longer safe. The heavy guns that were designed to counter armoured battleships were too ponderous and had too slow a rate of fire to effectively engage these fast-moving targets. So, starting about 1890, this threat was countered by small quick-firing guns, such as the Maxim one-pounder "Pom-Pom", and the 3-pounder and 6-pounder Hotchkiss guns. In the British system, smaller guns were named according to the weight of the shell they fired - a 3-pounder gun fired a 3-pound (1.36 kg) shell. Larger guns were designated by the diameter of the bore.

Defining the Response - The Owen Committee

To overcome the general chaos of British coast defence weaponry at the turn of the twentieth century, the British formed a Committee on the Armaments of the Home Ports in 1905 to examine the problem (the "Owen Committee"). The committee was primarily interested in the defence of the ports in the British Isles, but the logic of their assessment was also extended overseas.

It was assumed that Britain would have maritime supremacy. The committee, therefore considered that fixed defences did not have to provide permanent protection against a prolonged siege. They only had to hold out until the arrival of the Royal Navy, and be capable of inflicting sufficient damage that the enemy would be at a disadvantage when the navy arrived. Ideally, this would completely prevent an attack. However, if the prompt arrival of a British force was not certain, such as at a remote port, the defences had to be sufficient that the enemy would concentrate on less hazardous undertakings, such as attacking commerce at sea. The committee did not address the problem of naval landings, only the possibility of attack by warships.

The committee asked the Royal Navy to specify the threat, which was then separated into four classes or categories. Firstly (Class "A"), battleships armed with up to 12-inch (305-mm) guns could bombard a major naval base, which would have equipment and repair facilities whose destruction could have a major effect on the war. These engagements could be at an extreme range of up to 18,000 yards (~16,450 m), but a maximum of 10,000 yards (~9,150 m) was a more likely limit.

Secondly (Class "B"), armoured cruisers armed with up to 9.2-inch (234-mm) guns could attack a relatively undefended port, particularly if it contained a collection of shipping, or had special supply or repair facilities. However, this form of attack would be unlikely where the approach to the port involved navigating up a river or needing a skilled pilot.

Thirdly (Class "C"), an unarmoured cruiser or armed merchant ship equipped with 6-inch (152.4-mm) guns could attack shipping in a commercial port, or pursue a ship into the harbour. Given the number of potential enemy raiders, and the difficulty of finding them, this method of attack was considered to be quite likely. Related to this unarmoured threat, an enemy could attempt to block the entrance to a port or harbour by sinking a ship in a suitable location, or by mining the channel.

Finally, fixed harbour defences such as obstructions or booms, or ships in the port, could be attacked by high-speed torpedo boats, probably at night. However, the Royal Navy considered this to be an unlikely scenario at a commercial port.

In each case, the navy stressed that deterrence was as good as destruction. Because of the relatively small number and high value of major warships, an enemy would be unlikely to attack a port if it might result in the loss of even one ship. Unstated, but equally true, was that a commerce raider, far from home, could not afford to sustain any type of major damage, and would avoid any port that could defend itself.

To meet these threats, and to standardize the weaponry, the Committee recommended four types of guns. Against the Class "A" and "B" threats, the committee believed that the 9.2-inch Mark 9 and 10 breech-loading guns would be sufficient against all types of armoured ships. The 9.2-inch 380-pound (~172-kg) armour-piercing projectile could penetrate about six inches (~15 cm) of Krupp Cemented Armour (the protection standard at the time) up to a range of about 6,000 yards (~5,500 m). Also, considering the contemporary warship design, a large portion of any ship was unarmoured and vulnerable to a large lyddite (high explosive) shell. These projectiles could seriously damage any size of armoured ship, even a battleship with 12-inch guns. Although 12-inch guns had been proposed for some British coast defence sites, the angle of descent of the 9.2-inch projectile at long ranges (a major factor in the penetration of deck armour) was very similar to the 12-inch projectile. On the other hand, considering gun wear and rate of fire, the 9.2-inch gun was greatly superior to the 12-inch gun, and the committee did not recommend using anything larger than the 9.2-inch gun.

To meet the unarmoured cruiser (Class "C") threat, the committee believed the 6-inch (152.4-mm) Mk 7 breech-loading gun was adequate, and that high explosive shells would be more effective than armour-piercing projectiles. The gun could also be effective against ships being used as block ships or trying to penetrating a boom. They recommended that some 6-inch gun batteries should be supported by searchlights for night operations.

To defend against torpedo boats, the committee believed that the high rate of fire of the 12-pounder gun was a major advantage. However, they considered that the greater lethality of the 45-pound (20.4 kg) shell used by the 4.7-inch (120-mm) quick-firing gun overcame the disadvantage of its lower rate of fire. It had a greater range than the 12-pounder and could also be effective against block ships. The 12-pounder could be used as an enforcer for the Examination Service. In wartime, all ships entering a port were required to stop and be boarded to confirm their identity and inspected for contraband. If a ship did not stop, it would be fired upon by the 12-pounder. The committee noted that the 6-inch gun could also be effective against torpedo boats, especially if used with searchlights during a night engagement.

This was the recommended solution to the assessed threat in 1905. The committee went on to review in detail the defences of the individual British harbours. The main overseas bases generally followed the overall plan, although a few locations, such as Gibraltar and Singapore, had larger guns. Finances were always a consideration, but for the remainder of the coast defence era, including two world wars, the armament at a defended port in the British Commonwealth normally included 9.2-inch, 6-inch, 4.7-inch, and 12-pounder guns. This book discusses the 9.2-inch guns that the Royal Regiment of Canadian Artillery used to defend Canadian harbours for the next 50 years.

With the 9.2-inch calibre selected for the standard heavyweight coast defence gun, the British gradually standardized the weapons at their home ports and overseas. The calibre was already in service with the navy. The Mk 1 to Mk 8 9.2-inch guns were nineteenth century Royal Navy weapons, although a few guns had been transferred to the coast defence role when their ships were decommissioned. The 9.2-inch Mk 9 gun was designed about 1895 as a coast defence gun, but it had a rather complicated breech mechanism and only fourteen Mk 9 guns were built.

The 9.2-inch Mk 10 gun was introduced about 1900. It had improved rifling, and a more efficient breech mechanism. The Royal Navy eventually had 112 guns mounted in their ships, although twelve were later transferred to the army. Another 170 Mk 10 guns were built for the British Army, and they eventually became the standard counter-bombardment guns in the coast artillery. Since Halifax, NS, and Esquimalt, BC, were major Royal Navy bases until 1905, the British provided weapons and garrisons at each port. By 1905, two 9.2-inch Mk 10 guns had been installed at Sandwich Battery and a third at Fort McNab in Halifax. On the west coast, construction had started for the installation of two guns at Signal Hill on the east side of Victoria harbour. These five guns represented the counter-bombardment protection for the two ports for the next 35 years.

Chapter 2 - Canadian Coast Defence before 1905

After the War of 1812, the Rush-Bagot Treaty effectively disarmed the Great Lakes. Later, the Webster-Ashburton Treaty of 1842 and the Oregon Treaty of 1846 resolved outstanding issues with the United States and further lowered tension along the common border. However, the size of the forces raised during the American Civil War (1861-65) made it clear that there could be no effective landward defence against the United States. Strategically, this eliminated the Great Lakes as a coast defence issue, and the ice in Hudson Bay was a reasonable deterrent in the north. The Pacific Coast was largely ignored, so this left only the east coast ports and the entrance to the St. Laurence River to be protected.

After Confederation in 1867, the Canadian Government became responsible for the defence of Canada, although the Royal Navy retained responsibility for the seaward defence beyond the three mile limit. By the end of 1870, most British troops had left the country. The exception was Halifax, Nova Scotia, which continued to be the main Royal Navy base on the eastern North Atlantic coast. There, the British Government continued to provide a garrison, weapons, and gunners to man the major defences of the port, assisted by the local Canadian Militia. Later, a similar agreement was negotiated at Esquimalt on Vancouver Island on the west coast. These arrangements continued until 1905, when the responsibility for the defence of both naval bases was turned over to the Canadian government.

In 1867, the standard heavy coast defence gun in Canada was still the 32-pounder smoothbore gun firing a 32-pound (~14.5 kilogram) spherical shot, although ten 7-inch (~178-mm) Armstrong rifled breech-loading guns were in the country (but were not all mounted). The 32-pounder was large enough to seriously damage a major wooden warship. In addition, ships mostly constructed of wood (which still formed the vast majority of most navies) were especially vulnerable to fire, and shot that had been heated in a furnace was a significant threat. However, by 1840, France had naval guns that could fire explosive shells, and the Royal Navy had reluctantly adopted shell guns to complement their smoothbore cannon.

In Canada, there were major defences at Halifax, Nova Scotia, Saint John, New Brunswick, Québec City, and Kingston, Ontario. Other ports on the east coast and on the Great Lakes often had a Militia artillery battery with one or two smoothbore guns, some of which were quite antiquated. The inland defences gradually fell into disuse, although Kingston and Québec remained active as schools of artillery. Canadian coast defence was not a high priority with the parsimonious government and, by the end of the nineteenth century, the coast defence guns anywhere except Halifax and Victoria were essentially obsolete.

At the turn of the twentieth century, British defence policy assumed that, in any war, Britain would retain control of the sea. Major warships were powered by coal and, strategically, this required coaling stations all over the world. These needed to be protected from enemy attack, although the scale of defence depended on the strategic importance and facilities of the port. Realism intruded to the extent that it was accepted that there might be a short period at the beginning of a war when British control of the sea might not be absolute, so a major overseas base might need to defend itself for a period of up to three months before relief arrived. The contemporary coast defence terminology included the terms “naval base”, “supply port”, and “defended port”, although there were no official definitions.[2] A heavily-defended base with a major dockyard was considered an “Imperial Fortress”, of which there were officially four: Gibraltar, Malta, Bermuda, and Halifax.

Fortresses needed to defend themselves from both land and sea and were rarely monolithic structures. There was normally a citadel, or main redoubt, which was supported by detached batteries that covered specific passages or channels. On the landward side of the redoubt, there was usually a dry or wet ditch lined with steep masonry sides. The walls were low to minimize the effect of enemy artillery, and were designed in an intricate geometric pattern that ensured interlocking crossfire could be directed at an attacker. On the seaward side, the walls were stone structures or earthworks. Although, by the 1860s, tests had demonstrated the vulnerability of stone walls to the new elongated projectiles, a ship, being a moving platform, could not effectively concentrate its fire on a single point of the wall and batter it to dust. On the other hand, the fortress or battery needed a large number of guns to effectively engage a moving ship during the relatively short time that it remained within range.

Halifax was the major Royal Navy base on the northeast coast of North America. In 1903, it had a British garrison of 1,783 soldiers. It had a central defence position manned by the permanent garrison - the Halifax Citadel - and a collection of gun positions that were, rather interchangeably, called batteries or forts (for example, Ogilvie Battery or Fort Ogilvie). The gun positions were fortified to a minor extent and were sited to cover the approaches to the port. As weapons improved, new gun positions had to be constructed to make the best use of the new technology and increased range of the guns.

Britain first considered mounting breech-loading artillery at Halifax about 1886, with 6-inch and 10-inch guns being in place by 1896. Rearmament continued into the early years of the twentieth century, and by 1905, the port was defended by three 9.2-inch breech-loading (B.L.) guns, ten 6-inch B.L. guns, five 4.7-inch quick-firing (Q.F.) guns, and eight 12-pounder Q.F. guns. In addition, the port examination service, which boarded and inspected all incoming shipping in wartime, was supported by two 6-pounder Hotchkiss guns.

On the west coast, Esquimalt was rated as a defended port, not a fortress, but it was still a naval base and dockyard. A defended port was considered to be a supply station and refuge for commercial shipping. It was sufficiently armed to deter or defeat raids on the harbour by armed vessels or small landing parties, but was not expected to withstand an invasion.

The Royal Navy had used the harbour at Victoria, BC, for a long time, but the base had no permanent armament.[3] However, in 1877-78, the tension between Britain and Russia highlighted that Britain's only naval base on the west coast of North and South America was essentially undefended. Five gun batteries were quickly constructed using earth and timber ramparts, but the Commander-in-Chief of the Pacific Squadron, Admiral de Horsey, declared the new batteries to be inadequate. He recommended that a permanent garrison of Royal Marine Artillery, modern guns, and a submarine minefield be established at Victoria.

The threat of war declined, and it was 1893 before Canada and Britain reached an agreement. Between February 1894 and October 1897, two new batteries were constructed: one at Macaulay Point on the site of the earlier earthwork batteries, and another at Rodd Hill, a rock bluff overlooking the western side of the entrance to Esquimalt harbour. Each fort mounted three 6-inch Mk 6 breech-loading guns on a Mk 6 disappearing mounting. The guns were operated by the Royal Marine Artillery, who proof-fired the guns in late October 1897. A company of the Royal Garrison Artillery replaced the Marine gunners in 1899. In 1898, construction began on three more batteries of smaller, quick-firing guns. In 1905, Canada took over responsibility for the defence of the port at Victoria and the naval dockyard at Esquimalt. When the British left in 1906, they had already begun construction of the emplacements, and left behind two 9.2-inch Mk 10 guns that would be eventually mounted on Signal Hill, starting in 1912.[4]

Chapter 3 - Defending a Port[5]

The following description of the artillery organization of a defended port dates from 1914, but there were few significant changes after the reforms caused by the Owen Commission settled down. The Royal Navy, and later the Royal Canadian Navy, were the primary defence against enemy warships at sea, and were responsible for the provision of obstacles in the water, such as booms, mines, and breakwaters. In Canada, in the approaches to the port, the Royal Canadian Artillery manned fixed and movable guns that were the last line of defence. They engaged ships that evaded the navy, provided covering fire to protect the naval obstacles, and controlled the searchlights at night. This role was later expanded to include anti-aircraft defence although, during the Second World War, the AA gunners had their own organization in parallel with the coast gunners. The Royal Canadian Engineers were responsible for the construction and maintenance of the defensive works and supporting accommodations, water supply, generators for power and lights, and initially the telephone and telegraph lines. The Royal Canadian Corps of Signals later took over communications. Infantry regiments were responsible for the protection of vulnerable and critical points, and defence against landing parties.

Under the official British definition, Canada only had one fortress - Halifax. However, being the only Commonwealth naval base on the Pacific coast of North America, Esquimalt was also unofficially accorded the title. During the Second World War, with the increase in the number of defended ports, senior officer ego entered the picture and there was a certain amount of squabbling by the port commanders to get their defended ports also rated as fortresses. National Defence Headquarters (NDHQ) had other priorities and took the “OK - whatever - don’t see why not” approach to the problem. For practical purposes, all the defended ports in Canada had a similar overall organizational structure, and the terms “fortress" and “defended port” in this book are considered equivalent.

The senior army officer at the port was the fortress commander, who was in charge of all aspects of the land-based defence, and was the primary liaison with the navy. The guns were commanded by the fire commander. Guns were normally grouped into batteries. A battery usually consisted of two or more guns of the same type in a single location. However, depending on the layout of the defences, a battery could include different types of guns, different roles, and several locations.

A fortress included four or five types of permanently mounted guns. Heavy “counter-bombardment" guns, larger than 6-inch calibre, were sited to engage armoured ships at long range. These were supported by “close defence” medium guns (4.7-inch to 6-inch calibre) positioned to defeat lightly armoured or unarmoured ships. Small “anti-motor-torpedo-boat” quick-firing guns (less than 4.7-inch calibre) were positioned to deter small, fast unarmoured ships such as torpedo boats and (later) submarines, and they were assisted by light automatic weapons. These were official roles and definitions. In reality, the defence of the port was a coordinated effort where an attacker would encounter increasing levels of fire as he entered the harbour. If there was no long-range threat to deal with, there was no objection to a heavy gun smashing a motor torpedo boat, assuming it could be hit, and even light guns could damage an unarmoured target. Close defence and Q.F. guns were normally supported by searchlights for night engagements. In addition, as necessary, there were mobile field guns to protect the landward side of the fortress or port, and help the infantry deal with landing parties. In due course, anti-aircraft guns were added.

The Fire Commander

The fire commander, normally a lieutenant colonel, commanded all the artillery in the fortress, and tactically controlled the searchlights. He was normally located at the fire command post (FCP), which, ideally, was placed so that it could see all aspects of the defence. However, depending on the harbour layout, other fortress observation posts might be necessary to cover channels that could not be seen from the FCP. The fire commander was in direct telephone contact with all his battery commanders, observation posts, and searchlights.

The Battery Commander

The battery commander, normally a major, commanded the guns in a given location. Frequently, the guns would be of the same calibre (for example, 6-inch close defence guns), but it was not unknown for a battery to operate two types of guns in more than one role (for example, the two 9.2-inch and two 6-inch guns at Sandwich Battery in Halifax). In this case, each of the two groups would have a section commander reporting to the battery commander. The battery commander had a battery observation post where he could see his area of responsibility, and observe the fire of his guns. The battery observation post had optical instruments to establish the range to the target, and a plotting room to track the target and calculate firing data for the guns.

The Section Commander

In the battery, the guns were directly commanded by a section commander, normally a lieutenant, with a warrant officer class 2 (sergeant-major) as the assistant section commander. This worked well enough where the guns were in close proximity, such as Sandwich Battery or Signal Hill, but became more complicated when the guns were separated, such as at Devils Battery or Albert Head. In that case, it would be normal for the section commander to be with one gun, and the assistant section commander with the second gun. As will be noted later, the third gun in each battery was rarely manned.

The Gun Detachment

Each 9.2-inch gun was commanded by a non-commissioned officer, normally a sergeant, who was called the gun captain or the detachment commander (artillery gun crews are called detachments). He was responsible for all aspects of the operation of his gun. Each gun had two gun layers, one of whom tracked the ship though a telescopic sight on the mounting, or laid the gun on the required bearing if the ship could not be seen. The second layer set the elevation, deflection, and ballistic correction data on his sight, and then tracked the target for range. One of the layers also fired the gun on the orders of the detachment commander. The detachment included other gunners to load and supply ammunition to the gun. See Chapter 11 for details of the gun drill procedures.

Engaging a Target

Rangefinding

The accuracy of long-range artillery fire depends on the ability to determine the range to the target. This could be done by eye but, with the increasing range of coast defence guns at the beginning of the twentieth century, optical position finders and rangefinders were in general use. A depression position finder (DPF) was used with the 9.2-inch guns. It worked on the principle that the exact height of the instrument above sea level was known by survey data, and the angle from the DPF down to the waterline of the target ship could be accurately measured. From this, with a correction for the state of the tide, the horizontal range to the target could be calculated using trigonometry. Other corrections, such as for the curvature of the earth, could also be applied. Depression position finders had a theoretical maximum range of 20,000 yards (18,300 m) or more, but the instrument had to be placed sufficiently high above the water to be able to measure the angle to the target with the required accuracy. For example, the position finder at Sandwich Battery was 176.12 feet (53.7 m) above mean sea level and was effective from 1,400 to 14,000 yards (~1,280 to 12,800 m). This capability was degraded in mist, haze, and essentially non-existent at night.

Once the DPF had established the range to the target, the firing data (range and bearing) for the guns would be calculated, and one gun would fire a shot. The waterspout from the impact would be observed, and a correction issued to bring the impact onto the target. Another shot would be fired and the process repeated. Of course, the ship was moving, which complicated the process somewhat.

Optical rangefinders, such as the Barr and Stroud rangefinders that were standard equipment in the British Army and Royal Navy, were also used. Later, during the Second World War, towers were built near the guns and radar was used to determine the range and bearing to the target, which was a vast improvement over the optical devices, unless the radar was jammed.

Laying on a Target

Guns in a battery were laid individually on a target. Each gun normally had two gun layers: one responsible for tracking the target in bearing and the other for setting the range to the target. To engage a target, one of four different methods of gun laying could be ordered: “Automatic Sights”, “Case 1”, “Case 2”, or “Case 3” (contemporary terminology used Roman numerals). The method chosen depended on the visibility of the target from the gun, and the source of the rangefinding. (See “laying and firing the gun” in Chapter 11 for a full description of the methods of gun laying).

Engaging a Target by Day

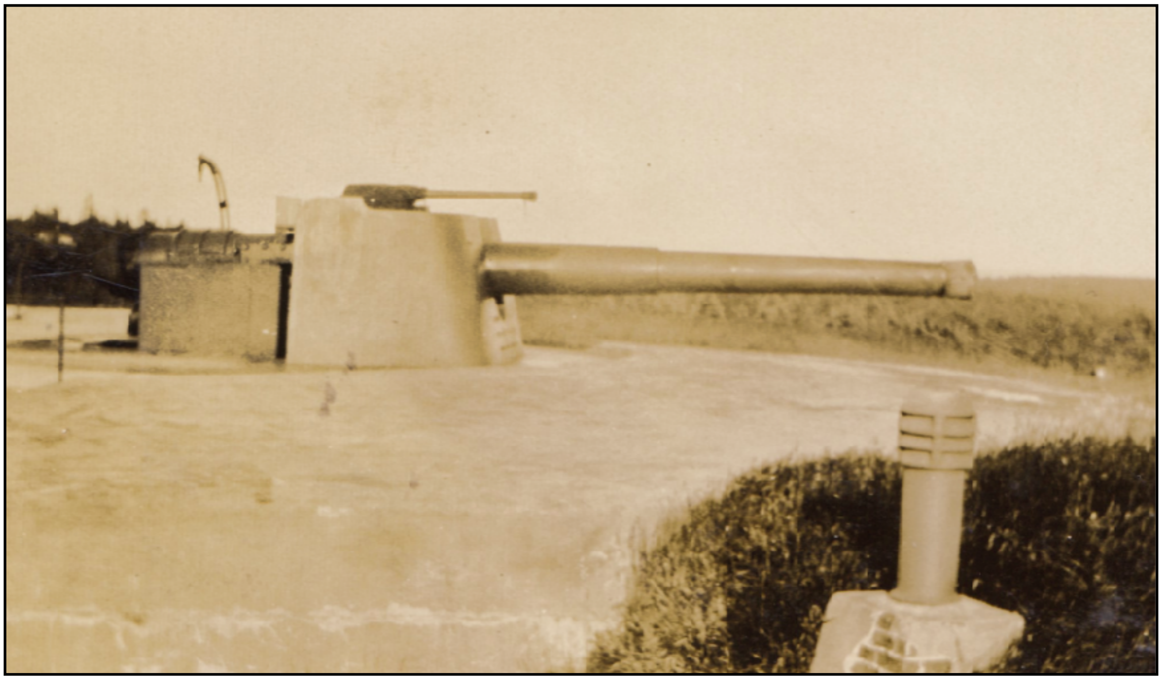
To engage a target in daylight, on arriving at his observation post, the battery commander ensured that he had communications with the guns, that the guns were manned and had ammunition, and that the rangefinding and plotting instruments were properly set up and ready for use. He then verified that any necessary corrections had been made to the range tables, such as calibration data, gun muzzle velocity, wind direction, and the state of the tide. When the gun detachments, or the section commander, reported that their guns were ready and that ammunition had been brought up from the magazine, he reported “ready” to the fire commander. After confirming the identification of the target, and having received orders to fire, he proceeded to engage the ship. There were two general types of engagement: “battery fire”, and “gun fire”. In battery fire, the guns were fired in succession from the right at intervals of a few seconds. This method was normally used to confirm that each of the guns had the correct target and range. Once this had been established, gun fire would be ordered and the guns fired independently under the control of the section commander or the gun captain, with range and elevation corrections provided from the command post as necessary.

Engaging a Target by Night

Engaging a target at night, or in conditions of reduced visibility such as fog, used a similar procedure as in the daytime, although before the advent of radar, long-range engagements were unlikely. A short reaction time was essential, and shelters were provided for the detachments in the immediate vicinity of the guns, allowing them to be quickly manned in the event of an alarm.

Until the advent of radar during the Second World War, coast artillery was severely handicapped at night. Guns assigned to the close defence role were supported by searchlights sited to illuminate the target area. In general, the lights fell into three categories: lights for general observation at the limit of the defences, diffused beam lights to illuminate a general area of water, and concentrated beam lights that lighted up a specific ship. If the 9.2-inch guns were supported by searchlights, they could be assigned a secondary close defence role, as at Albert Head Battery at Esquimalt.

Chapter 4 - The Early Years, 1905-1918



The 9.2-inch gun at Fort McNab, Halifax, about 1917. Robert Bedley.

The next four chapters give an overview of the history of the 9.2-inch guns in Canada. The emphasis is on the chronology, movements, and events affecting the weapon system as a whole. It should be kept in mind that, while this book is about the heavy counter-bombardment guns, each defended port also had 6-inch, 4.7-inch, and 12-pounder guns as part of the port defences, and during the Second World War, other types of heavy guns also served in the counter-bombardment role (see Annex A).

Halifax, Nova Scotia

When Canada took over responsibility for the defence of Halifax and Esquimalt in 1905, there were five 9.2-inch Mk 10 guns on Mk 5 barbette mountings in the country. Three were mounted in Halifax: two at Sandwich Battery and one at Fort McNab. The other two were at Esquimalt, BC, but the guns had not been installed in the emplacements.

Fort McNab

Construction of the gun positions on McNab's Island in Halifax harbour began in 1888 and was completed in 1892. The original armament consisted of three 6-inch Mk 4 breech-loading (B.L.) guns and one 10-inch Mk 1 B.L. gun. Two of the 6-inch guns on the right flank were replaced by 6-inch Mk 7 B.L. guns in 1903. A 9.2-inch Mk 10 B.L. gun (#L/264) on a Mk 5 barbette mounting (#A2488) replaced the third 6-inch Mk 4 gun on the left flank in 1904. Barrel #L/264 was manufactured in Britain at the Elswick Ordnance Company in 1904 and mounting #A2488 had been made at Cammell Laird, Limited, in 1903. The battery magazine was authorized to hold 75 armour-piercing, 175 high explosive, and 50 shrapnel shells. This was the configuration of the battery when it was taken over from the British in 1905. The British had planned to replace the 10-inch gun with a second 9.2-inch gun, but this never happened. The 10-inch gun was dismounted in 1911 and buried to the south-southeast of the emplacement in 1913. In recent years, it has been dug up and is on display at York Redoubt in Halifax.

Sandwich Battery

Fort McNab was supported by Sandwich Battery near Ferguson's Cove on the mainland on the western side of the harbour. The battery was built between 1900 and 1905 by civilian workmen supervised by Royal Engineer officers. To construct the position, the top of a solid granite hill was blasted away. The terrain to the north, south, and west was very rocky, with large patches of marshy ground. The land near the battery was uninhabited, with the nearest settlements being Ferguson's Cove one mile to the north and Herring Cove two miles to the southwest. The ground to the front of the battery sloped steeply to the shore and was considered impassable, except by infantry.

The battery consisted of two 6-inch Mk 7 B.L. guns and two 9.2-inch Mk 10 B.L. guns on Mk 5 Barbette Mountings (#L/224 on #A2300 and #L/286 on #A2301). The four guns were capable of all-round traverse, and could cover the land approaches to the southwest and west in the event of a land attack on the port The battery could assist in preventing hostile troops from landing on the west side of Halifax harbour from Chebucto Head to Herring Cove, and could also cover the west side of McNab Island. The 9.2-inch guns were not supported by searchlights, and were manned only in daylight.

The two 9.2-inch guns were mounted in 1906, and formed "A" section of the battery. The barrels and mountings had been manufactured at the Vickers, Sons, and Maxim Company in 1903. The guns were 206 feet (~63 m) above mean sea level. They could elevate from -4° to +15°. Their automatic sights had an effective range of 7,100 yards (~6,500 m). The height of the guns and their maximum depression limited the minimum range to 810 yards (~730 m) from the shoreline.

The two 9.2-inch gun emplacements were constructed of heavy concrete and connected by a covered concrete tunnel. The magazine was under the tunnel, with a projectile room adjacent to each gun, and a central cartridge room between the projectile rooms. The ammunition in the magazine varied over time, but the maximum storage was 250 armour-piercing shot, 250 high explosive shells, and 100 shrapnel shells, with the required number of propellant charges, fuzes, and primer tubes. There was a projectile and cartridge hoist from the magazine to the ground level in each emplacement, which was called the "pit". For ready-use ammunition, each gun had two covered cartridge recesses and a covered ledge capable of holding fifteen projectiles. The emplacements were open at the rear.

Before the First World War

When the British turned over the operation of the Halifax defences to Canada in 1905, No. 1 and No. 2 Companies of the Royal Canadian Garrison Artillery moved from Québec City to Halifax to take over the batteries. No. 1 Company manned the gun on McNab Island (and others), and No. 2 Company's responsibilities included the guns at Sandwich Battery (or Spion Cop Battery as it was known at the time). Because of funding restrictions, the coast defences at Halifax were manned to a minimum standard. Annual training was carried out, and live firing occurred most years - when it did not conflict with the fishing season! The annual Militia Reports usually indicated that the training was as good could be expected given the lack of funding. The officers were interested and the men were enthusiastic, but the two batteries were not at full strength and essentially unable to do more than provide a skeleton detachment for the guns. In 1912, 6-pounder sub-calibre guns were ordered as training aids for the 9.2-inch guns. This helped during the annual training, because it reduced the necessary safety restrictions when the guns were fired, and the ammunition was much cheaper. Nevertheless, for all practical purposes, the Canadian government paid little attention to the defences of Halifax until the First World War.[6]

Having been used mainly for summer training with tents for quarters, at the beginning of the First World War, the accommodations at Sandwich Battery were not suitable for permanent occupation. This resulted in the construction of a new barracks, washrooms, kitchen, and mess hall. In order to protect the gun detachments from rifle fire from the west and southwest, two concrete walls were constructed, and steel plates were fitted to the railings around each gun platform.

The weather in November 1914 was extremely cold every night. The guns were completely exposed to the elements and it was difficult to keep them in action. The Inspector of Ordnance Machinery (the ordnance engineering officer responsible for the maintenance of the guns) constructed sheet iron hoods that fitted over the breech of each gun. A small oil lamp was then put under the hood and its heat kept the obturator pads, which sealed the breech gases on firing, from freezing. Also, to keep the traversing and elevating gears from freezing, an oil heater was put inside each of the pedestals (the base of the mounting), and a sentry was ordered to traverse and elevate the barrel at least every 30 minutes, both by day and night.

The Barrel Choke and Cracking Problems[7]

At the beginning of the war, the guns were not really serviceable, although they could have been used in an emergency. In August 1913, the Inspector of

Ordnance Machinery (IOM) in Halifax reported that “choke” had appeared in the two Sandwich Battery guns at the second step in the barrel. He provisionally condemned the barrels. The IOM was the senior mechanical engineering officer in the supporting Canadian Ordnance Corps workshop. Large British gun barrels of the late 19th and early 20th century had an inherent flaw known as “steel choke”, which occurred after a large number of firings. The barrels were constructed with a liner that fitted inside the main barrel or “A” tube. This liner (the “inner “A” tube”) contained the rifling, and the drag of the projectile’s driving band as it went up the barrel caused the liners to be gradually stretched forward. In an extreme case, the resulting projection at the muzzle could be simply cut off but, in addition, the liners began to form a ridge inside the bore near the shoulders of the “A” tube (see Annex B for a detailed description of manufacturing a gun barrel). This ridge was sometimes known as “copper choke”, because it tended to accumulate copper from the projectile’s driving band. The ridge gradually constricted the bore and could, in an extreme case, slow the projectile sufficiently to initiate the fuze, with the result that a premature detonation would occur either within the bore or shortly after the projectile left the muzzle.

The IOM reported that the diameter of the bore at the choke point in both barrels was already below the limit for condemnation of gun barrels in the UK, and was rapidly approaching the limit for condemnation at foreign stations. The British had different standards for home and overseas use. Since the inspection, the guns had fired two series of five rounds and the choke in barrel #L/286 had become worse by 1/1,000 inch after each series. As a temporary solution, the copper had been removed chemically and the bore rubbed with emery paper, which would allow the guns to be fired safely. However, this method would not work indefinitely, and unless the choke was removed completely, the gun would be frequently out of action for decoppering. The gun on McNab Island was in similar condition, and the IOM recommended that a lapping (grinding) and milling machine should be obtained to properly solve the problem. On 20 August, the Canadian High Commissioner in Britain was requested to investigate purchasing the machine.

Although the IOM on the spot could recommend condemning the gun barrels, the final decision rested with Woolwich Arsenal in Britain, who were advised of the situation. On 25 October 1913, the Arsenal replied that the barrels should be considered unserviceable until they had been properly repaired. They considered that lapping and milling was the only method of restoring the barrels to within acceptable limits. Lapping (grinding) would restore the bore to its normal diameter across the lands (the raised part of the rifling). Milling would then re-cut the grooves of the rifling to their original state. A machine was ordered from the British War Office, at a cost of $6,570, which could lap and mill the 9.2-inch guns. Since the 6-inch guns at Halifax were also showing signs of choke, suitable adapters were ordered with the machine. The machine was ordered on 9 December 1913, with delivery forecast for August 1914.

This created another problem. The lapping machine needed a 100-volt 5,200-watt power source, and the closest electrical power to Sandwich Battery was at the searchlight station, about a mile away. Therefore a large truck-mounted electric generator was also ordered. In July and August 1914, the copper ridge was temporarily removed from all the barrels using an improvised grinder, which allowed the guns to be used in an emergency. However, this did not clear out the grooves, which meant that copper would quickly build up again.

Although Canada was officially at war starting in August 1914, Halifax reported to NDHQ in April 1915 that they had not started lapping and milling the barrels at Sandwich Battery, because the truck-mounted generator had not arrived. They proposed to start the project with the McNab Island barrel, because the island had its own electrical power generator.

There was obviously no sense of urgency, because on 24 January 1916, Halifax reported that the McNab barrel had been lapped and 14 out of 37 grooves had been milled. They estimated another five weeks to complete the project, and then the lapping and milling of the two barrels at Sandwich would take about seven weeks each. The latter was unlikely to start before 1 May, because of the weather. The generator truck finally arrived at the end of March 1916, and the barrels at Sandwich Battery were completed by early August. Over the next year, barrel #L/264 on McNab Island fired seven full and eighteen ¾-charges. Twenty-five rounds per year per gun was the normal allocation of ammunition for live firing practice.

On 16 December 1916, Halifax reported that barrel #L/264 at Fort McNab was again out of action. The IOM had examined the bore using mirrors and binoculars, and believed that the liner (the inner "A" tube) was cracked. Impressions (wax mouldings of the interior of the bore) had been taken and the cracks appeared to be well defined. The impressions were sent to Woolwich for confirmation of the condemnation. While reviewing the case, NDHQ were upset that the memorandum of examination (the gun history book) showed no evidence of the lapping and milling repairs. Halifax were suitably contrite for the lapse in paperwork. With the book updated, NDHQ then complained that the gun had been used for practice firing before the lapping and milling had been completed. Until that time, only emergency use had been authorized. By 17 January 1917, the accusations had settled down sufficiently that the Chief Inspector at Woolwich Arsenal was asked to confirm the new condemnation sentence. In February, Halifax advised NDHQ that the other two barrels (#L/224 and #L/286) also showed evidence of cracks. NDHQ asked the High Commissioner in London if they could get replacement barrels. He replied that there was no possibility of replacing the barrels, and suggested that Ottawa ask the Midvale Steel Company in the United States if they could reline the barrels. This turned out to be impossible.

In February 1917, even though its impressions had not arrived, Woolwich Arsenal confirmed the condemnation of #L/264. However, in March, when the Arsenal examined the impressions of the other two barrels, they concluded that there were signs of scoring, but no cracks. They deferred the condemnation of #L/264 until its impressions arrived. They again recommended lapping and milling. NDHQ advised Halifax, questioned the competence of the inspecting officer, and ordered that new impressions be taken.

In April, Halifax rebutted by stating that the inspection using a mirror and binoculars indicated a more severe condition than the impressions. The defects were so obvious that any inspecting officer would doubt the serviceability of the barrels. They quoted in detail the regulation that stated: “if there be any doubt as to the serviceable state of a piece [ordnance], it must be provisionally condemned pending the decision of the Chief Inspector, Woolwich”. They also quoted a similar paragraph from the 1908 Treatise of Service Ordnance. This time, Halifax forwarded a large number of impressions in order to have the best results, although they noted the weather conditions had been very bad for obtaining any accurate impressions. Remember that the guns were mounted in open emplacements completely exposed to the Canadian winter and kept in action by oil lamps under metal covers. Consider the difficulty of pressing hot wax into a crack or defect several feet up a nine-inch diameter tube (or even keeping the wax malleable enough to be pressed into a crack in a cold barrel).

This sort of arguing about the condition of the guns is a common theme in the coast artillery files. The technical inspector on the spot would examine a barrel, and based on measurements, the regulations, and his experience, would decide that a barrel was not serviceable. He would provisionally condemn the barrel, and request NDHQ to confirm the sentence. NDHQ might or might not have a suitably qualified artificer on staff to check the work, but they had an additional consideration - finance. Repairing or replacing a barrel cost money, which might not be in the defence budget. However, if the barrel was condemned, there would be an immediate operational deficiency, which, if not resolved, could be embarrassing, or worse if the gun had to be used operationally. If there was no money in the budget, it was often easier to refuse to confirm the condemnation and try to second guess the man on the ground. The extreme case was a 6-inch gun in Halifax that was damaged by a premature explosion in the barrel in 1923. It was provisionally condemned by the Halifax IOM, but the sentence was not confirmed by NDHQ. The argument as to whether the gun was serviceable continued until the late 1930s when the gun was transferred to the west coast. There, it was inspected and again provisionally condemned by the local IOM. The argument over serviceability of the gun then continued with the authorities on the west coast. The argument ended only when Canada got out of the coast artillery business in the late 1940s.

In May 1917, Woolwich reiterated that the barrels were scored but not cracked, although it was possible that the scoring could develop into cracks. The barrels were declared serviceable, but Woolwich recommended that they be re-examined after firing another ten rounds. Keep in mind that a cracked gun barrel could be a significant safety problem to the firing detachment, which would not apply to the experts in the Arsenal.

Halifax reported completion of the new round of lapping and milling on 25 July 1917, and noted that the cutters on the machine were completely worn out. NDHQ must have ordered replacements, because on 19 October 1917, Halifax complained that the replacement cutters were for the newer Mk 10 barrel with 46 rifling grooves, whereas Halifax had the original style of barrels with 37 grooves. NDHQ were asked to get the proper cutters. By the time the replacement cutters arrived at the end of December, it was too late in the season to proceed with the project without constructing a temporary structure around the guns with appropriate heating. The lapping and milling was finally completed in the spring of 1918, and the war ended with the guns considered to be fully serviceable.

Signal Hill, Esquimalt, British Columbia[8]

Mounting the guns at Signal Hill, Esquimalt, about 1912. The first gun appears to be basically assembled, with the tripod gyn still in place. The second gun barrel is being parbuckled (winched and rolled) up a timber roadway. The timber in the foreground gives an idea of the size needed for the ramp supports and rollers. Notice the complete lack of engines or power machinery. Fort Rodd Hill via Jack Bates.

On 5 May 1903, the [Victoria, BC] *Daily Colonist* newspaper reported that the British had started constructing emplacements on Signal Hill for two 9.2-inch Mk 10 Breech-loading guns on Mk 5 Barbette Mountings. The sites for the guns on the summit of the rock had been marked out in white paint. The roadway around the northern face of the hill and the new buildings at the foot of the hill were expected to be completed soon.

On 28 August 1904, the construction work was reported to be progressing satisfactorily under the direction of Major Bland of the Royal Engineers, and was expected to be completed in the near future. Royal Artillery gunners from Work Point Barracks would be trained to handle the 9.2-inch guns. By 13 November, while more rock still had to be blasted, most of the debris had been removed and the concrete work was about to begin. Some 6,000 square feet of concrete had to be laid before the guns, which were lying detached at the foot of the hill, could be mounted. The amount of rock that had been blasted out for the emplacements was sufficient to create the new roadway leading to the crest of the hill.

However, in February 1905, the Canadian Government announced that it would be taking over the defences of Halifax and Esquimalt from the British. The British garrison would start to be withdrawn on 1 July.

On 10 May 1906, Lieutenant Ellison of No. 5 Company, Royal Canadian Garrison Artillery, took over the Signal Hill battery. It had not been completed. The gun barrels lay by the side of the approach road, unprotected from the weather. The *Daily Colonist* reported that the emplacements were ready, and the Royal Engineers had been preparing to install the guns when Ottawa ordered the work suspended. Notwithstanding the Canadian government's agreement to maintain the Esquimalt defences at the same level as during the British era, it would be years before work continued.

For the next six years, no action was taken to mount the guns, or even keep the Esquimalt defences manned to the degree that had been agreed with the British. Despite many editorials in the press and urging from local officers, the Canadian Government firmly established its principle of neglecting its defences in peacetime, which continues to this day. Finally, on 7 December 1911, it was announced that the Royal Canadian Engineers of the Esquimalt garrison would install the guns on Signal Hill. What was not addressed was the men required to man the guns. At the time, the total strength of the Permanent Force for the entire province of British Columbia and the Yukon was approximately 150 all ranks. This was insufficient to man even a fraction of the smaller guns at Esquimalt, let alone the 9.2-inch guns.

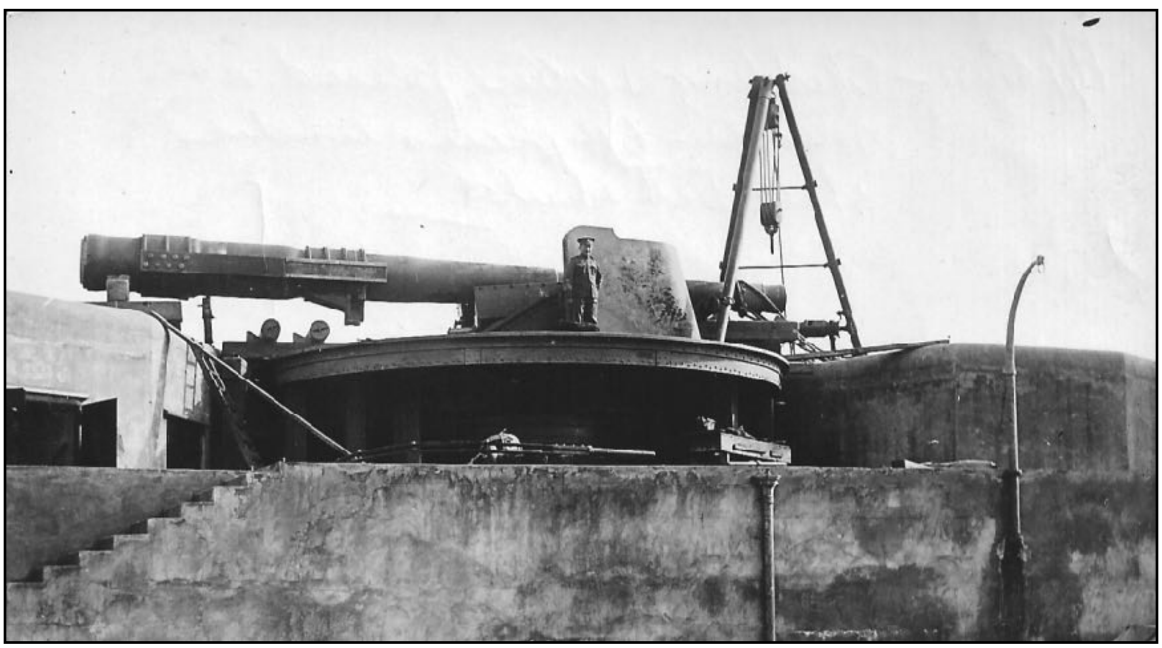
On 26 March 1912, Captain W.B. Almon and a detachment of 35 non-commissioned officers and men from No. 4 Company, Canadian Garrison Artillery, in Québec City arrived to assist in mounting the two guns at Signal Hill. The *Daily Colonist* noted that the local gunners had already moved about 90 tons of material up the hill (not quite one gun - a complete barrel and mounting weighed about 125 tons).

The newspaper announced on 12 August 1914 that the 5th Regiment, CGA, would fire the first test rounds (probably proof rounds) from the 9.2 inch guns on Signal Hill at 6 p.m. that day. People living in the vicinity of the battery were warned to open their windows and take precautions against damage from the concussion from the firing. The tests apparently went well. One of the barrels, #L/220, had been manufactured at the Royal Gun Factory in 1903, and its mounting #A2302 had been made at the Vickers, Sons, and Maxim Company in

1903. The other barrel, #L/242, had been manufactured at the Elswick Ordnance Company in 1902, and its mounting #A2303 had been made at Vickers, Sons, and Maxim in 1903.

The first operational firing practice took place on 6 October 1915, when three rounds were fired from each gun. A six-foot-square (~1.8 m) canvas target was anchored at some distance off William Head at a range of 8,500 yards (~7,750 m) from the battery. The weather was clear, completely free from haze and smoke, and the gunners were able to see clearly. The first shot hit the water close to the side of the target, and the second hit about the same place. The third was "a trifle short" and to the right, but would have hit a ship-sized target. The three last sent columns of water into the air directly over the target. The shooting was declared to have been "exceptionally fine".

The people whose homes were in the immediate vicinity had been warned, and all their windows were opened to prevent them being broken. However, the residences of Major Moore and Major Belson, which were close to the guns, were damaged, with plaster being knocked from the walls of most of the rooms in Major Moore's house. The newspapers do not record any other firings during the war. This property damage on firing, and the subsequent restrictions on live fire training was one of the reasons why the Signal Hill battery was never a success.



Installing the guns at Signal Hill, Esquimalt, about 1912. The barrel has been rolled up on top of the emplacement and is supported by timber at the rear and by the cradle at the front. The next step will be to slide the barrel forward into the cradle. The man beside the shield gives a scale. The tripod on the right is an artillery gyn - it was the only method of lifting the equipment. No power machinery was used. Fort Rodd Hill via Jack Bates.

Chapter 5 - Between the Wars, 1918-1939[9]

The end of the war stopped most of the squabbling about the serviceability of the barrels at Halifax. Nevertheless, regardless of the interpretation of the details, the barrels were arguably not in good condition. Barrels were still not available from the War Office but, in 1921, Canada purchased three replacement barrels from the British Admiralty surplus war stock at ten percent of their cost price.[10] The two British services apparently did not share their resources. One barrel went to Fort McNab and two were mounted at Sandwich Battery. All the new barrels had more modern 46-groove rifling.

Replacing the Fort McNab Gun Barrel, 1921

Barrel #L/178 replaced #L/264 at Fort McNab during October and November 1921. It was not a new barrel. Manufactured by the Elswick Ordnance Company, #L/178 had been first installed somewhere in Britain in 1901. It was apparently then moved to a new location in 1912. In 1916, its inner “A” tube (containing the rifling) was replaced, and it then remained in storage in Britain until it came to Canada in 1921.

Installing a 28-ton barrel on an island was no easy task. The steam lighter *Kitchener* picked up #L/178 at the Halifax Gun Wharf on 4 October and carried it to the Range Pier on the island. At high tide, the large crane on the lighter placed the barrel on a temporary sleigh 70 feet (~21 m) from the head of the wharf. The barrel and sleigh were then manually hauled up the road, through Fort McNab’s eastern gate, and across a temporary timber built-up road to the emplacement. The rope tackle was attached to permanent holdfasts in the road and trees on either side of the road, and temporary holdfasts were easily driven into the ground where required. The working party consisted of one officer and thirty six other ranks. It took about 48 6-hour working days, although the report noted that the time could have been significantly reduced by increasing the number of men and working in shifts. The mounting was not changed or modified. The old barrel, #L/264, was placed in storage on the island (outside on wooden skids). Barrel #L/178 would remain in operation at Fort McNab until 1941, when it was moved to the new Devils Battery at Hartlen Point on a new Mk 7 mounting.

Replacing the Sandwich Battery Gun Barrels, 1921

The procedure was no less onerous at Sandwich Battery. There, barrel #L/334, made at Vickers, Sons, and Maxim replaced #L/224. Barrel #L/322, manufactured at the Elswick Ordnance Company, replaced #L/286.

The lighter "*Kitchener*" transported the barrels to Ferguson's Cove. Since the lighter could not be brought close to shore, a ramp was built into the water at low tide, and the lighter’s crane lowered the barrels onto the ramp. They were then separately parbuckled (rolled) up to the roadway using a winch. There, they were rocked up on thick wood beams at each end (the muzzle was raised a bit, supported on the timbers, then the breech end was lifted and supported, then the muzzle, etc). Finally, a 30-ton gun drug (a heavy cart for moving barrels) was pushed underneath, and the gun lowered onto the drug.

The bridge leading from the cove had to be reinforced and a timber corduroy road laid over it. Manually operated winches and crab capstans were used to move the barrel as far as the top of York Hill, with holdfasts being created whenever necessary, and the gun drug running on a plank roadway. Check tackles and brakes were used on downhill grades. For the rest of the way, block and tackle was used, with horses and men providing the power.

Barrel A/2 (#L/322) was mounted first, being rocked up from the gun drug onto timber skidding at the breech and muzzle. A ramp was built to the left of the concrete apron. The barrel was then parbuckled (rolled) up the ramp using a winch and a 6-inch (~15 cm) rope. On the top, the barrel was rested on 6-foot (~1.8 m) timbers and then rocked up on breech and muzzle skids. A crab-capstan with a 4-inch (~10 cm) rope then pulled the barrel forward.

The front and rear bands and sliding bars on the carriage were then installed (see the description of the mounting in Chapter 12). A permanent sleigh on 12-inch (~30 cm) oak rollers was then placed under the barrel, the breech and muzzle skids were removed, and the barrel "mounted in accordance with the *Coast Artillery Training Manual Volume 11, 1920*". Barrel A/2 (#L/334) was brought up the same way and installed on the second mounting. The old barrels were heavily preserved and left at the rear of the position.

All this work was carried out using block and tackle and manual labour.

The British Mk 6 Mounting

With the replacement of the gun barrels at Halifax in 1921, there were five 9.2-inch Mk 10 barrels on Mk 5 mountings and three spare (unserviceable) barrels in Canada. The mounted guns were essentially in preservation, although they were used for periodic training by the 1st Halifax Regiment, Canadian Garrison Artillery (CGA), and the 5th B.C. Regiment, CGA, in Victoria.

In 1916, the British had started developing a new Mk 6 mounting for the 9.2-inch gun. It had higher sides that raised the trunnions so that the gun could achieve a higher elevation (and hence greater range). The increased height forced changes to the gun shields and other parts. To increase the rate of fire, the loading gear was converted to a hydraulic system, which was powered by a gasoline engine. The Mk 6 mounting had a maximum elevation of 30º, increasing the maximum range to 21,000 yards (~19,200 m) using a 2 calibre-radius-head (c.r.h.) projectile, or 25,000 yards (~22,860 m) using a 4 c.r.h. projectile. The 2 c.r.h. projectile had a stubby nose, whereas the 4 c.r.h. projectile was more streamlined, had less aerodynamic drag, and better range. See Chapter 12 (Ammunition) for a description of c.r.h.

At the same time, because they had a large number of Mk 5 mountings in service, the British also prepared a design that converted a Mk 5 mounting to the Mk 6 standard. This was designated the Mk 6A mounting, and used many of the existing parts of the Mk 5 mounting. Although the new designs had been approved in 1918, Canadian artillery officers visiting Britain after the war noted that only a few Mk 6 mountings had been built. The gasoline engine powering the hydraulic system was replaced by an electric motor in 1927.

The 1929 Review

After the war, the British continued to work on new mountings for the 9.2-inch gun, but without any urgency. NDHQ was generally kept informed of new developments by reports from Canadian liaison officers and others undergoing training in the UK. Also, the British published a quarterly "*List of Changes in War Materiel and of patterns of military stores which have been approved and sealed with instructions relating thereto*" that described new or upgraded equipment in detail. However, few of the approved modifications were applied to Canadian guns and mountings.

During the summer of 1929, the Chief of the General Staff (CGS), Major-General A.G.L. McNaughton, ordered a review of the 9.2-inch gun mountings. The report was quite thorough. The Mk 5 mounting used in Canada was capable of 15º elevation, giving an extreme range of 15,000 yards (~13,700 m) using 2 c.r.h. projectiles, and 17,600 yards (~16,000 m) using 4 c.r.h. projectiles. The British Mk 6 or 6A mounting had a maximum elevation of 30º, resulting in a maximum range of 21,000 yards (~19,200 m) and 25,000 yards (~22,860 m) respectively, which was a significant increase.

From the Canadian viewpoint, converting the Mk 5 mountings to the Mk 6A version would increase the range and rate of fire at a lower cost than buying new Mk 6 mountings. However, the cost of conversion, which would also mean bringing the mountings up to date vis-a-vis the list of changes, would still be expensive. Also, the existing rangefinders and other fire control equipment service were limited to a range of 14,000 yards (~12,800 m), so new instruments would be needed, and the electrical system for transmitting bearing and elevation from the battery plotting room to the guns would have to be updated. Finally, because of the increased range, the current locations of the gun batteries might not be suitable, and the cost of building new emplacements could be very expensive.

The study noted that Britain was reportedly designing a new mounting with a maximum elevation of 55º, but no official announcement had been made and few details were available. The British Ordnance Board was also considering refitting their 9.2-inch guns with a liner that had a smaller propellant chamber. This could be a serious problem if it affected interchangeability of ammunition in existing weapons. Since Canada also had a large deficiency in the quantity of ammunition in stock, this could be a future complication.

A separate report noted that the expenditure of 9.2-inch gun ammunition from 1922 to 1929 inclusive totalled 20 Equivalent Full Charges (EFC) per year for the five guns (4 EFC/gun/year). An EFC was (and is) the equivalent of one round fired with a standard full charge, and it could/can be used to give an approximation of wear in a gun barrel. The guns frequently fired reduced charges in training, so an EFC was not necessarily an indicator of the number of rounds fired. For example, a ½-charge caused less than half the wear of a full charge, and it would take several rounds fired using ½-charges to make up one EFC. The actual rounds fired and the charges used were recorded in each gun's "memorandum of examination" (later called the "gun history book"), which gave a complete usage and maintenance history of the weapon. The 9.2-inch barrel had a theoretical life of 450 EFC, and on average, mathematically, the guns had 112 years of life left. The report was an academic study and did not consider other factors in determining serviceability. In reality, for the 9.2-inch barrels, barrel choke was a more frequent reason for condemnation than wear and erosion.

On 17 September 1929, General McNaughton sent a personal letter to the British Chief of the Imperial General Staff (CIGS) asking if the Mk 6 and 6A mountings were satisfactory and, if so, what would they cost? If not, were the British considering a new mounting? The CIGS replied that the Mk 6 and 6A mountings had been experiments to evaluate the use of power elevation and a power-operated shell hoist. Traversing the gun remained a manual operation. A maximum range of 27,000 yards (~24,700 m) was possible, but the increase in rate of fire had not been sufficient to warrant further work, and both mountings were considered obsolescent.

He noted that a new Mk 7 mounting with a maximum elevation of 35° was about to begin testing. It would have improved power elevation, and also include power traverse, as well as power loading and ramming. The maximum range with a 4 c.r.h. projectile was expected to be about 29,000 yards (~26,500 m), and he expected the mounting to achieve a rate of fire of three rounds per minute. The existing Mk 10 barrels could be used with the new mounting. The cost of conversion was expected to be about £7,000 per mounting. McNaughton took no further action.

In Britain, the development of the Mk 7 mounting continued. New features were added to the Mk 10 barrels that were to be used on the mounting. These included "air blast" that forced compressed air into the breech before it was opened after firing, in order to extinguish any remnants of burning propellant. Also, the vent (for the firing tube) was modified with a water baffle that sprayed cooling water on the obturator and breech screw after opening. The possibility of smouldering fragments in the chamber and the general heating of the metal components when firing was always a problem with large breechloading guns. The propellant was tightly bound and sewn into cloth bags. If a smouldering piece of propellant from the last shot was still in the chamber after firing and came in contact with the new charge, it could prematurely ignite the charge.

Also, if there was a long delay between firing successive rounds, the heat build up in the metal components could heat up and “cook off” the new charge. As a routine operation, the chamber was washed out with water between each shot, and wet cloths were placed over the open breech screw to reduce heat between firing each shot.

In November 1932, the War Office advised NDHQ that the Mk 7 mounting had passed its tests, and had achieved a rate of fire of three rounds per minute. They estimated the cost to convert a Mk 5 mounting to the Mk 7 design would be £9,000, plus another £2,700 to modify the gun shield.

In early 1933, as a result of the Baldwin Committee report on British coast defence policy, the War Office advised all the Dominions that the UK intended to upgrade all their 9.2-inch mountings at home and abroad to the Mk 7 standard. This would increase their maximum range to 29,200 yards (~26,700 m). The cost of converting one mounting had been estimated at £30,000, or £23,800 (each) for six mountings, if ordered at the same time. Given the price increase from a few months earlier, the cost accountants had obviously caught up with the engineers.

The War Office estimated that Woolwich Arsenal could convert about six mountings per year on a sustained peacetime basis. Since it was undesirable to strip coastal defences during the project, a float of Mk 5 mountings was needed in order to set up a production line. The UK had a few spare mountings, but they were only sufficient to meet British needs. If the Dominions wished to take part in the project, they would have to contribute mountings to the float. Their decision would have to be taken quickly, because the mountings selected for the float would have to be sent to Woolwich. It would also be possible to manufacture completely new mountings to the new standard, and the cost would not be much greater than the cost of conversion.

Although NDHQ examined the proposal, no action was taken to join the project. This was probably for financial reasons, but also, in informal conversations, senior British artillery officers had stated that the conversion programme was not their preferred solution, and had only been suggested because of the large number of existing 9.2-inch mountings. They much preferred a turret-style mounting, and a two-gun turret style Mk 8 mounting had been proposed.

Events in Britain 1933 - 1935

The Commonwealth Conference in 1932 had re-affirmed that the Dominions would use British equipment and doctrine, which effectively made Britain the sole supplier of coast defence guns (and other military equipment) throughout the Empire. However, that did not mean that the Royal Artillery had a clear doctrine and policy on coast artillery. Staff at NDHQ regularly studied the minutes of various British committees, trying to keep informed about their current thinking, but there was considerable confusion about British intentions.

About 1933, the British revised their overall standard for a coast artillery battery. In the future, each counter-bombardment battery would have three guns (instead of the current two). This created a better pattern of shot on impact when firing a salvo, and had a better chance of absorbing casualties and still keep a battery in action. The three guns should be at least 100 yards (~90 m) apart. The gun emplacements would be "shouldered" into the forward slope of a hill, and connected by underground cable tunnels that were large enough for men to pass easily through them. The tunnels would connect all the guns to a junction in the centre of the battery position. From there, other tunnels would lead to a power house and to command and observation posts. The power house would be 200 yards (~180 m) behind the guns, and would have two generators, each capable of powering all the guns. The observation posts would be sited where they could best observe the required arc of fire and control the guns. They would be weather-proof, but would not be armoured against shell splinters. Housing and administration buildings would be 400-500 yards (~360-460 m) behind the guns.

Each gun emplacement would have a working area about 40 feet (12 m) square, with a splinter-proof shelter for its detachment, and an underground magazine capable holding 90 complete rounds of ammunition. If the magazine was on the same level as the floor of the emplacement (i.e. shallow depth), then trolleys (small carts on rails) would move the ammunition into the emplacement through steel doors behind the gun. If the ammunition supply was by hoist directly from a deep underground magazine, then the point of delivery would be at the floor level in the emplacement pit. A narrow gauge railway would bring ammunition from outside the battery area to the magazines (remember that each shell weighed about 380 pounds (~172 kg)). The construction cost of a battery position in the UK was estimated at £55,000, exclusive of the gun and mounting, although this would be somewhat dependent on the location.

This was a new British policy, and it was not mandatory that Canada adopt these standards, nor was the Canadian government willing to spend the money. It was also intended for implementation in Britain, and took no notice of the Canadian climate. However, this specification formed the basis for the new batteries that would be eventually be constructed in Canada.

An NDHQ evaluation of the gun mounting modernization project and the new battery standard in November 1933 used the British cost estimates. However, the staff were uncertain if those costs included supporting equipment such as generators and cabling. There would certainly be additional costs for new fire control instruments, transportation, and accommodation. There was no argument that the five Canadian Mk 5 mountings needed to be updated, and taking part in the British modernization project could save money. However, because it would be a major multi-year undertaking, government approval of the funding would be needed, and McNaughton decided not to include the project in the 1934/35 budget.

In November 1933, the British revised their coast artillery terminology. All guns (not just the counter-bombardment batteries) were reclassified into:

> "Approved Armament" [guns that were in their assigned location and mounted, ready for use];
>
> "Fortress Reserve Armament (spare)" [a replacement for an approved armament gun, which was stored at its defended port];
>
> "Fortress Armament in Reserve and Allotted" [an unmounted gun that had an assigned wartime or emergency location, and that was stored at the defended port]; and
>
> "Unallotted General Reserve Armament" [reserve guns stored anywhere that could be sent anywhere].

The five mounted Canadian 9.2-inch guns were all classified as Approved Armament. The three spare barrels at Halifax were Unallotted General Reserve (although they were unserviceable until relined). In theory, Approved Armament guns had a ready supply of at least 275 rounds of ammunition per gun - a standard that was totally ignored by Canada.

On 24 January 1934, the British Royal Artillery Committee (RA Committee) reviewed a Vickers, Ltd., proposal for a new "turret style" 9.2-inch mounting, which would be similar to the Mk 2 turret for their 15-inch guns. The committee was not impressed. The arc of fire was limited to 260º, which would not be adequate for all coastal batteries. The mounting did not have power loading, would be expensive, and a prototype would have to be built and tested in the UK before it could be recommended for adoption by the Dominions.

In reviewing existing reserves, the committee believed that there were sufficient spare 9.2-inch Mk 10 gun barrels to outfit any new mounting that might be ordered. However, if a new or modified barrel was developed for a future mounting, it had to have an inclined vent, a powered breech mechanism, and use a larger firing tube (primer). After discussion, they recommended that Woolwich be asked to design a modification to convert the existing Mk 10 breech for power operation.

More importantly, the minutes of the meeting noted that the project to convert the Mk 5 mountings to the Mk 7 standard had started, and that nothing would be allowed to interfere with that project.

A month later, on 28 February, a technical meeting at Woolwich Arsenal discussed a proposed new [Mk 8] mounting, as well as various improvements to the Mk 7 mounting. The RA Committee approved the recommendations from this meeting on 25 April, and asked the Superintendent of Design at Woolwich to prepare sketches of the proposed Mk 8 mounting.

On 30 May, in response to the January meeting, Woolwich submitted a design for a power-operated breech mechanism. The RA Committee approved the conversion of a single Mk 10 breech mechanism for testing.

In the meantime, the Ordnance Committee had been investigating the need for an inclined vent that would include a water baffle, and a larger primer tube for the barrels on the Mk 7 mountings. In June, they recommended that an existing Mk 10 breech mechanism be modified for trial. This was approved, but on 27 June, the RA Committee restricted the future use of a power-operated breech to the Mk 8 mounting. The Mk 7 breech would remain manually-operated.

Priorities changed at the annual British Coast Artillery Conference, in November 1934. After a review of the current situation by the Superintendent of Design at Woolwich, the Director of Artillery decided that production of design sketches for the Mk 8 mounting would take precedence over improvements to the Mk 7 mounting. (Design sketches are very preliminary drawings using very rough calculations. They cannot normally be used for production.) It was understood that the Mk 8 design would also be a conversion of the Mk 5 mounting. It would follow on from the existing conversion project and would try to maintain the level of production. The conference recommended that production of the Mk 7 mountings should be curtailed as much as possible, and that the design of the Mk 8 mountings should be expedited so that manufacture of the new mountings could start in 1936/37. So much for the policy from the previous January that nothing would interfere with the conversion project.

In December, when the Director of Artillery approved the recommendations of the Coast Artillery Conference, he asked when Woolwich would be able to supply the drawings. In response, the Superintendent of Design at Woolwich Arsenal stated that sketches of the Mk 8 design would be completed by 4 March 1935.

On 11 March 1935, the RA Committee examined the sketches of the Mk 8 design, as well as sketches of its proposed emplacement. The committee did not consider the design completely satisfactory, but deferred detailed criticism until decisions could be made on the required thickness of armour protection, and the acceptability of exposing personnel while manually loading the gun (the long rammer required a large platform behind the breech).

By the end of the month, the Director of Artillery had concluded that the proposed Mk 8 design was not satisfactory. In its defence, he believed that the design had been hampered by the requirement to use existing parts from the Mk 5 mounting. In his opinion, a turret style mounting would be more efficient with better weather and poison gas protection. It might be more expensive, but could reduce the cost of the emplacement. Changing the material for the gun shield (for example, using mild steel or bulletproof plate instead of armour plate) might also provide a cost saving. He asked the Ordnance Committee to investigate the required protection against shell splinters. The committee quickly reported that a 1-inch (~25 mm) thick vertical panel of any material would not provide the required protection, and began trials to find a solution.

In April 1935, NDHQ asked the War Office if it would be possible to modify a Mk 10 barrel to the standard required for the proposed Mk 8 turret, and still be able to use the barrel in a Mk 5 mounting. If so, what would be the cost to modify two barrels and include relining to remove choke. The reply noted that the experimental Mk 8 mounting had been abandoned, and the design for a proposed new [Mk 9] mounting was not sufficiently advanced to state if the new barrel could be used in an older mounting.

In September 1935, after a visit to the War Office, Colonel N.O. Carr reported to NDHQ that the Mk 7 was the only approved new 9.2-inch mounting. No others had progressed beyond the elementary design stage. The Mk 7 used the same pedestal as the Mk 5, with a modified central pivot and shell pit shield. Everything else on the mounting was different. Existing Mk 10 barrels could be used with the Mk 7, with the only change to the breech being the fitting for the air blast mechanism. Everything on the mounting was power operated, except the breech. A Mk 10 barrel could be relined and brought up to modern standard, and still be used on the Canadian Mk 5 mountings. The time required to reline a barrel would be about nine months plus transportation time. Although unintended, considering the highly volatile circumstances in the UK, McNaughton's lack of action had probably saved Canada considerable confusion and money.

The Esquimalt Review, 1935

By the mid 1930s, NDHQ had realized that the defences at Esquimalt were unsatisfactory, and should have priority in any modernization programme. The location of the 9.2-inch guns on Signal Hill was completely unsuitable, and training was restricted because the muzzle blast of the guns was a threat to windows and plaster in the town below. A new site at Albert Head to the south of the port had been examined and proposed for the port's counter-bombardment battery.

In March 1935, the gun barrels at Esquimalt were carefully inspected. They were more than 20 years old, although they had not been heavily used. Considering the wear on the inside of the barrel, they had a probable remaining life of 360 rounds, if "choke" was not considered. However, they were subject to the same choke problems as the Halifax guns during the First World War, and both barrels were close to the choke limit. The minimum acceptable diameter of the bore was 9.161 inches, and they had been measured at 9.181 inches in 1929.

One solution would be to replace the inner liners in the three unserviceable barrels at Halifax, including removing the shoulders that caused choke, and enlarging the chamber to make it suitable for all types of cartridges. This would cost about ￡1,800 per barrel. If Canada was to take part in the British conversion project, then the relined barrels could be returned with the new or converted mountings to Esquimalt, after which the barrels and mountings presently at Esquimalt would be sent to the UK for conversion.

Relining the Reserve Guns

In January 1936, the Canadian Master General of the Ordnance advised the DND Deputy Minister that the guns at Signal Hill at Esquimalt were too shortranged and poorly sited, and recommended construction of a new battery at Albert Head. The battery would include three modern guns, with rangefinders and suitable fire control instruments to achieve a maximum range of 30,000 yards (~27,400 m). In the short term, the two guns at Signal Hill would be relocated to the new site.

To properly equip the new battery, the three reserve barrels in Halifax would be sent to Britain to have their inner "A" tubes replaced ("relined") and brought up to modern standards at a cost of $33,300 including transportation. It would be necessary to acquire three modern mountings ($504,600 tentatively), and procure rangefinders and other support equipment (cost unknown, but probably considerable). Other costs would include appropriating land at Albert Head (cost unknown), and constructing the new battery emplacements, magazines, and other structures ($300,000).

The Deputy Minister approved the project and NDHQ asked the Canadian High Commission in London in February 1936 to get an official cost estimate from the War Office for relining the three unserviceable barrels.

Canada (and the other Dominions) did not normally deal directly with British manufacturers. Instead, a request was sent to the War Office (WO) for a specific piece of equipment, based on the British Catalogue of Ordnance Materiel. The procurement document was called a War Office Requisition (WOR). For items that were not included in the catalogue, the Canadian High Commission in London would submit the request to the War Office and assist in working out the details. The WO then either provided the equipment from stock, or let a contract to the manufacturer. The WO was responsible for the contract to produce the equipment, the detailed specifications, any necessary testing and quality assurance, and arranging for shipping. This ensured that British equipment was standardized throughout the empire, with the downside being that the receiving country had little say in priority or costs. In general, a piece of British equipment demanded on a WOR would be provided at cost plus a 15% fee. Whenever possible, Canada obtained the drawings and specifications from the War Office, and manufactured the item in Canada. For example, many of the gun carriages for the Canadian field artillery and all of their supporting limbers, wagons, and gun tools were produced at the Ottawa Car Manufacturing Company. However, in the 1930s, this was not feasible for large coast defence guns.

In March 1936, NDHQ advised the Headquarters of Military District No. 6 in Halifax that funding to reline the barrels of the three unserviceable Mk 10 barrels (#L/224, #L/264, and #L/286), and modify their breech mechanisms to accept air blast, had been included in the 1936-37 Departmental Estimates, which had been placed before parliament. The barrels were still in storage at the battery locations. Halifax was to prepare an estimate of the cost, time, and any special equipment or facilities that would be needed to move the barrels to the dock in Halifax and prepare them for shipment to Woolwich Arsenal in Britain. Halifax replied that it would take one officer and forty men approximately 18 days to move the barrel from Fort McNab to the Range Pier on the island, and 90 days to move the two barrels from Sandwich Battery to York Beach. Then, the lighter *Kitchener* would move the three barrels to the gun wharf at the dockyard. The SS *Alfreda* and one tug would be needed to tow the *Kitchener.* It would take 7½ hours to move the barrels from the beach and the island to the gun wharf at an estimated cost of $745. Including repairs to the Range Pier, the total cost was estimated at $4,627.25. Then the fun began.

NDHQ was not impressed with the estimate and sent a rebuttal on 7 April. Why had the estimate not included the use of modern tractors? A gun drug (a specialist trailer for moving large gun barrels) was available in Halifax - why was it not being used? In 1921, the McNab barrel had been moved from the pier to the fort in four days using timber skids and manual tackle, so why would it take four times as long to take it out? Why was it necessary to repair the Range Pier, when the *Kitchener* had a crane and could pick up the barrel from the beach? NDHQ ordered that Halifax should start moving the barrels from the parapets to the roadway behind the batteries immediately.

On 18 April, Halifax explained that they had considered the use of the gun drug, but not a mechanical tractor. At Sandwich Battery, this could save 24 days time and $30.48. The cost of the military labour to move the guns was definitely not being included in the estimate. However, at Fort McNab, the problem was moving the barrel from the parapet to the outside of the fort, not in moving it from the fort to the shore. A tractor was not feasible due to space problems. The repairs to the pier were necessary because the water at high tide was not sufficient to allow *Kitchener* to move close to the beach. Finally, work could not start immediately because it would affect the approved annual training plan.

NDHQ summarily closed the discussion on 24 April by stating that the preliminary movement of the barrels to the embarkation point would, in itself, be good training in a rare coast artillery procedure, and that they would arrange for the necessary changes in the training schedule. Halifax was ordered to immediately begin moving barrels to a location where they could be picked up by *Kitchener* when Parliament approved the funding. The discussion itself had taken more than a month.

The High Commission confirmed on 14 May 1936 that the barrels could be relined at a cost of approximately ￡3,200 each, with delivery about 14 months after the work started. On 15 June, the Minister of National Defence requested authority from the Governor General to reline the three barrels at a cost of $33,300. On 16 July, NDHQ advised Halifax that the funding had been approved for WOR #7244, and ordered them to move the barrels to the embarkation point with the “utmost despatch”. By 11 August, the three barrels were ready for loading, and were shipped to Woolwich on the SS “*Artigas*” on 21 August 1936.

This started the process of modernizing the five original barrels, but no funds had been allocated to take part in the British mountings conversion project. Nevertheless, NDHQ staff continued to examine options and gather data.

The Cost of Upgrading a Battery

The mountings at Esquimalt also needed to be modernized, but it was not feasible to completely eliminate the counter-bombardment defences at the port while the mountings were sent to Woolwich for conversion. In February 1936, NDHQ asked the High Commission in London to investigate getting two Mk 7 mountings from the conversion project, with the promise that the two Mk 5 mountings at Esquimalt would be returned to the UK after the Mk 7 were delivered. In other words, first get the new mountings and then replenish the float. In May 1936, the High Commission replied that this was possible, but the actual mountings that would be converted would have to be removed from another British overseas location. This would take time, and it there would be further delays after they were delivered to the UK before the conversion work could start. The conversion would cost ￡17,750, plus an addition ￡4,750 for Mk 5 mounting parts that would have to be taken from British stock in order to complete the work. There would eventually be a credit for the Mk 5 parts from the Esquimalt mountings. To save money, they suggested that Canada should return only the parts that could be used in the conversion and scrap the rest. The estimated credit would be￡3,900 per set of parts, if they were fully serviceable.

At the same time, the High Commission provided a detailed list of fire control instruments that would be needed in a modern coast defence fortress.[11] However, they could not estimate a delivery time because the equipment was not in stock and would have to be ordered from the manufacturers. At the fortress level, the fire command post (where the officer who commanded all the guns in the fortress was located) needed a type "R" position finder (￡550) and a No. 3 Mk 1A stereoscopic telescope (￡60). The fortress plotting room needed a cross-observation plotting table (￡450) and a fall of shot encoder (￡18). Each fortress observation post needed a No. 3 Mk 1A stereoscopic telescope (￡60), and either a depression position finder (￡550), or a No. 10 director (￡150) and a No. 10 (18-foot Barr and Stroud) rangefinder(￡1080). This equipment served the port as a whole, not just the 9.2-inch guns.

At the battery level, a 9.2-inch counter-bombardment battery plotting room needed a Mk 2B fire direction table (￡4,000) with a battery plotting room switch to control the wiring used to pass the data (￡170), a ballistic correction calculator (￡90), a No. 2A Mk 2 co-ordinate converter (￡550), and a coast defence predicting disc (￡10). Each battery observation post (BOP) needed a depression position finder adapted for electrical data transmission to the plotting room (￡610), two No. 3 Mk 1A stereoscopic telescopes (￡120), a fall of shot decoder (￡22), and a time of flight indicator (￡110). In addition, if the BOP was sited on low ground, a No. 9 (30-foot Barr and Stroud) artillery rangefinder would be needed (￡1,400). For a two gun battery, the electrical transmission gear included two No. 3 bearing receivers (one for each gun), two No. 3 range receivers, ten transformers with various ratings, a rotary converter, twelve alternating current control elements, twelve Mk 2 Magslips, seven terminal boxes, and two transformer boxes, for a total of £728. Short distance cables and junction boxes added another £100 and long distance cabling cost £150 per 1,000 yards.

This is a rather detailed list, but it illustrates that setting up a coast defence installation was not limited to the guns themselves. For the first time, it established the approximate cost of the new fire control equipment needed to upgrade each defended port. It did not reflect the full cost, because the quotation was only for a two-gun battery (which was all that had been requested), and the new standard was for three guns. On the other hand, depending on the layout of each port, some equipment might not be needed, but the total cost for the instrumentation alone was more than £10,000 per defended port - and this only included what was essential for the heavy counter-bombardment battery. Each port also had 6-inch, 4.7-inch, and 12-pounder gun batteries, all of which needed upgrading. And the estimate did not include other equipment such as power generators, searchlights and, above all, the cost of the infrastructure.

The letter from the High Commission also noted that the design of the Mk 8 turret mounting would not be complete for about two years. In the file, that comment is underlined with a big question mark. There was a lot of confusion about the Mk 8 designation. As noted above, the War Office had stated in 1935 that the Mk 8 mounting based on a Mk 5 conversion had been cancelled. However, another handwritten note in the file indicates that "there were several Mk 8 mountings". As will be discussed, the possible provision of a Mk 8 two-gun turret mounting continued into the Second World War, so the British must have continued development of an experimental mounting after removing the limitation that it be a modification of the Mk 5 mounting.

The Treatt Report and the Ultimate Plan for Coast Defence, 1936-37

On 8 March 1936, in defiance of the 1919 Treaty of Versailles, Germany reoccupied the Rhineland and the international situation deteriorated. With the government forced to take an increased interest in defence, DND asked the War Office to provide the services of a coast artillery expert to examine the Canadian defences. Major B.D.C. Treatt, MC, RA, came to Canada and visited the ports and installations on both coasts, accompanied by qualified Canadian officers. He submitted a comprehensive report on each port, recommending changes to the fixed defences that were necessary to ensure the security of the harbours and other potential enemy targets. His reports were generally accepted by NDHQ. He did not visit Québec city, which indicated the NDHQ evaluation of the strategic importance of the port. Several entries in the files indicate that arming Québec was considered a political requirement, not an operational necessity.

In 1937, the Government announced that the defence of Canadian coasts, seaports, and railway terminals would be a high priority. Based upon the Treatt Report, the Chiefs of Staff Committee prepared a plan for the fixed defences on both coasts. This plan was approved by the Minister of National Defence, and became known as the Ultimate Plan for Coast Defence. It included all calibres of coast defence artillery, but this book will consider only the heavy counter-bombardment batteries.

The Ultimate Plan called for seventeen 9.2-inch guns to protect the four defended ports in Canada. Four new batteries would each have three guns on new mountings that could elevate to 35º, which significantly increased their range. Devils Battery would be constructed at Hartlen Point in Halifax, NS; Oxford Battery at Sydney, NS; Mispec Battery at Saint John, NB; and Albert Head Battery at Victoria, BC. After the new guns were installed, three of the five existing 15° mountings would be moved to Lingan Battery at Sydney, and the other two to a new battery on Trial Island near Victoria. Taking part in the British mountings conversion programme was obviously not being considered.

Based on the requirements for the Ultimate Plan, three Mk 7 mountings for Albert Head Battery were ordered in fiscal year 1936/37 on War Office Requisition (WOR) #7329. At the same time, the fire control equipment for that battery was ordered on WOR #7330. It was planned to use the three Mk 10 barrels being relined in the UK on these mountings. This order would later cause confusion, because the British thought that it was part of the conversion project and that three Canadian Mk 5 mountings would be returned. However, the Canadian intention was to get new mountings for the three spare barrels. In March 1938, the War Office stated that the three Mk 7 mountings would be available in 1939/40.

More orders followed in fiscal year 1937/38. Two Mk 10 barrels were ordered as spares for the east coast (WOR #8394), and one for the west coast (WOR #8395). Three new Mk 10 barrels on Mk 7 mountings were ordered for Saint John, NB (WOR #8396), three Mk 10 barrels on Mk 7 mountings for Devils Battery in Halifax (WOR #8397), and three Mk 10 barrels on Mk 7 mountings for Oxford Battery at Sydney, NS (WOR #8398). Also, 750 rounds of ammunition were ordered. However, the British advised that it would be several years before they could fulfil these orders. This caused the Ultimate Plan to be modified.

The Interim Plan for Coast Defence, 1938

As a result of the long delivery time for the equipment, an “Interim Plan of Coast Defence” was prepared early in 1938. This plan redistributed all the available guns in Canada, from both army and navy resources, to provide the best possible defence at each port. The guns would be installed in permanent emplacements that would be designed for the ultimate armament, but modified to temporarily use the existing guns. This would allow an easy and inexpensive transition to the Ultimate Plan when the new guns became available.

Under the Interim Plan, the two 9.2-inch guns at Signal Hill in Esquimalt would be moved to Albert Head. Both Sandwich and McNab Batteries at Halifax would remain operational until guns were available for the new Devils Battery. Two naval 6-inch guns from the scrapped cruiser HMCS *Rainbow* were moved to Sydney, NS, to provide some protection until 9.2-inch guns were available for the new Oxford Battery.

Although Saint John, NB, was considered a commercial port and had the lowest priority, the dry dock at Courtney Bay was the only facility on the Canadian east coast capable of repairing major warships, and had to be protected. When, as a temporary measure, the British offered three 7.5-inch guns that had been removed from a scrapped *Hawkins* class cruiser for Mispec Battery, they were quickly accepted. Construction was authorized on 24 August 1939 and the guns were operational by July 1940.[12] The batteries at Lingan and Trial Island were postponed.

Construction of the new battery at Albert Head started in 1937. Since this was the first Canadian battery to be constructed to the new British standards, there were many details to be worked out. (Indeed, since the British had constructed Sandwich, McNab, and Signal Hill batteries, Albert Head was the first heavy battery designed and constructed by Canadians.)

Unlike previous batteries where the guns were very close together, under the new system, the three guns were separated by about 100 yards (~90 m). In theory, if no corrections were applied, when a salvo was fired, the three shells should impact the sea with the same pattern and separation as the battery on the ground. This was a significant dispersion when shooting at a ship. Because of this, a "pivot gun" in the battery was selected as the gun for which the basic fire control calculations (range and bearing) were based. To engage a point target, corrections could be applied to the bearing and range set on the other two guns to converge the salvo on a point. At Albert Head, it was decided that No. 2 gun (the centre emplacement) should be the pivot gun, because the two flank guns could see and lay initially on its sight to get all three barrels parallel. The locations of the pivot on each gun (the metal bearing about which each gun rotated on its mounting - not to be confused with the pivot gun of the battery) were accurately surveyed in relation to each other in order to calculate the corrections.

The two Mk 5 mountings would eventually be replaced by three Mk 7 mountings, and the trunnions of the two mountings were at different heights. Therefore the survey data for the automatic sights (see Chapter 12) was based on the height above mean sea level of the base of the pedestal and not on the trunnion height. A special correction then had to be applied to the automatic sight on each gun. There were many other details to be resolved, but these give an idea of the factors that had to be considered when constructing a new coast artillery battery.

Ammunition was expensive, and firing the main guns in practice involved sea closures and range safety problems. To train the gunners, sub-calibre guns and aiming rifles were often used to ease the range control problem. For the 9.2-inch gun, a 6-pounder sub-calibre gun could be attached to the mounting and aligned with the main barrel. All the normal gun drill procedures would be carried out, but on the order to fire, the 6-pounder would be fired instead of the main armament. The target distance was scaled down to the 6-pounder's maximum range of about 4,000 yards (~3,650 m). There was a very large difference in the cost of the ammunition, which allowed more live firing in training. As part of the new equipment, three 6-pounder sub-calibre training guns were ordered for the battery. To train the gun layers, an aiming rifle could be mounted inside the gun. The gunners aimed the gun using their normal procedures, but actually fired only a large-calibre rifle bullet that was bore-sighted in the main barrel. However, at Albert Head, except for No. 3 gun, the terrain prevented the use of the standard 1-inch aiming rifle.

On 25 March 1938, War Office advised Canada that one of the three 9.2-inch Mk 10 barrels that were in the UK to have their liners replaced had been completed. The second would be ready in April, and the third in May. Each barrel would then require a month for proof firing and inspection. Notwithstanding the War Office estimates, the barrels were not shipped to Esquimalt until 2 September 1938. The estimated completion and delivery dates from the War Office were rarely met. As soon as they arrived, the two barrels from Signal Hill (#L/220 and #L/242) were removed from their mountings and shipped to the UK to be relined. The War Office estimated that this would be carried out during 1939/40, after which they would be delivered to Halifax. The two mountings at Signal Hill were moved to and installed at Albert Head in early 1939, using locally manufactured adapters for their Mk 5 mountings. Two of the relined gun barrels were used, with the third remaining in storage pending arrival of its Mk 7 mounting.

In peacetime, the guns were frequently place in preservation and the sensitive or expensive parts removed and placed in storage. At Halifax, Sandwich Battery was used for summer training and Fort McNab was essentially unused. However, early in 1939, at Fort McNab, the gun stores were returned from storage and the position finder was remounted in the observation post, allowing the battery to become operational on short notice.

In Britain, the conversion programme for the Mk 7 mountings was being carried out at Woolwich Arsenal. However, it eventually became obvious that the project was beyond the capabilities of the Arsenal and, on 25 October 1938, the War Office asked the Dominions for a summary of their large gun requirements in order to make up an attractive bulk order for the large British armament firms. Canada did not reply to the request.

The Canadian Director of Mechanization and Artillery, Colonel N.O. Carr, met with British officers at the War Office in London on 26-27 August 1939. It was immediately apparent that there was confusion about the overall Canadian requirements for heavy guns. Including the five mounted guns in Canada and the three barrels being relined, the British summary of the Canadian War Office

Requisitions indicated a total requirement for 21 9.2-inch barrels (two more than required) and seventeen mountings. Carr did not have copies of the relevant paperwork and was unable to clarify the requirements on the spot. However, he was able to clear up the confusion over the three mountings for Albert Head. The British believed that these mountings were part of the conversion programme and that three Mk 5 mountings would be returned from Canada in exchange. After discussion, the British agreed that they had misunderstood that the original requisition had been for new mountings for the three spare barrels that had been relined, and that Canada was not committed to return any Mk 5 mountings in return for the Mk 7 mountings for Albert Head.

However, the WO were adamant that they would not supply any *further* Mk 7 mountings without the return of an equal number of Mk 5 mountings. Carr argued that this would mean that Canada could only get another five Mk 7 mountings, whereas six were needed for two three-gun batteries to meet the new *British* standard. The WO finally agreed that they would consider a request for one mounting [implied with gun barrel] without replacement, but the requisition would have to be placed quickly. In summary, if Canada agreed to return the five Mk 5 mountings, the WO could possibly supply up to six Mk 7 mountings and barrels by December 1942. In case of an emergency, the Mk 5 mountings might not need to be returned immediately on receipt of the Mk 7, and could continue in service for a few months.

Complicating matters, the British advised Carr that they were stopping production of the Mk 10 barrel. It would be replaced with an all-steel Mk 15 barrel that was being designed for the Mk 8 turret. The Mk 15 would be interchangeable with the Mk 10 except for the breech, breech bush (which locked the barrel parts together), and breech mechanism. When used with the Mk 8 mounting, the breech of the Mk 15 barrel would be power operated.

However, while a satisfactory breech mechanism could be designed to allow the Mk 15 to be used with the Mk 7 mounting, the current breech mechanism on the Canadian Mk 10 barrels could not be used unless the breech bush was changed as well (effectively completely rebuilding the barrel). If Canada bought the Mk 8 equipment, we would have two types of incompatible 9.2-inch barrels in service.

On the other hand, the British indicated that the Mk 15 barrels could be manufactured to be 100% interchangeable with the Mk 10 barrels in Canadian service, including the breech mechanism. These would be usable in the Mk 5 and Mk 7 mountings (but not in the Mk 8 mounting). Either way, there would be two major incompatible versions.

Carr's original report indicates a certain amount of technical confusion. Whether the confusion originated with Carr or the British is unclear, but the Mk 8 mounting was in the design phase and its technical details were probably still changing. The situation was not satisfactory, and the files contain many messages over the next few years requesting confirmation that the specific barrel that was about to be delivered would actually work in the Canadian mountings.

The British refusal to supply more than six Mk 7 mountings left one battery in the Ultimate Plan without guns. Furthermore, they could not predict when the new Mk 8 turret mounting would be available, but most likely it would be after 1942. This affected Saint John, NB, which had the lowest priority in the Ultimate Plan. The estimate of the very long delivery time for the Mk 8 turrets led to the acceptance of a British offer of three 7.5-inch guns from a scrapped *Hawkins* class cruiser that were installed at Mispec Point at Saint John in 1939/40.

Carr's report also reviewed the Canadian 6-inch coast defence gun requirements, but that is outside this story. During the meeting at the War Office, he concluded that the overall Canadian coast defence plan would have to be reviewed in light of the new information, and the War Office therefore stopped all action on Canadian requisitions (except for the three mountings for Albert Head). Ironically, as Carr noted in his report, the stoppage would not have much effect, since the delay in submitting the requisitions had put Canada at the bottom of the production list.

Within a week, Britain declared war on Germany, and all the rules changed.

Chapter 6 - The Second World War, 1939-1945

A 9.2-inch Mk 10 gun on Mk 5 Barbette Carriage, probably at Fort McNab in Halifax early in the Second World War. The 6-pounder Hotchkiss sub-calibre gun, and the auxiliary ammunition hoist can be seen above the shield. The men provide a scale for size. LAC 399220.

Following the German invasion of Poland on 1 September 1939, Britain declared war on Germany on 3 September, and Canada followed by declaring war on 10 September. The defence of Canadian coasts and harbours suddenly took on greater urgency.

On the other hand, the actual threat that would be countered by the 9.2-inch guns was not a major problem. In 1939, Germany had two modern battleships with 11-inch (28 cm) guns, two old pre-dreadnaught battleships with 11-inch guns, three “pocket” battleships with 11-inch guns, and two heavy cruisers with 8-inch (20.3 cm) guns. Given the superiority in numbers of the Royal Navy, the chance of them crossing the Atlantic with the objective of attacking ports in Canada was low. A greater threat would be armed merchant ships or submarines, both of which were a problem for the 6-inch close defence and smaller guns, not the heavy guns.

Possibly a bit of perspective is in order, lest it seem that the counter-bombardment batteries were merely window dressing. At the beginning of the war, in the British Isles, there were thirteen 9.2-inch Mk 5 batteries (27 guns total) and another three Mk 6 or Mk 6A batteries (six guns total). A further twelve Mk 5 batteries (20 guns) and five Mk 7 or Mk 9 batteries (fourteen guns) were installed in twelve overseas countries of the Empire, not counting the Dominions. At Dover, a new four-gun 9.2-inch Mk 7 battery was constructed in 1941. During the rest of the war, those four guns took part in about 70 engagements, fired 2,500 rounds of ammunition, and wore out 20 barrels. The group responsible for replacing the barrels became so experienced that the last barrel exchange for the four guns took six days, working only from dawn to dusk.[13]

On 2 September 1939, as a result of Carr's report about the British confusion, NDHQ compared the Canadian coast defence requirements to the existing War Office Requisitions. There were six 9.2-inch Mk 10 gun barrels in Canada, and two in the UK for relining. There were three barrels on order for each of Mispec Battery at Saint John, NB, (WOR #8396), Devils Battery at Halifax (WOR #8397), and Oxford Battery at Sydney, NS (WOR #8398). In addition, WOR #8394 ordered two spare barrels for the east coast, and WOR #8395 ordered one spare barrel for the west coast, for a total of 20 barrels. There were five Mk 5 mountings in Canada and a further twelve Mk 7 mountings on order, including the three for Albert Head. This made a total requirement for seventeen complete equipments and three spare barrels.

Under the Ultimate Plan, the five Mk 5 mountings would be redistributed to Trial Island and Sydney when the new Mk 7 mountings were delivered. However, since the War Office would not provide additional Mk 7 mountings [beyond the three on order for Albert Head] without the return of the Mk 5 mountings, the plan needed to be amended.

The immediate threat was to the east coast, so NDHQ staff recommended that the three new Mk 7 mountings on order for Albert Head be redirected to Halifax and installed at the proposed Devils Battery. The three Mk 5 mountings at McNab and Sandwich Batteries could then be sent to the UK for conversion. This would allow the three Mk 7 mountings for Oxford Battery to be delivered.

The three Mk 7 mountings originally ordered for Devils Battery would be sent to Albert Head, and the two Mk 5 mountings currently at Albert Head would then be sent to the War Office for conversion. This assumed that the WO would allow the single new mounting to make Albert Head a three-gun battery.

Two 45° Mk 8 twin turret mountings would be ordered for Saint John and its three Mk 7 mountings would be cancelled. Once the Mk 8 turrets were installed, the three 7.5-inch mountings currently at Mispec Battery in Saint John would be sent to Trial Island. Three spare Mk 10 barrels were needed - one on the west coast and two on the east coast - plus a spare barrel of the new type for Saint John.

On 10 September, the minister approved the changes to the Ultimate Plan, and the diversion of the three new Mk 7 mountings from Albert Head to Devils Battery. At the time, neither Devils nor Oxford Batteries had construction funding in the parliamentary estimates.

On 25 September 1939, NDHQ advised the War Office of the new plan. Contractually, the delivery destination for WOR #7329 for Albert Head would be changed to Halifax. The revised details for the new "variable parts" would be sent to the WO as soon as possible. The variable parts were the parts of a mounting that were designed and manufactured for the specific site where it was installed. These included the cams for the automatic sights (which depended on the height of the trunnions above sea level), limits on the traverse mechanism that depended on the arc of fire, etc. The War Office replied that production of the variable parts would take six months from receipt of the data.

Mobilization of Sandwich Battery, 1939

On mobilization in 1939, the accommodation at Sandwich Battery was again found to be inadequate for permanent residence. Keep in mind that the battery included two 6-inch guns in addition to the two 9.2-inch guns and, at full strength, had a lot of gunners. The old kitchen and mess hall were too small and in poor condition. The barrack rooms, wash rooms, canteen, and sergeant's mess badly needed repair, and the buildings that housed the orderly room, battery commander's office, first aid station, and quartermaster stores were also unserviceable. Consequently, a considerable amount of construction was necessary,

During the fall of 1939, a new building to house the battery commander's office, orderly room, and guard room was built just inside the entrance to the fort. The lower part of No. 1 Barrack Room, which had been built into the side of a hill was closed in and converted into a quartermaster's store. The old orderly room and first aid station was remodelled into the fort hospital. The gunner's canteen, kitchen, and sergeant's mess were all enlarged.

During the spring of 1940, a new gunner's mess and kitchen was constructed outside the entrance to the fort. Later, a stage was added to the mess hall so it could serve as an entertainment venue as well. The latter work was a self-help project carried out by the personnel of 53rd Heavy Battery. The old gunner's mess was renovated and turned into a barrack room. A partition was erected in the sergeant's mess, creating a canteen. The old warrant officers and sergeant's canteen was then given to the junior non-commissioned officers (bombardiers and lance-bombardiers - equivalent to corporal and lance-corporal in the infantry). The old building that had been used at the outbreak of war as a quartermaster's store, and later converted to a recreation room, was completely redecorated and made into a recreation hall, including a dry (non-alcoholic) canteen. Reading material was supplied by Canadian War Services.

During August 1940, the officer's mess was renovated, with civilian workmen doing the carpentry work under the supervision of RCE personnel, assisted by members of the battery. The painting was carried out by 53rd Heavy Battery. The fort boundary fence was extended in the spring of 1941 to include the gunner's mess hall and kitchen.

All in all, a lot of construction work was carried out at Sandwich Battery.

The Mountings Procurement Problem

On 17 November 1939, the British reassigned to South Africa one of the mountings that was being manufactured for WOR #7329 (Devils Battery). There was no discussion with Canada before the reassignment, again highlighting the general British attitude towards the Dominions. A week later, the WO advised that they hoped to deliver the mountings for Devils Battery in June 1940. They stated that the existing capacity to manufacture heavy mountings in the UK was so strained that no delivery forecast was possible for the other Mk 7 and Mk 8 mountings on order. They noted that a simplified mounting was being investigated, and asked if Canada could manufacture the mountings or procure an equivalent mounting in the United States.

The situation was obviously not satisfactory and, on 5 February 1940, a high-level meeting at NDHQ discussed the possibility of manufacturing 9.2-inch gun mountings in Canada. Attendees included Major General W.H.P. Elkins, Master General of the Ordnance; Colonel Butler from the War Supply Board, and Lieutenant Colonel G.P. Morrison from the Directorate of Mechanization and Artillery. The meeting determined that there were four options:

(a) Manufacture complete Mk 7 mountings in Canada;

(b) Manufacture the proposed simplified Mk 7 mounting in Canada;

(c) Convert the existing Mk 5 mountings to Mk 6A mountings in Canada; or

(d) Procure these or equivalent equipments in the USA.

Colonel Butler noted that coast defence had a low priority in Britain, and the overall production forecast was not encouraging. The Mk 7 mounting was currently manufactured only at Woolwich Arsenal. The Arsenal was the original designer and had only produced informal drawings and specifications suitable for in-house manufacture. Those drawings were not adequate to transfer production to a third party. Vickers-Armstrong Ltd., had stated that they would need two years and the loan of key men from Woolwich before they could take over production. Although a simplified version of the Mk 7 mounting was being designed, it would be nine to twelve months before the design was complete.

Even when the Mk 7 or the simplified/modified Mk 7 drawings eventually became available, it would take nine months to adapt the 2,500-3,000 drawings for Canadian manufacturing processes before an order could be placed to build the Mk 7 mounting in Canada. Then, another two years would elapse before one or two mountings could be manufactured. And even then, Canada would still be dependent on Britain to supply special items. Manufacturing the mountings in the United States would mean converting all the drawings to American standards, which would take about the same time before manufacturing could begin.

The simplest option would be to convert the Canadian Mk 5 mountings to the Mk 6A configuration, for which production drawings were available. This could carried out in Canada by any large engineering firm, but the Mk 5 mountings would be out of action for nine or ten months while the work took place. Even then, this would not be a perfect solution. The Mk 6A mounting had a maximum elevation of only 30º, resulting in a range of 27,900 yards (~25,500 m). It was still loaded manually, limiting the rate of fire to 1.7 rounds per minute. In comparison, the 35º Mk 7 mounting had a range of 29,700 yards (~27,150 m), and its power ramming increased the rate of fire to 2.9 rounds per minute. Note that there are variations in the quoted ranges in this chapter. The ranges are taken from the original documents in the file, which are not necessarily consistent over time. Indeed, some of the ranges are theoretical because the prototype mounting had not been constructed and tested. The details in the technical descriptions in Chapter 12 are sourced from the final published handbooks, and should be considered authoritative.

The officers attending the meeting agreed that the best solution would be to wait for the completion of the simplified Mk 7 design, unless the Canadian General Staff were willing to take the Mk 5 mountings out of action while the Mk 6A conversion was carried out in Canada. They did not discuss the Mk 8 turret mounting because it was still at the mock-up stage.

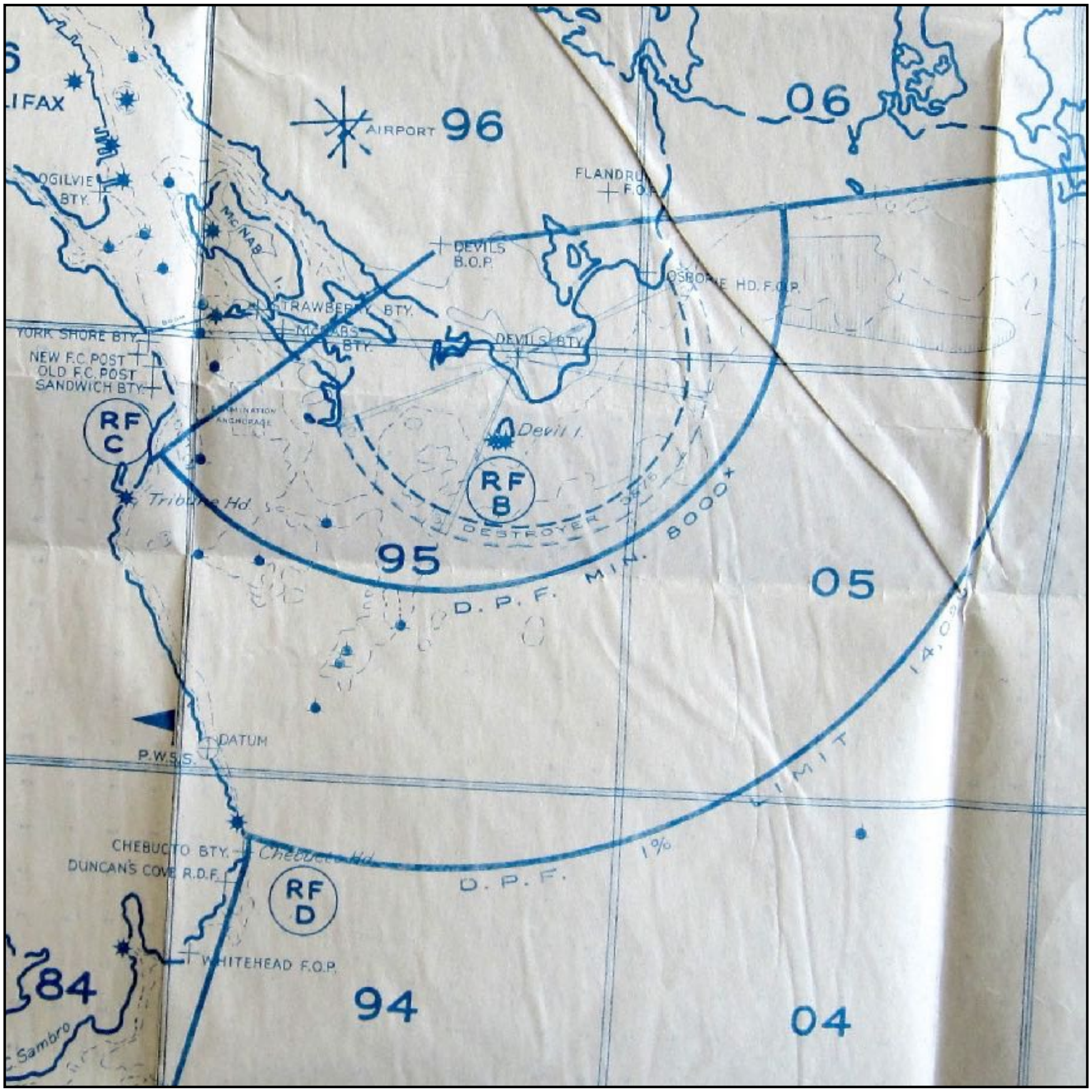
When he was briefed, the Chief of the General Staff decided to wait. He was not overly concerned about enemy cruisers and battleships attacking our harbours. However, the threat could not be ignored, and he was not willing to take the Mk 5 mountings out of action.

In July 1940, the War Office notified Canada that contracts had been let for the guns for Devils, Oxford, and Albert Head Batteries. No delivery dates were stated, but NDHQ staff considered it would be several years. About the same time, Colonel Morrison, who had been investigating possible American alternatives, reported that there was no American equivalent of the 9.2-inch gun. Their 8-inch railway gun might be acceptable, although Canada would have to convert to the American fire control system. He was sceptical about the potential value of the proposed Mk 8 mounting and believed there was little to be gained by placing orders for that equipment until better information was available.

Construction of Devils Battery Begins

It was extremely difficult to get any estimate of delivery dates from the British, but Canadian Military Headquarters in London advised Ottawa on 8 August 1940 that the first mounting for Devils Battery at Halifax would be complete in November 1940. The second one was due in January 1941, and the production date for the third one could not be forecast. The two gun barrels that were being relined would probably be ready in September 1940. This notification was enough to begin constructing the battery, although the estimated delivery dates were later revised to March 1941, April 1941, and July 1941.

For the counter-bombardment role in the defence of Halifax, the Treatt report had recommended that a three-gun battery of 9.2-inch Mk 10 barrels on 35º mountings be built near Hartlen Point. This would be supported by a new battery of three 6-inch Mk 7 guns near Chebucto Head across the entrance to the harbour. The Hartlen Point site overlooked the small Devils Island, which would give the battery its name, and provided excellent coverage of the approaches to Halifax harbour. Unfortunately, it was on very low ground (the trunnion height of No. 1 gun was only 75 feet above mean sea level). This would result in endless drainage problems in the underground facilities.



A diagram of the entrance to Halifax harbour with the arc of fire covered by Devils Battery. The outer arc is the limit of the depression position finder in order to obtain one percent accuracy in determining the range - about 14,000 yards (~12,800 m). Between them, Devils and Chebucto Batteries gave an effective cross fire at the entrance to the harbour. Fort Record Book.

The battery was generally constructed to the new British standards. Civilian contractors began excavating the site in late 1940 in preparation for the underground concrete work. By mid-April 1941, all the concrete had been poured for the gun positions, pump chambers, engine room, plotting room, magazine and tunnels, and the surface buildings were under construction. The supporting infantry barracks had been completed, and were occupied successively by several infantry regiments doing guard duty at the fort gate and patrolling along the beaches. The battery observation post (BOP) about two miles away was under construction, but neither the fortress observation post at Flandrum nor the radar site at Osbourne Head had been started.

The Mk 9 Mounting is Announced

On 26 September 1940, the War Office announced (again) that the Mk 8 mounting had been cancelled. The design for the modified/simplified Mk 7 mounting was nearing completion and it would be designated the Mk 9. The Canadian contracts would be changed, and Mk 9 mountings would be provided for Oxford, Albert Head, and Mispec Batteries. Design drawings would be forwarded when available. Once again, not that it mattered in this case, if there had been any discussion with Canada about changing the contracts, it is not recorded in the files. On the other hand, the cancellation of the Mk 8 mounting eliminated the difficulty of having two incompatible 9.2-inch gun systems in the country.

About the same time, the War Office announced that the Mk 15 barrel had been approved for Imperial service. It was an all-steel design (not wire-wound), with an Asbury single-motion breech mechanism that could be adapted to power operation. It could use either an electric or percussion firing lock, but the primer tubes were 0.5-inch (12.7 mm) diameter (compared to the 0.4-inch (10.16 mm) primers used with the Mk 10 barrels). The WO asked if Canada wanted Mk 15 barrels in place of the Mk 10 that had originally been requested for Mispec Battery. They also stated that the order for Oxford Battery could be switched to Mk 15 barrels since manufacture of the Mk 10 barrels for that location had not started. After the WO confirmed that the Mk 10 and Mk 15 barrels could be used interchangeably on any of the Mk 5, Mk 7, and Mk 9 mountings, the switch for Oxford Battery was approved. The barrels were not strictly interchangeable because they used different sizes of primer tubes. This was a not an issue as long as all the barrels in a battery used the same size, but it led to the eventual procurement of a spare barrel for each battery, rather than a spare barrel pool on each coast.

In February 1941, Canadian Military Headquarters in London reported that the first Devils Battery mounting would be ready for shipment in March, the second in April, and the third in July. Also, the two relined barrels from Esquimalt (#L/220 and #L/242) were being prepared for shipment. They arrived at Halifax in April, and despite initial confusion about whether they had been converted to the Mk 15 standard (using 0.5-inch primer tubes), they were later confirmed as Mk 10 barrels with a Welin screw breech using 0.4-inch primer tubes. They were put in storage pending the arrival of the mountings.

The Supercharge Saga - Part 1

The supercharge saga began in February 1941. When they were preparing to order the fire control equipment for Albert Head, Oxford, and Mispec Batteries, the War Office requested confirmation that Canada wished to continue to use the normal full charge [propellant] and not supercharge for the guns. A supercharge contains more propellant than the normal full charge. This gives increased range, but at the cost of greater wear in the barrel, and increased stress on the mounting. They stated that the policy for the Imperial services was to use supercharge, as it increased the maximum range of the gun by about 2,000 yards (~1,800 m). Although the supercharge would fit in the chamber of the Mk 10 barrel, other "variable parts" would need to be modified if supercharge was to be used. These included sights and elevating mechanisms on the mounting, and various fire control instruments such as the ballistic correction calculator, time of flight indicator, and fire direction table.

The 9.2-inch guns used a "fixed charge" which meant that the amount of propellant was always the same, and the range was adjusted by changing the elevation of the barrel. The standard charge for operational use was a "normal full charge" that nominally weighed 120 pounds (~54.4 kg), although the actual weight varied slightly over the years as the composition of the cordite changed. Because of the weight of the charge, it was delivered to the gun and loaded as two ½-charges, each weighing 60 pounds (~27.2 kg). For training, a reduced "¾-charge" could be used. This was less expensive, created less wear on the equipment and, because of its reduced maximum range, required less restrictions on the ship channels while using the gun. The reduced charge was loaded as a normal ½-charge and a special 30-pound (~13.6-kg) ¼-charge. The new supercharge weighed up to 125 pounds 3 ounces (~58.8 kg), depending on the type of cordite used. It was also loaded as two ½-charges.

Since the instrumentation for Devils Battery had already been manufactured, supercharge was not really practicable for that location. Also, Colonel Morrison noted that Canada had 1,600 normal full charges in stock, which was sufficient to supply Devils Battery for its intended life span. However, he strongly recommended that the variable parts for Albert Head, Oxford, and Mispec Batteries be prepared for supercharge.

A problem with adopting supercharge was that, while Canada was manufacturing the "W" type cordite that was used in normal charges, it had no plans at that time to produce the "SC 205" cordite used in the supercharge. Therefore, if the variable parts were manufactured for supercharge, then Canada had to obtain an initial supply of the ammunition from the UK at the same time as the new guns, and Britain had to be agreeable to Canada placing future orders for the cordite.

In April, the War Office confirmed that they could provide some supercharge ammunition at the same time as the guns, but not the full scale recommended for operations. However, in the case of Albert Head, some variable parts for normal full charge had already been made, and if Canada wished to convert to supercharge, then the WO should be advised immediately.

The discussion in Canada continued. It was believed that none of the current Mk 5 mountings could take supercharge, but there was general agreement that the other three batteries should be fitted for supercharge. In the case of Albert Head, the variable parts that had been manufactured for the normal charge would be accepted and placed in reserve. It was suggested that the operational ammunition for all the batteries should be ordered immediately, but the Chief of the General Staff decided that ammunition for the new batteries would only be ordered when it was clear that the mountings would be delivered within a year. The tone of the CGS memorandum was rather negative concerning the forecast delivery of the mountings, which was understandable considering the continual delays and missed delivery dates. The War Office was advised of the decision to use supercharge.

In July 1941, following yet another query on interoperability, the War Office confirmed that the Mk 10 and Mk 15 barrels were ballistically similar when using the same charges. The normal ¾-charge used in training was equivalent to a ½-supercharge plus a small incremental charge. However, the WO did not plan to produce the incremental charges until the existing half and quarter normal charges had been used up.

Setting Up Devils Battery, 1941

Devils Battery is described in more detail in Chapter 8. On 17 April 1941, the two barrels from Esquimalt that had been sent for relining in 1938 (#L/220 and #L/242) returned to Halifax. Together with the barrel currently mounted in Fort McNab, these three were intended for Devils Battery. The mountings had not yet arrived.

About the same time, a sergeant and ten men of the Royal Canadian Engineers arrived at Devils Battery to prepare the engine room and pump chambers for their machinery. Not much equipment had arrived, but they prepared the base plate for the hydraulic pressure pump, set up a 3-panel electrical switchboard in the engine room, and installed an air compressor in each of the three pump chambers. In early May, two Dominion Crossley 245-horsepower D-80 diesel engines and one Dominion Crossley 85-horsepower D-15 diesel engine arrived with all their accessories and installation kits. The setting up of these engines took almost three months but, by the end of July, they were running and had been tested by a Dominion Crossley engineer. Thereafter, they were operated for an hour each week to keep them in good working condition.

At the end of May, staff at Atlantic Command Headquarters began studying how to move the gun barrels and mountings to the battery site. Although generally in compliance with the new British standard, the recommendation to have a light rail connection from a main railway line into the battery position had been ignored. They eventually decided to move the equipment by train from the

Halifax docks to a point about two miles from the battery, and then use a truck and low-bed trailer. A railway crane would transfer the barrels and mountings from the rail car to the trailer. Removing them from the trailer and placing the barrel on the mounting could be done "by manual means" (i.e. use an artillery gyn with a block and tackle, and make sure the men had a good breakfast). The cost was estimated at $6,000. The staff recommended waiting until the first mounting was available, which was expected to arrive on 3 July.

By 1 August 1941, the construction of the three concrete gun emplacements, the plotting room, engine room, and four main concrete tunnels had been completed. The tunnels, pump chambers, plotting room, command post, magazines, and parts of the gun emplacements had been covered with earth. In addition, two "H" huts, four other buildings, a pump house, and a guard room had been constructed in an administrative area to the rear of the emplacements.

A week later, a master gunner was stationed at the battery to supervise the installation of the guns and mountings. A master gunner was a senior artillery non-commissioned officer, usually a Warrant Officer Class 1 or Class 2. He was trained in all aspects of the construction, operation, and maintenance of artillery weapons and technical gunnery, and was the technical equivalent of an Armament Artificer in the Royal Canadian Ordnance Corps (later Royal Canadian Electrical and Mechanical Engineers). The qualification required a twelve-month course in the UK, *after* the candidate had completed all levels of training in Canada.

On 5 August, the Director of Engineering Services at Halifax advised that the T. C. Gorman Construction Company had brought special engineering equipment from Montreal to Nova Scotia to install the American lend-lease 10-inch guns on McNutt Island at Shelburne, NS. That operation was complete, and the equipment was available to assist in moving and installing the barrels and mountings at the Devils Battery site, if required. Photos taken during the installation of the guns show a large tracked construction crane on the site.

On 9 August 1941, CMHQ advised that the second mounting for Devils Battery (that was supposed to be ready in April) had been shipped from the UK on the SS *Barrington Court*. However, when the ship arrived in Montreal on 8 September, there was no mounting, it was not listed on the ship's manifest, and there was considerable consternation. CMHQ insisted that it was on the ship (and stored in No. 2 lower hold). After a flurry of messages, Halifax reported on 10 September that the mounting had arrived in Sydney, NS. By 12 September, it was confirmed in to be Halifax. Nobody really seemed to know how it got there.

Another mystery occurred in August, when eleven crates of pump parts with an estimated value of about $20,000 were discovered on the Halifax wharf. Each case weighed more than a ton, and they had been there since January 1941. The initial report stated that the contents were rusty and some of the crates filled with water. Investigation revealed that they had originally been shipped to Esquimalt in December 1940, and then forwarded to Halifax. Since that time, they had been sitting on the wharf, uncovered and exposed to the weather. It was eventually established that they were for the pump room of a 9.2-inch gun battery with Mk 7 mountings, in this case, probably for Albert Head whose mountings had been reassigned to Devils Battery. A more detailed inspection revealed that there was no apparent damage to the parts, and the local RCOC workshop removed the surface rust, cleaned and greased them. For most of the month, correspondence moved back and forth from NDHQ to Halifax as to who would pay for the movement of the crates to the battery, and it was eventually agreed to move them using army vehicles and labour (i.e. no apparent cost).

The working party that would mount the guns arrived on 18 August and the movement and installation of the first gun began the following day. One officer and 40 other ranks of the 52nd Coast Battery arrived on 22 August, to assist with the work and become familiar with the system. They would be the unit operating the guns after the installation. The left gun (X-3) was mounted first, with most of the work being finished by 12 September. The next day, the installation of the right gun (X-1) began, leaving an ordnance artificer and a party of men to fit all the small parts to X-3. The main work on X-l was finished on 27 September and the working party left soon after, because the third mounting had not yet arrived. During October, the fitting of the small parts to the two mountings continued, as well as the installation of the generators, pumps, and other equipment in the power room and magazines.

On 12 November, CMHQ reported that the third mounting (X-2) was being prepared for shipping. The first components arrived on 12 December, and the installation began. However, the mounting arrived in several shipments and was a long time being assembled. The final cost of moving all the equipment from Halifax to Devils Battery was $10,572.44. This included moving the barrel from Fort McNab to Devils Battery, and moving the McNab mounting to Halifax dockyard.

X-1 and X-3 mountings were tested manually (i.e. no power operation) on 15 January 1942. The tests were satisfactory, and the guns were considered to be in action, and the battery was operational. X-2 was finally tested on 21 April 1942 and was reported in action as of 24 April. It should be noted that all three were British Mk 5 mountings that had been converted to the Mk 7 standard; they were not new mountings. All three guns fired live ammunition and were calibrated on 30-31 July 1942. Setting up the battery had taken almost a year. In fairness, the threat was low, and Sandwich Battery remained operational during this time, so Halifax remained protected. Also, the 9.2-inch guns were not the only guns being installed in Canada, and the Canadian Army Overseas had priority for personnel and resources. Live firing for training was restricted to full calibre ammunition for the first year. The three 6-pounder sub-calibre guns for Devils Battery did not arrive until July 1943.

In December 1942, the British advised that all future 9.2-inch and 6-inch coast defence batteries in Britain would have at least three guns. The main reason was that, while firing a salvo at long range, three guns were the minimum required to get a good indication of the main point of impact (the centre of the salvo). All

British two-gun batteries would be upgraded, and orders for additional guns should be submitted from the Dominions as soon as possible. NDHQ replied that all planned batteries would have three guns.

With the delivery of the Mk 7 mountings for Devils Battery complete, and the UK production standardizing on the Mk 9 mounting (which was not a conversion), NDHQ asked the War Office in January 1942 if it was necessary to return the three Mk 5 mountings for conversion. At the same time, they asked Halifax to confirm that the McNab mounting had been removed from the island and stored locally.

In February, the War Office replied that the Mk 9 mounting did not depend on the Mk 5 to any appreciable extent, and the Mk 5 mountings did not need to be returned. The priority for the issue of the Mk 9 mountings would be based on strategic considerations and other commitments - yet another confirmation that Canada had no say in the delivery of equipment. That cleared the way for the five Mk 5 mountings to be modified to the Mk 6A standard in Canada, and the search for a suitable contractor began immediately. In May, NDHQ informed CMHQ in London that the Mk 5 mountings would be converted in Canada. The first mounting (that had been removed from Fort McNab the previous August) was sent to the Dominion Bridge Company in Montreal about this time.

The August 1942 Review

In August 1942, noting that the Mk 5 mountings were being upgraded in Canada, CMHQ asked if the three mountings for Albert Head Battery and two for Oxford Battery that were on order in the UK were to be cancelled. Staff in the NDHQ Directorate of Artillery drafted a rather snippy reply that the mountings were still required. However, before the message was sent, someone realized that converting and keeping the Mk 5 mountings in addition to the existing orders would require additional gun barrels at a cost of $300,000 and ammunition at total cost of $1,582,500. Understandably, this triggered a major review, resulting the current situation being reported to the Chief of the General Staff on 20 August.

> At Halifax, Devils Battery was operational with its ultimate armament of three 9.2-inch Mk 10 barrels (#L220 and # L242 that had been relined and #L178 from Fort McNab) on three 35° Mk 7 mountings (#31, #35, and [unknown]).
>
> The 9.2-inch battery at Fort McNab no longer existed. The Mk 5 mounting (#A2488) had been removed and sent to the Dominion Bridge Company to be converted to a C Mk 6A mounting. (The “C” Mk 6A designator was used to differentiate the Canadian mounting from the British version.) As noted above, the McNab gun barrel (#L178) had been transferred to the third mounting at Devils Battery.
>
> Sandwich Battery would remain in action to support Devils Battery until Chebucto Battery (6-inch guns) became operational in late 1942. Then, the two Mk 5 mountings (#A2300 and #A2301) would be sent to Dominion Bridge

for conversion to C Mk 6A mountings. The two Mk 10 barrels (#L322 and #L334) would be placed in temporary storage in Halifax.

The Dominion Bridge Company had a contract to convert the five Mk 5 mountings to the C Mk 6A standard. Work had started on the first mounting (ex-Fort McNab), which was expected to be competed by 15 October 1942. It would then be sent to Albert Head, where it would be installed in the empty emplacement using the spare Mk 10 gun barrel already at that location. It would be thoroughly tested, probably by 1 December 1942. If the test was successful, the two mountings at Sandwich Battery would be converted and sent to Albert Head to replace its two Mk 5 mountings, with the existing barrels on those mountings being transferred to the converted mountings.

Albert Head Battery was operational with its interim armament of two Mk 10 barrels (#L/224 and #L/286) on Mk 5 mountings (#A2302 and #A2303). A third Mk 10 barrel (#L/264) was on site awaiting the arrival of the C Mk 6A converted mounting from Dominion Bridge (#A2488 from Fort McNab). The decision to send the next two C Mk 6A converted mountings (#A2300 and #A2301 from Sandwich Battery) to Albert Head would be deferred until the first C Mk 6A mounting had been installed and tested. The ultimate armament of three Mk 15 barrels and three Mk 9 mountings was on order in the UK. The decision to cancel this order would be deferred until after the test of the first C Mk 6A mounting. Similarly, the decision to convert the two Mk 5 mountings currently at Albert Head (#A2302 and #A2303) would be deferred until after the test of the first C Mk 6A mounting.

Oxford Battery in Sydney currently had no counter-bombardment battery, with that function being filled by the 6-inch guns at Lingnan Battery. The ultimate armament of three Mk 15 barrels and three Mk 9 mountings was on order in the UK. Two mountings were expected to be available in May 1943, and two per month thereafter. The staff recommended that the construction of the emplacements should begin immediately, and that the operational ammunition for the battery should be ordered.

Mispec Battery in Saint John, NB, was operational with its interim armament of three 7.5-inch guns on naval mountings. Its ultimate armament of three 9.2-inch Mk 15 barrels and three Mk 9 mountings was on order. The 7.5-inch guns would be transferred to Trial Island when the 9.2-inch guns arrived.

Finally, two spare Mk 15 barrels were on order.

For the first time, the plan appeared practical and achievable. Every defended port had some form of protection in place. At least half of the planned upgrades were under Canadian control, and not subject to changes in British priorities. The CGS approved the report, and CMHQ was informed accordingly, although the message from NDHQ stressed that the delay in making decisions did not imply any lack of confidence in the Canadian conversion project.

The review also included ammunition. The accepted operational requirement for 9.2-inch armour-piercing (capped) (APC) ammunition was 250 rounds per gun (rpg), with another 63 rounds as a 25% reserve and 10 rounds for calibration, making a total of 323 rpg. Similarly, the total requirement for high explosive (HE) ammunition was 31 rounds per gun. As of August 1942, this quantity was on hand or had been ordered for the eight guns in Canada. More would be needed immediately as soon as the three guns for Oxford Battery arrived. For economy of production, the staff recommended that the operational scale of ammunition should be procured for a total of twelve guns (four batteries with three guns each). This would need an additional 1,264 APC and 97 HE rounds beyond the current stock. The procurement was approved.

Although this is the story of the 9.2-inch guns, other counter-bombardment guns were installed in Canada on an emergency basis during the Second World War (see Annex A). The United States had provided eight obsolete 10-inch M1888 guns under the Lend-Lease agreement. Two guns were installed at each of Fort McNutt at Shelburne, NS, Fort Prevel at Gaspé, Québec, Fort Cape Spear at St. Johns, Nfld, and Wiseman Cove Battery at Botwood, Nfld. On the west coast, two American 8-inch railway guns were installed at Prince Rupert, and two at Christopher Point on Vancouver Island. Each of those ports was either a convoy assembly area, or covered the approach to a strategic location. Most of the guns had been installed by the end of 1941, and all were manned by Canadian gunners. None of the guns were ever fired in anger.

By the end of 1942, there was increasing recognition that the threat to the east coast ports was considerably reduced. They could not be left undefended, but the probability of an attack by a heavy armoured warship was low. The German battleship *Bismarck* had been sunk, the *Tirpitz* was moored in a Norwegian fjord, and the other German heavy capital ships were pretty well bottled up. The Italian fleet was unlikely to leave the Mediterranean. Nobody would risk a major capital ship against a defended port without a specific objective, especially an overseas port that was far from home base. If a major warship did break out, then it would be pursued by allied navies and air forces, and the early sea battles in the Pacific had demonstrated the vulnerability of battleships to air attack. The real threat had been reduced to submarines or an armed merchant ship, neither of which needed a 9.2-inch gun as a counter. This assessment did not include the west coast, where the Japanese Navy still had a significant number of heavy warships.

On 16 December 1942, the Chief of the General Staff decided that the three 7.5-inch guns in place at Mispec Battery at Saint John would not be replaced with 9.2-inch guns. The Saint John defences had always been a bit problematic. The harbour was a gathering point for convoys, and contained a major dry dock, but Saint John was still considered a commercial port. Although not specifically stated, the decision also eliminated Trial Island at Esquimalt, since its guns were to come from Saint John. This left only three 9.2-inch gun counter-bombardment batteries in the Ultimate Plan.

It should be noted that, although each of the new batteries consisted of three guns, and each gun had its full quota of equipment and accessories, by this time, only two guns in each 6-inch and 9.2-inch battery were manned. The personnel at a gun battery was controlled by its “establishment” - a formal document that detailed the battery’s entitlement to men, weapons, and vehicles. The men were listed by rank and by their required trade or qualifications. Unlike the field artillery, where an establishment was generic and applied to all units of the same type, the heavy coast defence battery establishments were unique to a specific unit and location. The 1944 establishments of the 51st Coast Battery, RCA, at Devils Battery, the 56th Coast Battery, RCA, at Albert Head, and the 4th Coast Battery, RCA, manning the three 7.5-inch guns at Mispec Point in Saint John, NB, are in the relevant Fort Record Books. All show a battery headquarters and only two gun detachments. There are also occasional references to the “unmanned gun” at each site. Oxford Battery never became operational. As a counterpoint, the report of the CDX Radar Trials at Devils Battery in April 1943 note that all three guns were in action although, for a trial, the third gun could have been manned by gunners from another battery. Regardless of the official personnel state, each battery commander had the responsibility to keep all three three guns properly maintained and ready for action.

Changes in operations policy were sometimes announced indirectly. On 24 December 1942, NDHQ asked CMHQ to clarify a restriction that had been published in the British Ordnance Board Proceedings - a highly technical publication. It announced that the 9.2-inch Mk 13A high explosive shell with the No. 199 fuze was to be used only in Mk 10 barrels on Mk 5 mountings with normal full charge. NDHQ asked if there was a weakness in the structure of the shell. The reply stated that it was a result of the British policy of *operationally* restricting the Mk 5 mounting to a 4 c.r.h. projectile and normal full charge. The Mk 7 and Mk 9 mountings would fire 6 c.r.h. projectiles and supercharge. The Mk 13A shell could be fired safely using either the normal full charge or supercharge in any mounting. Supercharge could be safely used in a Mk 5 mounting as long as the recoil was limited to a maximum of 41 inches (104.14 cm). This would be publicized in the next revision of the relevant handbooks. The recoil mechanisms at Albert Head were adjusted accordingly, because the C Mk 6A mounting was still a modified Mk 5 mounting. This was a change because, up to then, NDHQ had believed that the Mk 5 mounting could not use supercharge.

In January 1943, the installation of the first C Mk 6A mounting (#A2488 from Fort McNab) began at Albert Head Battery. It was emplaced in the vacant B/1 gun emplacement, and was reunited with its original barrel, #L/264, that had been mounted on it at Fort McNab in 1904. That barrel had been part of the first relined group from Halifax. Later, when the other two mountings were converted and sent to Albert Head, their original barrels from Sandwich battery in 1906 were installed on the converted mountings. The files do not note if this was coincidence, or someone had a sentimental streak. Despite the earlier estimate that the mounting would be tested by December 1942, it was the following June before the mounting was proof fired. The proofing was successful and the gun was fired operationally about a week later. However, it was limited to the performance of the Mk 5 mounting because the improved fire control instruments for the longer range of the C Mk 6A had not been delivered. In July 1943, CMHQ were advised that the instruments were required immediately.

With the completion of Chebucto Battery at Halifax, the 9.2-inch guns at Sandwich Battery ceased operation in April 1943. The barrels were removed to storage in Halifax, and the mountings were sent to Dominion Bridge in Montreal for conversion. In November, the 6-inch guns at the battery were put into preservation and the personnel were reassigned. A maintenance party of 22 men remained at the battery until late in the war.

The 1943 Ammunition Study

On 24 May, the operations staff at NDHQ decided to reduce the quantity of anti-ship (armour-piercing) ammunition that was on order for the 9.2-inch guns. There were 12 guns and, under the existing doctrine, the required quantity ("scale") of ammunition was 250 rounds per gun for operations, 62 rpg as a reserve, and 14 rpg for calibration purposes, for a total of 326 rpg (3,912 rounds total). Note the slight changes from the previous year. All contracts in excess of that number were to be cancelled.

In addition, the scale for "anti-landward" (high explosive) ammunition was 50 rounds for operations and 12 rounds reserve per gun. The total requirement for high explosive ammunition was 744 rounds.

This triggered a highly mathematical study by the Director of Artillery on the quantity of ammunition that was required based on the expected life of the guns in service as compared to the operational requirements. The study dealt only with the propellant charges and not the projectiles.

For the 9.2-inch guns, there were eight Mk 5 gun barrels, of which two were spare barrels. Each barrel, when new, had an expected life of 450 equivalent full charges (EFC - see Chapter 12, Ammunition), and the estimated total remaining life of the eight barrels was 3,198 EFCs. In addition, a further eight barrels were on order, with a total life of another 3,600 EFC. This implied a total expenditure of 6,798 EFC before all the the guns would be theoretically worn out.

However, the actual number of required charges was less, since each supercharge cartridge caused greater wear in the barrel and was the equivalent of two EFC. There were 4,668 supercharge cartridges on order for the nine approved and three "unallotted" guns (these were probably the spare barrels on the basis of one for each operational battery - the study is not specific). This was 2,538 EFC more that the estimated remaining life of the guns. If the ammunition that would be required for ten years annual training was included (25 rounds per gun per year, including 5 full charge and 20 ¾-charges), this added another 1,050 EFCs for a total excess of 3,588 EFC over the expected barrel life. To fire this excess ammunition that was already on order, another eight barrels would have to be purchased.

The Director of Operations and Plans, commenting on the study, noted that armour-piercing and high explosive ammunition should be considered as alternatives as far as the life of the barrels was concerned, and not as separate requirements. Also, he considered that including ammunition for three years training was more realistic than ten years. He recommended that there should be no change to the official scale of required ammunition, but that ammunition should be procured only for the nine operational guns, and no ammunition should be procured for the spare/unallocated equipments. This reduced the total ammunition requirement to 2,934 rounds of anti-ship, 558 rounds of high explosive, and 675 rounds for three years practice ammunition. Mathematically. this would result in an excess of 500 EFC over the barrel life, but he considered that this was acceptable.

The Deputy Chief of the General Staff approved this proposal, and directed that the contracts be cancelled accordingly. The Director of Artillery's staff grumbled about the assumptions, but accepted the decision.

Coast Defence Reductions Begin

A general reduction in the Canadian coast defences began in September 1943. Some counter-bombardment batteries were taken out of operation completely, and others were reduced in strength with some of their guns placed in maintenance. The 10-inch emergency batteries at Shelburne, NS, Gaspé, Québec, and Botwood, Nfld, were closed. In addition, the 7.5-inch battery at Fort Martinière at Québec City, and the 8-inch battery at Christopher Point on Vancouver Island were taken out of action. The 8-inch guns at Fairview Battery at Prince Rupert, BC, lingered until 1 December. The 10-inch battery at Cape Spear in Newfoundland and the 7.5-inch battery at Mispec Point at Saint John, NB, remained in in action. (See Annex A for details on these batteries). Devils and Albert Head Batteries remained operational with two guns each. In November 1943, NDHQ referred to "the unmanned gun at Albert Head" and, as noted above, the 1944 establishments at Devils and Albert Head Batteries are for two gun detachments.

NDHQ issued detailed instructions for placing the guns in preservation. There were two categories. In the first, the guns would be placed in a state of short term preservation such that they could be returned to action with a week's notice. Easily removable parts, such as the sights, would be placed in indoor, heated storage. The canvas covers would be removed regularly to ventilate all parts of the barrel and mounting. Each week, the breech would be opened and the bore pulled through with fresh DND 65A oil, and other parts greased as necessary. The mountings were to be regularly inspected by maintenance personnel. This applied to the larger guns.

In the second category, applicable to the smaller calibres, the guns would be kept ready for immediate action, although the personnel assigned to the gun would be withdrawn from the unit. These guns were to be maintained to the same standard as the operational guns in the battery. In either case, it was emphasized that the battery commander was responsible for the care and maintenance of the non-operational guns.

In the fall of 1943, NDHQ began planning for the long term post-war operation of the 6-inch and 9.2-inch gun batteries. NDHQ remained concerned about the availability of gun barrels in the future, since Britain was the only source of supply. They asked the War Office about the possibility of relining several worn-out 6-inch barrels, and included a general query about the 9.2-inch barrels. In October, the War Office replied that reserve barrels in both calibres were being manufactured and it was unlikely that any existing barrels would be relined for several years. They recommended that, if a barrel needed a new liner, then Canada should buy a new barrel and return the old one for credit, based on its condition.

New Mountings at Albert Head

With the successful testing of the first C Mk 6A mounting at Albert Head in June 1943, the Mk 5 conversion programme restarted. By the end of November, the second converted mounting was nearing completion at Dominion Bridge. NDHQ issued instructions that, as soon as it was shipped, the second "unmanned" Mk 5 mounting at Albert Head should be removed and the necessary parts shipped to Dominion Bridge for conversion. They estimated that the converted mounting would be in transit crossing Canada for two to three weeks, which should allow enough time for the disassembly. The cost of disassembling the old mounting and assembling the new one was estimated to be $1,000. The military equipment and labour was, of course, not costed.

The second C Mk 6A mounting was shipped from Dominion Bridge on 16 December, and was on site at Esquimalt by 5 January 1944. The disassembly of the Mk 5 mounting had begun on 27 December 1943 and was complete by 7 January. Adapting the emplacement for the new mounting began the next day, and the new C Mk 6A mounting was installed by 2 February 1944. The barrel that had been removed from the Mk 5 mounting was installed on the C Mk 6A shortly afterward, and the equipment was declared operational on 2 April 1944. However, some modifications were not completed, including the water blast mechanism in the breech.

By that time, the third C Mk 6A had arrived, and dismounting the last gun (B/3) began on 13 April 1944. The installation of the new mounting was completed during the summer. During the entire project, at any given time, two guns at Albert Head were fully operational. Albert Head Battery is described more detail in Chapter 10.

Construction of Oxford Battery Begins

The E.G.M. Cape & Company, Limited, was the lowest bidder and was awarded the contract to construct Oxford Battery at Sydney, NS, at a cost of approximately $1.2 million dollars. The excavation of No. 1 gun emplacement started on 11 August 1943, and pouring concrete began on 25 August. Progress was slow and by 15 January 1944, the emplacement still was not ready.

The cost estimate to move the three guns and mountings from the railway stations at Sydney Mines and Florence, NS, to the battery location was $12,600. This included renting a trailer from Montreal and shoring up two wooden bridges. Keep in mind that Cape Breton Island had no permanent access to the mainland until the completion of the Canso Causeway in 1955. Before then, anything shipped by rail had to cross the Strait of Canso by the CN rail ferry. The first two mountings began arriving at Sydney on 24 January 1944. The 36th Coast Battery, which was stationed at Chapel Point, began transferring the heavy components onto flatbed trucks at the docks and moving them to the battery site. Cranes and trailers were borrowed from the RCAF and the Sydney harbour boom defence, and the move was completed in two days. Another 58 tons of metal arrived on 30 January. Weather caused delays, the roads were in very poor condition, and snow made the skidding (heavy wood used to keep the equipment off the ground) slippery and dangerous. Work continued at a slow pace but, by 6 February, more than 158 tons of materiel had been moved to the site.

The gun barrels arrived at Sydney on 10 February 1944. Each one weighed about 62,500 pounds (~28 tonnes). The carriages and cradles arrived (about 20 tons each) and were moved to the battery on 23-24 February 1944. At the battery, each cradle had to be removed from the trailer using an artillery gyn (a tripod with a block and tackle) in sleet. Reading the account of the assembly, it was a miracle that nobody was injured and no equipment was damaged in the transfer. In all, about 250 tons of materiel was moved to the site. Assembly of the first mounting began shortly after.

On 17 July 1944, the War Office advised CMHQ that the third mounting for Oxford Battery would be delivered in about six or seven months time. The mounting was eventually delivered, but the battery was never activated. It was declared non-operational on 10 August 1944, before the installation of the first two guns was complete. Nevertheless, construction of the battery continued at a slow rate. The first two guns were proof fired in March 1946. Two years later, in May 1948, the third gun fired three practice shots to proof the mounting. There are several accounts on the Internet that claim that the third gun was never mounted. The Fort Record Book contains the record of the three proof firings and lists of the senior officers attending each one. The battery might never have been operational, but its guns were eventually ready for action. A spare Mk 15 barrel was also stored at the battery. Oxford Battery is described more detail in Chapter 9.

The Supercharge Saga - Part 2

Production problems with the supercharge ammunition came to light in February 1944. Supercharge ½-cartridges were being manufactured at the Bouchard ammunition assembly plant at Blainville, Québec, (like the normal full charge, supercharge was loaded in two ½-cartridges) and a sample was sent to Devils Battery for testing. The trial did not go well. The battery commander reported that it was extremely difficult to remove the lids of the new type of supercharge cartridge cylinder and extract the cartridge. In one case, the outer cover, inner cover, and metal rim on the top of the cylinder were so locked together that the whole assembly came off as a unit. He estimated that two minutes would be required to open each cylinder, which would affect the rate of fire.

More seriously, the cartridges had a greater diameter than the normal full charge cartridge. When measured, the charge had a diameter of 8.4 inches (21.336 cm), which had to be jammed into the 8.25 inch (20.995 cm) diameter loading/ramming tube.

In the Mk 7 mounting, the two ½-charges were loaded separately into a "ramming tube" behind the breech. The projectile was then transferred from the ammunition hoist to a tray in front of the ramming tube. The automatic loader then sequentially rammed the projectile into the chamber, moved the ramming tube forward, and pushed the charges out of the tube into the breech behind the shell.

The overly-large charge diameter affected the alignment of the ammunition tray with the breech, the height of which had to be adjusted in order to properly ram the cartridges. This forced a change in height of the ammunition hoist where it met the ammunition tray. In turn, this meant that the shell trolley in the pit would not fit the lower end of the hoist. Even without these problems, it was extremely difficult to get the cartridge into the rammer tube. It took two men to force a supercharge ½-cartridge into the tube, whereas the normal ½-charge could be easily loaded by one man. This was the start of a large volume of correspondence, much of which was highly technical.

After reviewing the report, the Inspection Board of the United Kingdom and Canada replied that a new shipping container had been created locally because of the impossibility of obtaining the metal for the normal container. To ensure that it remained waterproof, an extremely tight secondary lid had been designed to fit over the normal cover. This secondary lid could be removed as soon as the cartridge was delivered to a magazine at the gun. The cylinder would then open normally.

The production drawings of the supercharge cartridge held by NDHQ specified a maximum cartridge diameter of 8.0 inches. They ordered all the cartridges in stock to be measured by passing them through a gauge. Of the 1,842 cartridges at Halifax, none of them would fit through an 8.0-inch diameter gauge, 96% passed through an 8.25-inch gauge, and everything passed through an 8.5-inch gauge. Halifax also reported that many charges were not a true circle. The cordite was not tightly bound inside the cloth cover, and was free to move into an oval shape or a twist. There was also considerable confusion concerning the correct version of the drawings. This information was reported to the Inspection Board.

The Inspection Board replied that the original design had been based on a 1941 message from the UK, which indicated the correct size for WM 256 cordite should be a 30-inch long cartridge with an 8-inch maximum diameter. A hand-made trial lot had been manufactured and proofed in Devils Battery with no problems. A later drawing from the UK had amended these figures allowing a greater diameter and length. The Board noted that the production process at Bouchard met the revised specification, but the requirement that the charge had to fit in the rammer tube as well as the chamber "had been overlooked". They also agreed that it was almost impossible to tighten the cordite bundles sufficiently to get the required amount of cordite in an 8-inch diameter tube, which was "an inherent flaw of design". The Board regretted that they had not kept NDHQ properly informed. In essence, Canadian-manufactured supercharge ammunition could not be used in the Mk 7 mounting.

The NDHQ reply to the Inspection Board expressed extreme dissatisfaction with the poor workmanship of the cartridges and the fact that DND had not been advised of the changes to the specification. However, that did not solve the problem. A total of 6,984 supercharge ½-cartridges were on order, of which 3,914 had been delivered, but could not be used in the Mk 7 mountings at Devils Battery. However, they could be used in the C Mk 6A mountings at Albert Head, and potentially the Mk 9 mountings at Oxford Battery, both of which loaded the cartridges by hand and did not have the ramming tube problem.

Testing proved that it was impossible to bind the specified supercharge cordite bundle sufficiently tightly to fit in an 8-inch diameter ring. The final solution was to send the oversized cartridges to Albert Head and Oxford Batteries, where they could be loaded by hand and rammed with no problems. The remainder of the cartridge order was changed to be a special lot of ammunition that was specifically sized to fit the ramming tubes at Devils Battery. This contained less cordite, resulting in a loss of muzzle velocity of about about 35 feet-per-second and about 500 yards (~450 m) in range. However, it would work in the automatic loader, and allow the mounting to retain its rate of fire.[14]

The Counter-Bombardment Batteries Stand Down

On 4 August 1944, before the supercharge situation was resolved, Albert Head Battery was declared non-operational. Nevertheless, work on assembling the third mounting continued and it was proof fired on 7 September 1944. With that firing, the three guns and mountings that had started their careers in Halifax almost 40 years earlier were reunited in a new battery 2,780 miles (4475 km) away on a different ocean. The battery was then closed, leaving only a small maintenance crew in place.

Devils and Oxford Batteries became non-operational on 10 August 1944 (strictly speaking, Oxford Battery never became operational). Critical or high value parts were removed for storage in the ordnance depots and the guns were placed in preservation. Apart from a small maintenance crew, the personnel at each battery were reassigned. The wartime service of the 9.2-inch guns was over.

Chapter 7 - The Twilight of the Coast Artillery, 1945-1954

Proof firing a 9.2-inch Mk 15 gun on the Mk 9 Mounting at Oxford Battery after the Second World War. Although the battery was never operational, all three guns were eventually mounted and proof fired. Oxford Battery Fort Record Book.

British Postwar Coast Artillery Policy

In December 1944, a British Defence of Bases Committee evaluated the future of coast artillery for the British Chiefs of Staff.[15] They examined the lessons of the war, and concluded that any purely static defence would be defeated by an attack that included air and sea bombardment. The successful defence of a port would depend on maintaining local air and sea superiority, which would not always be possible. Major warships could not be tied down for the close defence of a port, and it was impractical to restrict more than a few aircraft to protect a local area. Also, even if strong air and sea forces were available, an enemy could achieve temporary local superiority by using surprise, diversion, or superior force. Therefore, since air and sea superiority could not be guaranteed, coast artillery was still needed as insurance.

The air forces would usually be able to attack enemy ships beyond the range of any gun. Indeed, under favourable circumstances, they might be able to dispose of the threat completely. Nevertheless, the long range coast defence gun retained some advantages. Once installed, it was easy to maintain, and could be maintained at instantaneous readiness. It presented a small target to an air or sea attack, and radar provided good accuracy against long range or "unseen" targets.

The study had assumed that the 9.2-inch counter-bombardment gun could fire a 380-pound shell to a maximum range of 31,000 yards (~28,350 m) with a rate of fire of two to three rounds per minute. (In Canada, only the unfinished Oxford Battery approached this standard. Albert Head and Devils Batteries had less range and a slower rate of fire.) The committee concluded that a gun of similar calibre with a range of 40,000 yards (~36,500 m) would be needed in the future, and an even heavier gun might also be required.

The report was obviously aimed at the defence of Britain, whose situation and requirements were different from Canada. Nevertheless, its key recommendation was that heavy counter-bombardment guns were still required for the defence of important or isolated ports.

The British Chiefs of Staff approved the report, which then became British coast artillery doctrine. However, more and more, Canada was pursuing an independent defence policy.

Canadian Postwar Coast Defence Policy

The official Canadian policy at the end of the war was to protect important ports on both coasts from "hit and run" raiders.[16] A conference in Ottawa from 13-15 September 1945 covered all aspects of coast artillery, including the use of radar, training, manning the guns, maintenance, and many other topics. The transcript (held in the DND Directorate of History and Heritage) is large and includes verbatim comments by many senior officers.

There was a long discussion on radar. The Canadian Chiefs of Staff had agreed that early warning was an RCAF responsibility, and therefore, army radar installations would be limited to ranging and fire control. Although there was a lively discussion, it was generally agreed that engaging a target using radar was better than using optical rangefinders, although the radar could be jammed. With the capability to accurately track a target at any range using radar, the conference considered that the distinction between the counter-bombardment and close defence roles was no longer necessary. The original reason for the separation of the different roles apparently had been forgotten. The former was to deal with the heavy armoured warship, and the latter to engage a lightly armoured or unarmoured ship. On the other hand, there were few battleships in the hands of any potential enemy, and the modern 6-inch gun on a 45° high angle mounting could reach a range of 24,500 yards (~22,400 m), which was beyond the effective range of an optical system. It was also suggested at the meeting that the army coast defence radars could be used to assist commercial navigation in the ports they protected, although this seems more like trying to justify the radar installations.

In 1945, Britain stopped designating coast defence guns by their role (e.g. counter-bombardment), and reclassified the guns as light, medium, heavy, and super-heavy guns. The 9.2-inch gun was defined as a heavy gun (at least in the Canadian interpretation), and would remain in position at Albert Head, Devils, and Oxford Batteries, although in preservation. The batteries would be maintained by the Active Force, and periodically would be put in action to train the Reserve Force.

The formation of the Corps of Royal Canadian Electrical and Mechanical Engineers (RCEME) in 1944 had changed the maintenance procedures in the Canadian Army. Before the war, each of the combat arms (infantry, artillery, and later the armoured corps) was responsible the basic repair and maintenance of its equipment, supported by the Engineering Branch of the Royal Canadian Ordnance Corps. This meant that the various Corps were in competition for skilled tradesmen, which led to inefficiencies and misuse of personnel. In 1944, RCEME became responsible for the overall maintenance and repair of army equipment (with a few exceptions), which led to a general rationalization of technical trades immediately after the war. For example, all the RCA fitters (gun mechanics) were transferred to RCEME. A complex weapon system might need several different trades to carry out maintenance. For example, the gun itself might be maintained by gun mechanics, but the sights would need instrument repairmen, and radar repair was a completely separate trade.

As trades were consolidated and tradesmen reassigned to the Corps that “owned” their trade, it became necessary to spell out the responsibilities of each Corps with respect to the repair and maintenance of complex equipment. For the coast artillery, the Royal Canadian Artillery would be responsible for the operation, maintenance, and first line repair of all coast artillery and their associated searchlights and ancillary equipment. First line repair for the 9.2-inch gun included daily maintenance, cleaning, lubrication, and minor adjustments of the gun and its operational accessories. The Royal Canadian Engineers (RCE) would be responsible for the construction and maintenance of the works and buildings, such as magazines, emplacements, and troop accommodations in the battery locations. Since the supporting equipment included pumps and electrical generators that were maintained by the RCE, some RCE tradesmen were integrated into the coast defence battery. RCEME were responsible for the installation of the equipment, technical inspections, and all other repairs. It took several years after the war before the relevant RCA, RCE, and RCEME trades were amalgamated and stabilized.

In June 1946, the last two Mk 5 mountings, which had been removed from Albert Head, were nearing completion of their conversion to the C Mk 6A standard at Dominion Bridge. At the factory, the two mountings were completely assembled and tested, although without barrels. They were then disassembled and allocated as reserve armament with the intention of having one at the coast defence school on each coast to be used for training. This never happened although, after conversion, one mounting and barrel was sent to the west coast and held in No. 17 Regional Ordnance Depot. The other mounting was sent to No. 15 (later No. 12) Regional Ordnance Depot in Halifax.

After the war, the threat countered by the heavy coast defence gun continued to decline. Few potential enemies had major armoured warships and, by 1949, the 9.2-inch guns were no longer part of the overall plan for the defence of Canada. Although still considered to be reserve armament, the Vice Chief of the Canadian General Staff ordered that no modifications or major repairs would take place without specific direction from NDHQ. Any parts obtained for approved modifications would remain crated and in preservation. However, although NDHQ agreed to reduce the stock of ammunition, they were not willing to dispose of the guns.

Finally, on 11 October 1949, the planning directorates of the Canadian Army and the Royal Canadian Navy met and agreed on a coast defence plan that would be implemented in an emergency. This plan eliminated any role or requirement for the 9.2-inch guns. On 13 October, the Chief of the General Staff agreed that the 9.2-inch guns were no longer needed for coast defence. Both the guns and ammunition could be sold or scrapped.

Disposal of the Guns and Ammunition

On 31 January 1950, there were eleven mounted guns (three Mk 15 barrels on Mk 9 mountings at Oxford, three Mk 10 barrels on Mk 7 mountings at Devils, three Mk 10 barrels on C Mk 6A mountings at Albert Head, and two spare Mk 10 barrels on C Mk 6A mountings in storage). The equipments were complete, except for a few components for the air blast and rammers on the C Mk 6A mountings. There was also a spare Mk 15 barrel at Oxford Battery and four spare Mk 15 barrels in storage in Halifax. The associated fire control equipment was in storage in the Ordnance Depots on both coasts.

There was a total of 9,823 cartridges and 4,670 projectiles of various types. The estimated value of the ammunition on the east coast was $325,000. The ammunition could be sold (if possible), or drowned (having the RCN dump it at sea), whichever would be cheaper. Until a disposal decision was made, NDHQ suggested that the ammunition at Oxford and Devils Battery could be kept in the battery magazines, overseen by a caretaker. This was not a problem at Oxford, where the magazines were dry and could be heated with an electric heater. However, ammunition could not be kept at Devils Battery. Its magazines leaked badly and needed continuous operation of pumps and generators to keep the water at bay. If the battery was to be stripped of its ancillary equipment, the magazines would quickly be completely flooded. In the end, the ammunition was removed from both batteries and stored at the ammunition depots at McGivney, NB, and Debert, NS. The ammunition at Albert Head was removed to No. 38 Ordnance Ammunition Depot at Nanaimo, BC.

The ammunition was offered to the British, but they were not interested. After several reviews, NDHQ realized that there would be essentially no financial return from the disposal of the guns and ammunition. That opened the way for their disposal as mutual aid to the newly-formed North Atlantic Treaty Organization. Although he wanted a quick solution, the CGS agreed that if the equipment were to be offered to NATO, they could be left in situ for a short time while negotiations were underway, as long as there was absolutely no cost for keeping them. The guns and ammunition were then offered to NATO. The first offer did not include the fire direction tables, CDX radars, and other instruments, since they could be used elsewhere in Canada.

Although DND wanted to minimize any further expenses associated with the guns, it was realized that it would be a cost to remove the equipment. The Command Electrical and Mechanical Engineer in Halifax estimated that 107 RCEME man-days would be required to remove and prepare each gun for shipping - more if the equipment needed preservation. This did not include transportation, storage, etc. He underestimated a bit. The removal of the three guns at Oxford Battery, transporting them to the dock, and loading them on a ship eventually required 1,128 man-days (169 of them RCEME) - an average of 376 man-days per equipment, not including the officer in charge. The project also cost $5,347.00, mainly for the rental of cranes and transport vehicles. As was normal at the time, the actual cost of military labour was not calculated.

Portugal requested the guns and equipment at Oxford Battery, along with 1,500 cartridges and 1,000 shells. The guns were disassembled during September and October 1953 and moved to Point Edward Naval Base at Sydney, NS. From there, they were shipped to Ponta Delgada in the Azores on 28 November 1953.

There were no bids for the other eight guns, and the offer for mutual aid was cancelled. They were resubmitted to NATO as mutual aid on 20 August 1953, with 3,278 shells and 6,258 cartridges. Again, there were no bids, and the offer was again withdrawn. However, on 6 April 1954, Turkey requested the guns, if they were still available. NATO had no objections, and the last eight 9.2-inch guns and mountings, as well as the 7.5-inch guns from Mispec Battery were allocated to Turkey.[17] Starting in October 1954, the guns at Devils Battery were removed, and with the spare C Mk 6A equipment were ready for shipping at Shearwater, NS, on 3 December. The four spare Mk 15 barrels may have been included. The files are unclear as to whether they went to Portugal or to Turkey.

The guns at Albert Head were dismounted and removed by 22 November 1954 and, with the spare equipment in storage in Vancouver, shipped during October 1955. While loading the guns on the ship, one of the gun barrels, #L/264, was dropped from a height of about twenty feet. It sustained only minor damage. The accident was blamed on the inadequate strength of the slings, but there were no problems lifting the other barrels and mountings using the same slings. Since #L/264 was the oldest barrel and had been in Canadian service for more than 50 years, maybe it just didn't want to leave home.

Chapter 8 - Devils Battery, Halifax, Nova Scotia

Devils Battery looking seaward on 13 August 1941. The island is at the top, with the three gun positions in the centre of the photo. The emplacements are empty as the guns and mountings have not yet arrived. The administrative area is the group of buildings to the lower right. This photo shows clearly the proximity to the sea and the low-lying nature of the battery. Devils Battery Fort Record Book.

The chronological events leading up to the construction of Devils Battery in Halifax have been recounted in the previous chapters. This chapter includes more details on the construction and operation of the battery. All materiel has been sourced from the Devils Battery Fort Record Book, held in the Library and Archives, Canada.[18]

In his report, Major Treatt recommended the establishment of a counter-bombardment battery of 9.2-inch guns near Hartlen Point, supported by a close defence battery of 6-inch guns on the opposite side of the harbour near Chebucto Head. The site chosen at Hartlen Point was on the shore opposite the small Devils Island that gave its name to the battery. The location gave an excellent arc of fire covering the entrance to the harbour. Unfortunately, little attention appears to have been paid to the low terrain. The trunnions of the guns were barely 75 feet (~23 m) above sea level, resulting in endless problems with water leakage into the battery, especially the underground magazines.

Description

The Gun Emplacements

Each gun emplacement had a concrete base in which the gun holdfast was embedded. This was surrounded by a concrete parapet. Storage compartments for gun tools and equipment, ready-use projectile shelves and cartridge storage, and personnel shelters for the detachment were built into base of the parapet.

Devils Battery under construction on 8 April 1941. The three concrete emplacements can be seen, as well as the lines of the concrete underground tunnels that linked the emplacements to the main tunnel junction in the centre. The small building just above the junction is the cover for the command post, and is connected to the junction by a short tunnel. The large rectangular concrete structure beside each emplacement is the magazine, with the ground level entrance being the small square concrete structure that can just be seen behind each magazine. The tunnel connecting to the pump chamber for each emplacement is clearly visible. The construction in the extreme upper left corner to the left of the surface barracks accommodation building is the battery plotting room. Devils Battery Fort Record Book.

Each gun had an underground pump chamber that was connected to the base of the emplacement by a small channel, about 18 inches (~0.46 m) square. The channel ran from one wall of the pump chamber on an upward slant to the floor of the emplacement at the wall of the parapet. From there, the channel went straight to the centre of the holdfast directly under the pedestal. The part of the channel that was exposed on the concrete floor was covered by steel plates. The pump chamber housed the hydraulic pressure pump and its electric motor, the air compressor and storage bottles, a water tank for cooling the air compressor, hydraulic fluid tanks, oil separators, electric fuze and transformer boxes, and telephone and Magslip (data transmission) connections. Each pump chamber had a vertical shaft, approximately eight feet (~2.44 m) square, running to the surface, where it was covered by a shed-like wooden structure.

Each of the three pump chambers (one for each gun) was connected by an underground tunnel to a junction near the command post, which was a small insulated and sound-proofed room. The tunnels were large enough for a man to pass easily. From the junction, a larger tunnel ran to the engine room. Escape hatches ran vertically to the surface of the ground at the central junction, and halfway along the tunnels to the pump rooms. They had a steel ladder up one side, and the tops were covered by concrete structure with a hatch. Metal conduits carrying the main 600-volt power lines, the Magslip data transmission cables, and telephone cables ran along the walls of the tunnels from the engine room to each pump chamber. A water line to each pump chamber and magazine ran along the roof of the tunnel.

The engine room was a large underground concrete chamber that housed the three diesel generators, the main electrical switchboard, and their supporting equipment. It had a large overhead crane to move the machinery. A small bypass tunnel reduced the traffic directly through the engine room.

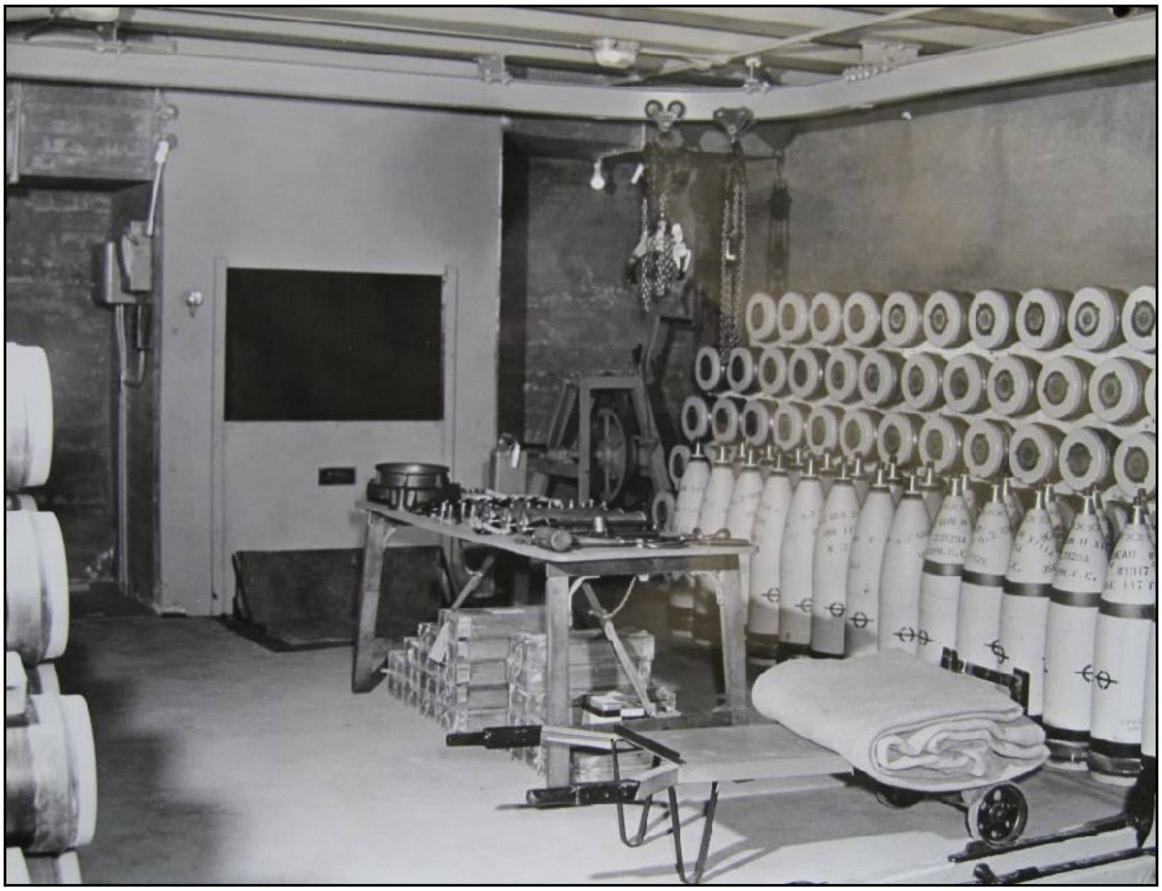
An aerial view of Devils Battery on 30 October 1941. The sea and the main arc of fire is to the upper right. The entrance to the tunnels and engine room is in the foreground, and the line of the tunnels can be seen by tracing the escape hatches. The left and right gun emplacements have guns mounted, but the centre emplacement is empty as its mounting had not yet arrived. The buildings to the left are the administrative area. The battery observation post is out of the photo to the left. Devils Battery Fort Record Book.

The main access tunnel ran from the engine room to an entrance that faced directly onto the road and harbour from the side of a large bank. A 1,000-gallon (~3,785-litre) fuel oil tank was in a large recess on each side of the tunnel.

The Magazines

Each gun had its own concrete magazine, which was 30 feet (~9 m) underground. Depending on the point of origin for the measurements, at most the floor of the magazine was only 35 feet (~10 m) above mean sea level. To prevent water out of the magazine, a special tunnel about eighteen inches wide by four feet high (~0.46 m by 1.22 m) ran completely around the magazine and was connected to the main drainage system. However, seepage was a major problem that was never solved.

The entrance to the magazine was through a concrete stairway to the surface. A sliding loading hatch was incorporated in the entrance, which covered a straight vertical drop to the bottom of the stairway. The magazines were completely separate from any other underground structure, with the only direct connection to any other location being the hatch to the vertical ammunition hoist running to the floor of the gun emplacement. This hatch was fitted with steel sliding doors at the top and bottom, which were arranged such that one of them was always closed. The hoist could be operated by an electric motor or by an auxiliary hand winch.



The projectile room in the magazine below the gun emplacement. The lift to raise the shell to the emplacement floor is in the background. The sliding doors were rigged so that the upper doors in the emplacement and the lower doors in the projectile room could not be opened at the same time. Note the handling gear and the trollies for the 380-pound projectiles. The table in the middle holds fuzes and tools; the boxes below the table are for the fuzes. This is staged photo. The vertical high explosive projectiles are all fused. Normally, the projectiles and fuzes would be stored separately and the shells would only be fuzed just before sending them up to the emplacement. The horizontal projectiles are armour-piercing, which used a fuze in the base of the shell instead of the nose. Devils Battery Fort Record Book.

The projectile room was concrete construction, and the cartridge room was fire-proof brick. An escape hatch ran from the projectile room to the surface. All fittings and connecting doors were copper, with large double steel doors at the main entrance. Lighting was 110-volt 60-cycle A.C., with 6 volt D.C. auxiliary power. There were three ventilators, one in the cartridge room and two in the projectile room.

The Battery Plotting Room

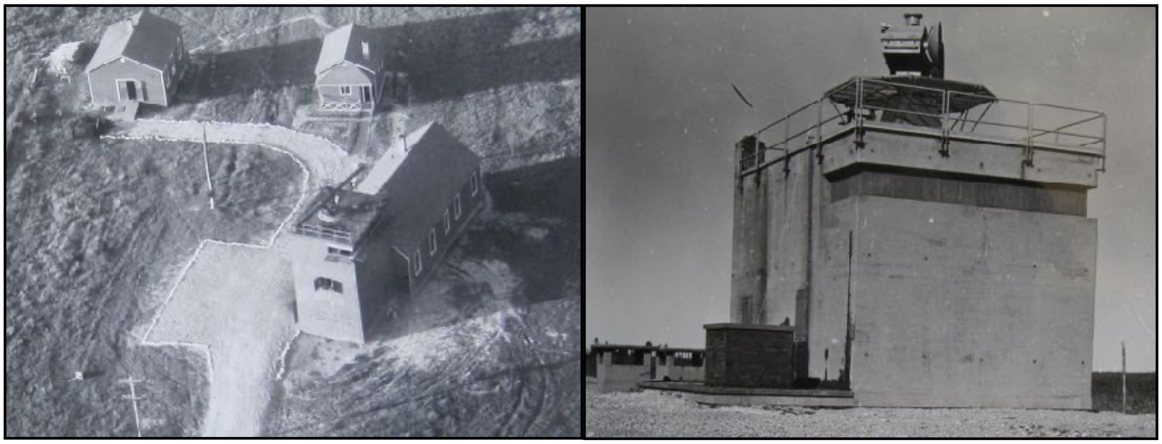
The battery plotting room (BPR) was a concrete underground structure completely isolated from the rest of the fort (apart from the cable connections). It was divided into four rooms and a small hallway. The ceilings of the rooms were approximately four feet underground, and connected to the surface by a two-level inclined shaft and a smaller vertical shaft at the end of a 20-foot (~6-m) tunnel. The surface ends of the shafts were covered by steel doors and hatch covers. Four ventilators ran to the surface. The BPR had a 110-volt lighting system and running water. The main room housed the fire direction table and co-ordinate converter, with all their associated equipment, and the Magslip controls. Two rooms were de-gassing chambers that were supposedly airtight. Although poison gas was never used during the Second World War, the war gasses used during the previous war had not been forgotten. The last room was a machinery room with the oil pump and spare parts for the fire direction table.

Accommodation and Housekeeping

Wooden barracks, officers quarters, and a mess hall were constructed at the rear of the battery to house the personnel. Water was initially supplied by a 620 foot deep (~190 m) well and pump. A 25,000-gallon cistern (holding tank) was built in January 1942. The well did not deliver enough water, and a second well was drilled in the summer of 1942. Even this fell far short of the demand, and water had to be hauled by truck to the fort. Finally, in the summer of 1943, a pipeline was laid to the 150,000-gallon (~568,000-litre) cistern at the A23 Artillery Training Centre some two miles (~3.2 km) distant and, for the first time, Devils Battery had a sufficient supply of water.

The Original Battery Observation Post

The original battery observation post (BOP) was a three story concrete structure, about 30 feet (~9.1 m) high, sited about two miles (~3.2 km) north of the fort on the highest point of ground in the area. It was electrically heated. On the top floor, large windows with folding steel shutters gave an uninterrupted view seawards to the south, and partly to the east and west. It had an external stairway and a pedestal on the roof for a No. 9A optical rangefinder. A Type "Z" Mk 2 Position Finder was mounted on the third floor. The position finder and the rangefinder were installed in early 10 December 1941, although neither instrument was in action for some time. A Magslip cable was laid in a tunnel from the BOP to the battery plotting room. During the winter of 1942, a metal and wood cover was built over the rangefinder on the roof to protect it from the weather. The housing was designed to blend in with the camouflage of the battery observation post (ie. a church area). It was a rather clumsy affair and traversed independently of the rangefinder, but nevertheless afforded good protection.



Left: the original battery observation post, camouflaged as a church, situated on high ground about two miles from the battery. This is an early photo after the installation of the optical rangefinder on the roof, but before the installation of the “steeple” covering the instrument. Right: the second battery observation post with the CDX radar mounted on the roof. The radar was not installed before the battery was declared non-operational, but it was eventually installed in early 1945 and used in the secondary role of coast watching. Devils Battery Fort Record Book.

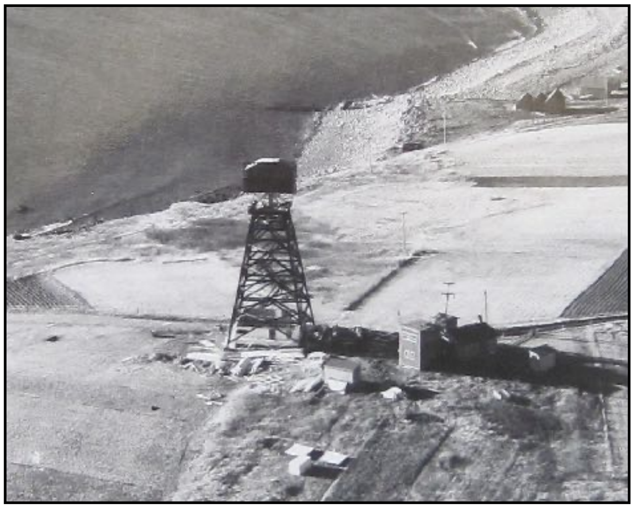
The CDX Radar

Excavation of a permanent site for a CDX radar a few hundred yards north of the battery began in early spring of 1944. The structure was a concrete blockhouse with the CDX radar dishes on top. The building was finished but the equipment had not been installed when the battery was declared non-operational on 31 August. The CDX radar equipment was installed by February 1945, and was put in action in a secondary role of coast watching.

Flandrum Hill Fortress Observation Post

The battery was supported by the Flandrum Hill Fortress Observation Post (FOP), which was a four story concrete structure with an internal stairway. The FOP was located to the east of the battery on high ground, and was connected to the fortress command post in Halifax, which would then pass relevant data to the battery plotting room. Construction of the FOP started in April 1942 and was completed in June. It was different from most OPs in that the pedestal for the position finder, rather than resting on the top floor, was completely independent of the building for its entire height of about forty feet (~12 m). It rested on its own foundation, which was also separate from the foundation of the main building. This was to ensure that the instrument was not affected by any swaying of the building. However, it was found that the pedestal settled considerably, and the instrument had to be re-levelled every month. On 11 June 1942, its Position Finder “Y" Mk 1 was hoisted to the top floor. Since the roof of the building had not been completed, it remained in its crate, and was finally set up during August. Sleeping quarters were provided in the building, but a mess hall and kitchen were built later, together with a well and pump house.

Osborne Head Radar Station



The CD radar site at Osborne Head. Devils Battery Fort Record Book.

The CD fire control radar at Osborne Head was a large cross-braced tower, fifty feet (~15.2 m) high, with a twenty foot (~6.1 m) square base. A building to house the electronics was built at the base between the legs of the tower. A smaller building outside the structure had a diesel-driven electric generator and a deep well with a pump house. Wooden barracks were constructed for the operators. The site was operational during the war, but would have been replaced by the CDX radar when it was installed. In late 1943, a naval gunnery range was established at Osborne Head to train gunners for defensively equipped merchant ships. It remained in use until 1989, when it was converted to a naval electronics test range.

The Plan for Mounting the Guns

Before the mountings arrived, Atlantic Command Headquarters created a plan for mounting the guns and rangefinders at Devils Battery. On 25 June 1938, while on his master gunner course in Britain, Master Gunner H.E. Chater, RCA, was given notes on how to install a Mk 7 mounting from a British armament artificer who had been involved in mounting the 9.2-inch guns in Singapore. The notes were very detailed, especially with respect to the order of assembly, and were included in the plan for the installation of the guns at Devils Battery. Not all the recommendations were technical:

> "Faults in the assembly are largely due to the officer in charge of the shift trying to make a name for himself by getting the mounting up quickly. This means weeks of extra work for the artificers, who have to work in confined spaces and remove some parts to place others in position. Though the mounting is up, it is not in action and will not be for a much longer period than if less haste had been made at the start."[19]

The plan for mounting the guns at Devils Battery is reproduced below in its entirety, with minor editing for readability. Note the amount of manual labour that was required. Additional explanations are in [square brackets].[20]

> *Introduction.* Because all three gun positions are exactly the same, one plan for mounting and dismounting the guns will cover all three situations. It is

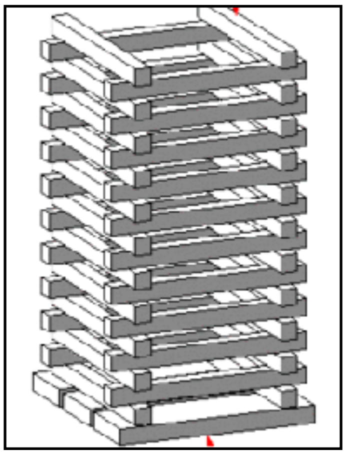
assumed that a crane of at least twelve tons capacity will be available. Otherwise, holdfasts with appropriate tackle, artillery gyns, and perhaps shear legs will be needed. This plan is intended as a rough guide only, and leaves the actual choice of skidding [planks and timber] and power machinery to the person in charge.

Assembling the Pedestal. Each half of the pedestal can be taken off the trailer at the end of the roadway at the rear of the emplacement. It can then be hauled on rollers up to and through the large emplacement doors by building a simple roadway of planks and using a block and tackle. The pedestal halves are right and left, not front and back. Care must be taken to ensure that each half of the pedestal goes through the doors front end first, in order to avoid unnecessary work in the enclosed space of the emplacement. Each half of the pedestal can be stopped just over its holding down bolts [which were embedded in the concrete emplacement floor]. Once the two halves are in place, they can be securely bolted together ,and the two bottom joint plates bolted into position. The pedestal can then be jacked down over the holding down bolts, and the nuts installed and tightened. There are no levelling nuts. Level is achieved by ensuring that the concrete immediately under the pedestal is perfectly level when laid. Note: the man holes in the pivot plate are not large enough to allow the two centre pivot casings and bracket to pass through them. It is extremely important that these parts are placed inside the pedestal at this time and remain there until needed. [Some of the instructions seem obvious, but keep in mind the comment of the British source above. They are probably based on unpleasant experience.]

Assembling the Pivot Plate and Plug. The pivot plate can be unloaded from the trailer and hauled to the emplacement doors in the same manner as the pedestal. An inclined ramp must be built, starting just outside the doors and ramping up to and then across the top of the pedestal. Care must be taken to ensure that the ramp is not so steep that the pivot plate will hit the roof of the emplacement over the doors. Using a gun tackle attached to the holdfasts embedded in the emplacement wall, the pivot plate can then be hauled up this ramp, and placed in position over the pedestal. Care must be taken that all joining surfaces are thoroughly scraped, cleaned, and coated with red lead or mineral jelly. The pivot plate can then be lowered onto the pedestal and bolted in place. The pivot plug can be set in its recess and the lower retaining plate bolted in.

Assembling the Roller Race. Assemble the rollers in their two steel hoops, and then hoist the complete ring onto the roller path on the pivot plate. The wavy side of the roller ring is the bottom.

Installing the Carriage Body. An inclined ramp must be built outside and behind the emplacement, from the ground some 60 feet (~18 m) to the rear of the emplacement to a point just above the level of the floor above the entrance doors. At the ground level, the rearmost crib must be built to ensure that the top of the ramp will be at the same height as the rear of the trailer, to allow the sleigh to move smoothly from the trailer to the ramp. The ramp should consist of two lengths (four pieces) of timber, each 30 feet long by 18 inches square (~9.1 x 0.4 x 0.4 m). Each length should be supported at both ends and in the centre.



Timber cribbing. Wikipedia.

Cribbing must be built up on each side of the rear portion of the upper emplacement floors, and covered with timber to ensure that no weight comes on the concrete and teak flooring. Cribbing must be built over the pedestal for the carriage body to rest on before lowering. The sleigh for the carriage body should consist of three 14 foot x 8 inch square (~4.3 x 0.2 x 0.2 m) timbers with 6 foot (~1.8 m) planks running crosswise. Ten inch (~25 cm) rollers should be used.

Jack the carriage body up above the trailer and slide the sleigh and rollers under it. Lower the body onto the sleigh. The drag-line of the crane can be used as power for hauling (as can a suitable holdfast and tackle). The body will then be hauled up the ramp and onto the skidding over the pedestal. From here it will be jacked down onto the roller case.

Installing the Shell Pit Shield. [The shell pit shield formed the floor of the upper working level of the mounting.] The front, rear, and two side cantilever brackets can now be hoisted into place and bolted to the carriage body. Note: when mounting a new gun or fitting a new shield, the front cantilever should be fitted first, and the mounting rotated completely to ensure that there is sufficient clearance all round the emplacement. The plates of the shell pit shield are then securely bolted into position. The centre pivot should then be slung into position, dropped into its bearing in the body, and the nuts tightened.

Mounting the Cradle. The cradle is the first part to be mounted from the parapet, using the crane, if available. Before the cradle (usually complete with elevating arcs) is mounted, the cross shaft holding the two elevating arc pinions should be fitted to the carriage body. The air cylinder and buffer cylinder for the recoil mechanism will probably come installed in the cradle. If so, the piston rod should be withdrawn and all packings carefully checked, lightly oiled, and reassembled. The trunnion bearings and trunnion must be thoroughly cleaned and greased. Cribbing must be built up from the rear of the body to a point just below the height of the rear transom of the cradle, when the cradle has been mounted and in a horizontal position. The cradle can now be hoisted into position, and let down easily into the trunnion bearings. Ensure that the elevating arcs and pinions are meshing properly. At this point, the cradle must rest on the two trunnions and the cribbing underneath rear transom of the cradle.

Installing the Gun Barrel. [Keep in mind that the barrel was more than 36 feet (~11 m) long and weighed almost 28 tons.] The guide clips of the cradle must not be in position, and the guideways for the sliding bars must be thoroughly clean and well greased with a graphite grease. The carriage body will have to be rotated so that the cradle is correctly aligned for the barrel to be run muzzle first onto its guideways. The body must now be jammed in this position, and cribbing erected between the emplacement floor and the shell pit shield, particularly under the front and rear cantilevers.

A horizontal ramp must now be built to the rear of the cradle using 20 foot x 18 inch x 12 inch (~6.1 x 0.46 x 0.3 m) timber. One length (two pieces) is sufficient. The ramp must be level and high enough that the top of the 30-foot (~9.1 m) blocks of the main ramp to the top of the emplacement will be about 6 inches (~15 cm) below the top of the guideways in the cradle. To the rear of the main ramp, another inclined ramp must be built connecting the 30-foot (~9.1 m) blocks to the rear of the trailer carrying the barrel. To the front of the cradle, another horizontal ramp must be constructed, level and parallel with the horizontal ramp at the rear of the cradle. Skids 20 feet x 12 inches square (~6.1 x 0.3 x 0.3 m) will be sufficient, with suitable cribbing underneath.

A suitable holdfast must be constructed at the front of the cradle. Fastening two 6-foot (~1.83 m) pieces across the doorway of one of the personnel shelters in the pit is the easiest method. A strong tackle using 6-inch (~15 cm) rope should be made up with the running end coming off the stationary block. Rope must be wrapped around the muzzle of the barrel for about one foot (~0.3 m) and the moving block fastened to a wire sling (if possible) with the sling attached to the rear of the lashing on the barrel. A steadying lever will be roped to the breech of the gun.

When all is ready the barrel will be jacked up on the trailer and 12-inch (~0.3 m) rollers positioned beneath it. Using the drag-line of the crane for power, if available, or manpower if not, the barrel will be hauled off the trailer, up the short ramp, and onto the 30-foot (~9.1-m) blocks. When in position, the front and rear gun bands and then the two sliding bars will be fitted, all joining surfaces having been previously cleaned and red-leaded [a rust preventative] just before assembly. The barrel will now be hauled forward. It will be found that, by keeping rollers under the rear, the muzzle will travel sufficiently far forward to enable rollers to be placed between the front ramp and the muzzle. The barrel can then be hauled directly forward until it is in the required position then, by jacking, the rollers can be removed and the barrel will settle down on its sliding bars. The buffer nuts can then be attached, and the guide clips put in position. Steel retaining bars will be bolted from the rear securing bolt of the clip plate on one side to a bolt on the sliding bars, to prevent the gun from sliding back before the recoil system is charged.

Assembling the Platforms and Small Parts. All the larger separate parts of the mounting should now be hoisted into position and properly assembled, as this will be almost impossible to do after the main shield is in place. These parts include the mantlet shield, the counterweight, the air blast bottles and frame, and the stationary platform, the ammunition hoist with its guideways and frame, various brackets, rammer, loading tray, girders for the main shield, and all the small brackets, hydraulic pressure pipes, air-blast pipes, etc., that can be easily installed without the direct aid of an RCOC artificer.

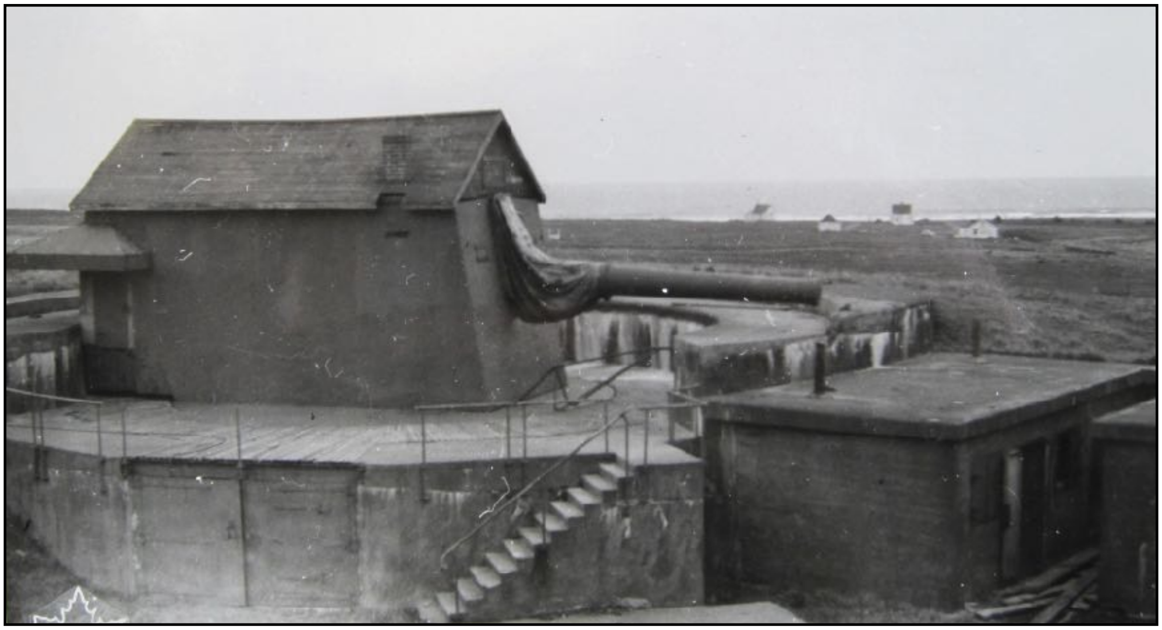
Assembling the Main Shield. With the girders supporting the shield having been assembled, the front portion of the main shield can now be hoisted into position and bolted up. The six side pieces can then be assembled (three on each side) and finally the three top portions.

Finishing up. All the heavy machinery and cribbing can now be removed, and the master gunner and artificer with a working party can complete the installation of the various small brackets, hydraulic pressure pipes, air blast pipes, auto and direction sights, D/C and E/R gears, electrical installations, electrical firing gear, breech mechanisms, etc. The various control levers and valves of the hydraulic system must be very carefully set up and adjusted, and all joints on the hydraulic gear and air blast system must be jacked with copper or white metal washers, care being taken to ensure that all joints are tightened up uniformly to ensure no damage to the washers. All working speeds and necessary adjustments to hydraulic gear, will be made in accordance with "*Notes on Operational Adjustments and Erection of Mounting 9.2-in. Mk 7 1942*". The hydraulic system must be thoroughly "bled" of air before starting to operate any of the individual systems, and after a good test of all systems, the hydraulic oil must be filtered to remove any foreign material which may have stuck in the pipes or motors. When all the various mechanisms have been tested and found to be working correctly, the mounting may be turned over to the officer commanding for operation.

This was the plan. If nothing else, it indicates the degree of effort that was necessary to mount a 9.2-inch gun. Although it appears long and detailed here, it was really only a guideline for the master gunner and artificers doing the work. Note the amount of manual labour involved in building ramps and cribbing and hauling multi-ton pieces of metal into position.

Installing the Guns at Devils Battery, 1941-1942

On 5 August 1941, a master gunner took up residence in the fort, and the working party of artificers who would carry out the installation of the guns arrived on 18 August. As noted earlier, the aerial photographs taken during the installation show a large mobile construction crane on the site, which would have been a significant assist to the workers. The installation of the guns began the following day. On 21 August, one officer and 40 other ranks from the 52nd Coast Battery arrived. While most of the work was supervised and carried out by the master gunner and the RCOC armament artificers, the gunners provided the manual labour. X-3 gun [the left gun] was the first mounting to be installed with the main work being finished on 12 September 1941. The next day, work started on X-l [the right gun], leaving an RCOC artificer and a party of men to fit all the



The rear of No. 1 gun emplacement (right hand gun) at Devils Battery after the gun had been installed and camouflaged. The rear doors that provide access to the pit (ground) level of the emplacement are in the left foreground. The circle of the shell pit shield can be seen to the front of the gun under the barrel. It formed the working platform for the gun inside the gun house (which has been camouflaged to appear to be a house). During installation, a ramp was built behind the emplacement over the doors and the concrete top of the emplacement covered by timber so that the carriage could be hauled up over the top of the concrete and eventually lowered into the emplacement. The flat roofed building to the right of the stairs covers the pump chamber for the emplacement. The gun is traversed to the right. The centre of its arc of fire was a rough line from the doors over the small buildings in the background. The proximity to sea level is apparent. Devils Battery Fort Record Book.

small parts to X-3. The main work on X-l was finished on 27 September and the gun mounting party left the fort soon after, since the X-2 [centre] mounting had not yet arrived. During October, the installation of the small parts on the two mountings continued. There are lurid stories on the Internet claiming that a barrel was dropped during the assembly. There is no mention of this in the fort record book, nor in the armament files in the LAC. If this had actually happened, the barrel would have to have been carefully examined and some report generated. It could not have been covered up, and the internet accounts are considered to be folklore.

During October, the hydraulic pumps and motors arrived for the pump chambers and were installed by the Royal Canadian Engineers. Civilian engineers from the Canadian Ingersoll Rand Company and Dominion Engineering Works Company assisted in the installation of the air compressors and the diesel engines respectively and, by the end of the month, the equipment in the pump chambers was successfully powered up. During November, the hydraulic system was installed in the guns, and pressure and exhaust lines were laid to the pump chambers.

On 12 December, parts of the third mounting (X-2) arrived and the installation started. However, the mounting arrived in dribs and drabs and was a long time being assembled. Mountings X-1 and X-3 were tested successfully on 15 January 1942 using hand power and Devils Battery was considered to be in action as of that date.

On 16 February, the hydraulic system on X-1 gun was powered up, with X-3 following the next day. After about a week of careful adjusting and testing, the gun detachments carried out their first gun drills using hydraulic power.

During January 1942, considerable work was carried out in No. 2 pump chamber to try and stop the water seeping into the room, which had completely stopped the installation of any high voltage electrical equipment. The X-2 mounting was successfully manually tested on 21 April. Hydraulic tests followed shortly after, but X-2 had to return to manual operations because of the leaks in its pump chamber, which again caused all the electric motors to be shut down.

On 16 July 1942, the installation of the electric firing gear was complete and tested on X-l and X-3 guns. X-2 gun followed on 29 July. All three guns fired live ammunition and were calibrated on 30-31 July 1942.

Improvements and Upgrades, 1942

The steam plant that heated all the underground works, except for the magazines, was finished during July. An workshop was built for the artificers and the machine tools were set up, although 220-volt electric power for the lathe and pedestal drill were not available for some time.

On 27 August, two 40-mm Bofors anti-aircraft guns were assigned to the defense of the fort, replacing three .50-inch Colt machine guns that had been the only anti-aircraft defence up to that time. The Bofors was being manufactured in Canada, and by the summer of 1942, was available in sufficient quantity that light anti-aircraft protection could be provided for the coast defence batteries. However, although the overall anti-aircraft defences of the ports and harbours were manned by anti-aircraft gun batteries, the 40-mm guns at the coast batteries were supposed to be manned by the coast gunners as a secondary duty. This saved manpower on paper, but never really worked. The gunners had to be trained to operate two very dissimilar guns, and acquire two different skill sets, such as aircraft identification and ship identification. Although the Colts were comparatively ineffective, having one of the ammunition numbers man a machine gun on an anti-aircraft mount to deter an attacking aircraft was feasible, but losing half a coast artillery detachment to man an anti-aircraft gun at the same time as trying to engage a moving ship was not. The two Bofors guns were withdrawn on 11 June 1943.

The 6-pounder sub-calibre guns arrived and were fitted to their parent guns on 8-9 October. The air blast fittings for the breech had been late in arriving, but were finally installed and tested on X-l and X-3 guns on 17 December 1942, and on X-2 on 17 February 1943. The X-2 installation could not be completed earlier because parts were not available.

Routine Operations, 1943-1944

By early 1943, both the Flandrum Observation Post and the radar station at Osborne Head were fully in action. In mid-March, a 30-foot (9.14 m) high wooden tower was erected just to the north-east of the fort. Shortly after, a new CDX type radar set was installed on top of the tower for an experimental shoot with the guns. The shoot was carried out on 10-11 April with excellent results, and the radar was then taken down and shipped back to the National Research Council for further adjustments and development. The tower was left standing, but was replaced in 1944 by a concrete observation post with a CDX radar on the roof.

The results of some of the shoots are recorded in the fort record book. In general, the 51st Coast Battery carried out a full-calibre live firing practice in the spring of each year, with other sub-calibre practice firings during the year. Some of the results were as follows:

> On 9, 10, and 13 February 1943, the battery fired a total of 344 practice shot using the 6-pounder sub-calibre guns. The gun drill was considered to be good, but the fall of shot could not be observed. This was not unusual with the small 57-mm 6-pounder shot in any sort of choppy water. The 6-pounder was used as “bring to” gun by the port Examination Service. A frequent excuse from ship’s captains who ignored the requirement to stop and be boarded by the Examination Service on entering the harbour was that they did not see the gentle reminder from the port’s 6-pounder gun. On the other hand, if the ship did not stop, the close defence 6-inch guns would gleefully drop a 100-pound (~45 kg) shot “as close as necessary”, which usually got the captain’s attention. On docking, the captain had to pay for the ammunition used to stop him, which was an additional reminder.
>
> On 15 March, a full-calibre 9.2-inch shoot fired fifteen 6-crh practice shot using ¾-charge. The results were not good because of poor settings on the sights. Also, No. 2 gun broke a retainer bolt and misfired.
>
> On 19 March, another full-calibre shoot fired twelve 6-crh practice shot using ¾-charge. Again the results were not good because the salvos fell far short. In this case, the fortress rangefinding system was blamed for the problem.
>
> On 22 March, they fired 137 practice shot using the 6-pounder sub-calibre guns. The drill was good, but the fall of shot could not be observed.
>
> On 10 and 12 April, they fired 26 full calibre practice shot and six armour-piercing (capped) shot using ¾-charge as part of the CDX radar trials. As noted above, the trials were considered very successful.
>
> On 7 July, they fired 138 6-pounder practice shot. The drill was good but, as always, the fall of shot could not be observed.

> During January and February 1944, they fired 403 6-pounder practice shot with the usual observation problems. Although this may seem frustrating, regardless of the results, gunners always appreciate live firing compared to endless dry-firing drills.
>
> On 7 and 9 February 1944, the battery fired 53 full calibre 4-crh and 6-crh practice shot using ¾-charge. The fort record book includes a very detailed critique on their performance by the chief instructor of gunnery at Halifax. However, in general, the critique was favourable.

The summer of 1943 passed without incident. The fort had been manned for two years, and many changes were noticeable. The ground had been filled in and graded completely around each gun position, bringing the level of the ground even with the top of the parapets. Two old ex-civilian buildings just inside the west boundary of the fort had been converted to storage sheds, and a hospital had been built just inside the northeast corner of the fort. New officer's quarters were built just outside the fort on the north boundary, and the old officer's quarters inside the fort was turned into a recreation hall. A new barracks was built to the north of X-3 emplacement. Grass seed and buckwheat was sown all over the fort and instead of a large expanse of mud and dirt, the surface of the fort was almost completely covered with a mixture of these two herbs.

Devils Battery Stands Down, August 1944

Devils Battery ceased operation at 0307 hours on 31 August 1944. (This is recorded in the fort record book. The master list produced by NDHQ notes the battery as non-operational on 10 August. This probably reflects the difference between the staff giving an order, and the work actually being carried out.) A maintenance group of a master gunner, one sergeant, and 21 gunners, as well as a sergeant and nine sappers from the Royal Canadian Engineers remained to look after the equipment and infrastructure. The remainder of the personnel were transferred to other batteries and depots.

Excavations for a concrete building for the CDX radar had begun early in 1944. The building was completed in August and, notwithstanding the closure of the battery, the supporting equipment was installed in September. The CDX radar was eventually installed on 5 February 1945, and put into action in the coast surveillance role.

After the War

The closure of the battery was not the end of the story. Easily removable equipment (such as sights, Magslip receivers, gun tools, etc.,) was removed from the guns and returned to the ordnance depots for preservation and storage. The guns themselves were placed in long term preservation - painted, oiled, and greased - and left in situ. The wooden accommodation and housing was allowed to deteriorate.

The ammunition was left in the magazines. Moving it to an ammunition depot would be a major expense, and as long as the battery had a maintenance staff, it was relatively secure. However, the water problems continued. In April 1946, the Command Ordnance Officer reported that there was considerable seepage in No. 1 gun's magazine. This was due to water coming through the walls, and down the escape hatch and ventilator. As a temporary measure, the cartridges had been moved to the other two magazines, but this was not a permanent solution because it overloaded those magazines. The Command Engineer questioned why the ammunition had to remain in the battery, but was told that it was an operations decision, which had been challenged but would not be changed. There was no immediate fix, but money was made available in 1948 to carry out some repairs. As noted in Chapter 7, authority was finally given in 1949 to remove the ammunition to a depot.

Dismounting the Guns, 1954[21]

The events leading up to the disposal of the 9.2-inch guns has been recounted in Chapter 7. Starting on 1 October 1954, as authorized under NATO JSC 6001 - 33/4-7 (RCOC) dated 15 September 1954, the equipment installed in Devils Battery, complete with fire control instruments, ancillaries, and associated stores were dismounted and sent to Turkey as NATO mutual aid.

The working party was commanded by Lieutenant M.J. Blackwood with Master Gunner L.E. Wheaton, seventeen men and three cooks from 49 Harbour Defence Battery, RCA, with three RCASC drivers, and a RCEME Armament Artificer, fitter, and operator for the medium breakdown vehicle ("wrecker" or "recovery vehicle" in modern terminology). Two night watchmen and some civilian carpenters and labourers were also hired. Lieutenant Blackwood had commanded the working party that removed the guns from Oxford Battery the previous year.

Unlike the installation thirteen years earlier, a large number of vehicles and powered equipment was available. These included a medium recovery vehicle with its crane and winch, a 5-ton forklift, an FWD tractor and trailer, a D6 Caterpillar tractor (later replaced by a larger D7 Caterpillar tractor), and a 15-ton crane. A 30-ton crane was later added.

Work started on 4 October, using the wrecker to remove shield plates, etc. It was found that the nuts and bolts holding the rammer canopy were so rusted that they could not be removed with wrenches, and had to be hammered off using a 10-pound sledgehammer. New nuts and bolts were obtained from the ordnance depot and placed in the shipment. Timber and skidding arrived on 6 October. Lack of a crane delayed the removal of the shield plates, and it was necessary to use the wrecker. This was slow, because of the 4-foot (~1.2 m) drop from the apron to the height of the gun working level (not the emplacement floor). This difference in height forced the boom of the wrecker be extended further and reduced its lifting capacity than would have been the case if the emplacements were more conventional. The work of chipping, cleaning and preserving the mounting progressed slowly due to heavy rain and wind gusts up to 50 mph (~22 metres/second).

The last gun barrel leaves Devils Battery in November 1954 on a civilian tractor-trailer. The weight was approximately 31 tons. The trailer was 23 feet (~7 m) long, and the overhang was 14 feet (~4.3 m). Devils Battery Fort Record Book,

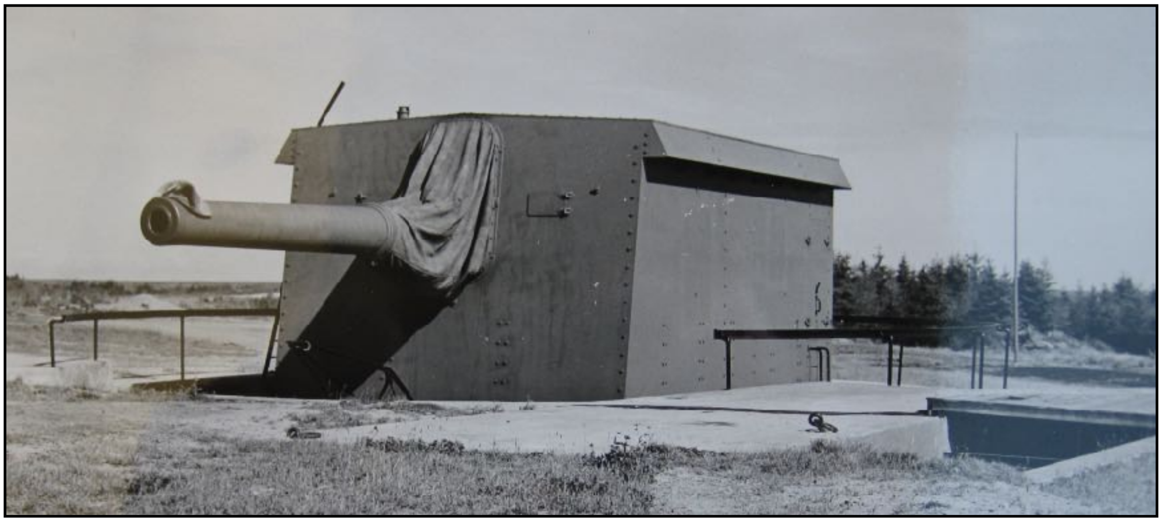
The 15-ton crane finally arrived on 2 November but, due to muddy ground, it was two days before it could get to No. 3 gun. The crane was quite effective when placed in position, even though the operator expressed doubts about its ability to lift the required weights. The crane had been originally rated for 20 tons, but had been derated to 15 tons due to its age and condition. By 5 November, due to the muddy ground, the situation was so bad that Blackwood asked HQ Eastern Command to provide two crawler cranes with a total lifting capacity of 40 or more tons. This was not approved, but the RCN provided a 30-ton wheeled crane to assist the existing 15-ton crane at the battery.

A D6 caterpillar tractor was obtained and used extensively to pull equipment out of the mud. Finally, on the weekend of 13-14 November, the temperature dropped and consequently the ground became quite hard, making it possible to move the wheeled equipment without being towed. However, rain started early on the afternoon of 19 November, and made it very difficult to move the pedestal from No. 1 gun to the cleaning area. It was necessary to pull the tractor-trailer with the wrecker and push it with the D6 tractor.

The movement of crates and equipment from the battery to Shearwater started on 22 November using all available trucks. Shearwater only had a 3-ton forklift available, which restricted the shipment to crates that could be handled by this vehicle. Two heavy civilian trailers arrived the following day on a seven day rental. The three carriage bodies and three barrels were transported from Devils to the Naval Armament Depot at Dartmouth on these two trailers on 23, 26, and 29 November. It was necessary to lay the carriage bodies on their sides to make the trip due to the 13-foot (~4 m) clearance at the underpass at Imperoyal. As soon as the barrels and carriage bodies had been moved to the Naval Armament Depot, the 30-ton crane was moved to Shearwater. This allowed the shipment of heavier items as there was a crane available at both the loading and unloading sites. Shipping of the stores to Shearwater was completed on 3 December.

By 30 November all cleaning, preserving, and crating had been completed and the area had been cleaned up as much as possible under the circumstances. All civilians were laid off except the night watchman. The skidding was returned, the camp closed, and the stores were returned to 12 Regional Ordnance Depot by 8 December. Devils Battery was abandoned.

Chapter 9 - Oxford Battery, Sydney, Nova Scotia



A 9.2-inch Mk 15 gun on Mk 9 mounting at Oxford Battery. Note the extreme simplification of the concrete in the emplacement with no parapet and the lack of an open pit behind the gun. The gun house is completely enclosed. Oxford Battery Fort Record Book.

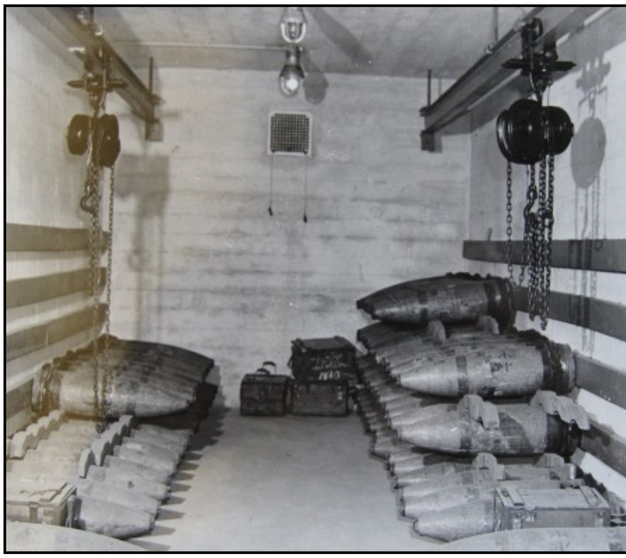
The chronological events leading up to the construction of Oxford Battery in Sydney, Nova Scotia, have been recounted in the previous chapters. This chapter includes more details on the construction and operation of the battery. All materiel has been sourced from the Oxford Battery Fort Record Book, held in the Library and Archives, Canada.[22]

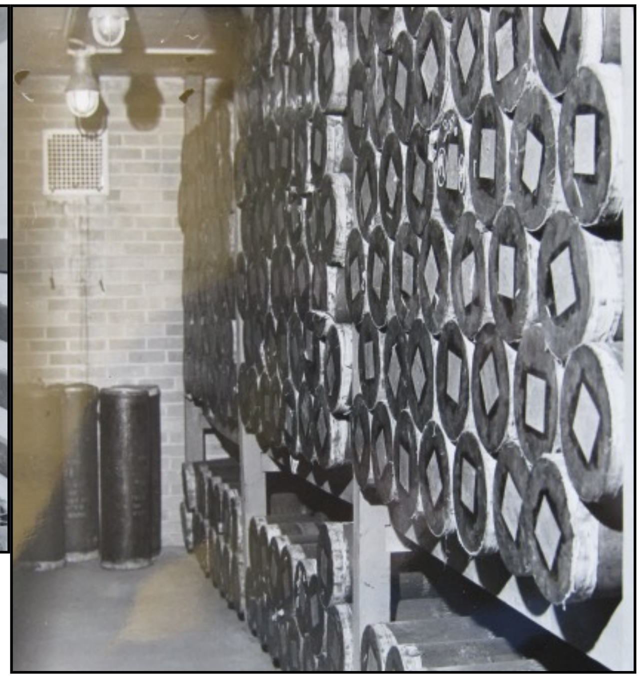
The Specifications

The construction of Oxford Battery began after Devils Battery had been completed, and took advantage of some of the experience from constructing the latter. A meeting in Halifax on 28 September 1942, with representatives from Atlantic Command, National Defence Headquarters, the Royal Canadian Artillery, the Royal Canadian Engineers, the Royal Canadian Signal Corps, and the Camouflage Department addressed the overall requirements.

The gun emplacements were to be built to the “modified emergency pattern”. All excess surface concrete was to be eliminated. There were to be no aprons, no parapet and, from one foot (~25 cm) in front of the gun pit shield, all concrete was to be be stepped down to to allow 18 inches (~0.46 m) of earth cover. There was to be no major depression to the rear of the gun pit as at Devils Battery, just steps down to the pit floor. The holdfasts in the concrete floor for the pedestal were to be redesigned and made as simple as possible.

It was extremely important to design the emplacements to ensure good drainage, and to prevent water from entering and ice from forming in the pit. The emplacements were to be heated, and the interior of the gun house had to be reasonably warm and dry [the Mk 9 mounting used a completely enclosed turret-style gun shield]. The cartridge recesses on the gun pit floor were to be lined and heated, and the lighting and switches, etc., in the gun pits were to be waterproofed. This is the first indication that the army was aware of the Canadian climate.





A magazine shell room (left) and cartridge room (right) at Oxford Battery. Each gun had two magazines. Oxford Battery Fort Record Book.

Each gun would have two magazines, with both projectiles and cartridges being stored in each magazine. The floor of the magazine would be at the same level as the floor of the gun pit (about seven feet (~2.1 m) below ground level). No magazine entrance would face seaward, and the magazines would be spaced so that if one was destroyed, the other would survive. The magazines would be the semi-surface type, with only light overhead concrete protection and covered with an earth mound with grass planted on top. The general idea was that if a magazine exploded, the force would be directed upwards and would not affect the adjacent structures.

Shells would be moved between the magazines and guns through covered trenches, the floors of which would be seven feet (~2.1 m) below ground. These would have concrete walls with a light roof for camouflage and snow cover. The trenches would have a single track trolley line, with the track grade kept constant between the magazines, the floors of the gun emplacements, and the battery ammunition delivery point. Trenches were considered superior to surface tracks due to the ease of concealment, and would also serve as a method of moving personnel around the battery area while avoiding tracks on the surface of the ground (the camouflage lessons of hiding surface movement from aircraft reconnaissance were being absorbed). The trenches would be adequately lighted, and there would be insulation under the gun pit shield and in the magazines.

An entrance trench from the accommodation area would connect to the main trench system. The trenches and trolley tracks between the magazines and the guns would enter the gun pit from the rear, but outside the seaward arc of fire of the gun. The trench trolley tracks would be brought into the gun pit and run parallel with the tracks for the loading trolley for a short length to allow the projectiles and cartridges to be rolled from one trolley to the other without lifting.

The personnel shelters and the storage room for the gun tools and equipment at each gun were to be an integral part of the gun emplacement. They would be below ground level, constructed of concrete, and proof from shell splinters. The ventilation and lighting in the shelters was to receive special attention in order to maintain the detachments at maximum efficiency. The shelters were to be properly floored and lined, heated by steam from the heating plant, and have built-in cupboards, shelves, benches, tables, and a latrine.

A central ten by sixteen foot (~3 by 4.9 m) general storage room, and a ten by six foot (~3 by 1.8 m) paint storage room were to be built, and would be of similar construction as the gun pit storage room. A workshop with three independent bays for the gun artificer, the RCE section (who maintained the generators and plant equipment), and the electricians would be designed in consultation with the RCOC, RC Sigs, and Directorate of Artillery.

Each gun needed an engine room with an electrical generator. A pump chamber would be incorporated into the engine room. Each generator was to be capable of handling two guns if necessary, and the necessary emergency wiring and switching was to be installed. The engine rooms were to be just below grade and splinter-proofed. They had to be carefully ventilated, lighted, sound-proofed, and equipped with sound-proofed telephone booths or loudspeaking telephones.

Each emplacement would have a recess for the proper termination of the Magslip and signal cables, which would be connected to the signal trenches and ducts. A ½-inch (~12-mm) conduit from the emplacement to the men's shelter was necessary for an alarm circuit.

All gun pits, magazines, stores, shelters, the battery plotting room (BPR), and the battery observation post (BOP) were to be heated by either hot water or steam from a central plant. Floor drains were required in all rooms or areas below grade. All wood was to be covered with two coats of dark green service paint.

The battery plotting room (BPR) was to be underground, and was to be shell and bomb proof. The command post, signals switching room, and generator room were to be incorporated in one building. It was to be floored, lined, and sound-proofed, and steam heated with suitable lighting. Gas proofing (from poison gas) could be provided, if necessary. The entrance would be by a sloped shaft, not a vertical shaft, and the emergency exit was to be well separated from the BPR. The emergency exit hatch cover was to be a sliding type, and designed to be easily moved by a wounded man or Canadian Women's Army Corps personnel. Latrines were to be provided for both male and female personnel. This is the first indication of the potential use of female personnel in the Canadian coast artillery. Although there is no evidence that females formed part of the batteries during the war, the postwar conference confirmed that women could carry out most of the coast artillery gunner functions, and could be an enhancement to recruiting.[23]

The interior layout of the battery observation post (BOP) would be determined by experiments at NDHQ. The camouflage officer would determine the most suitable shape for proper concealment. The interior would be steam heated, lined and floored, provided with latrines, and have suitable black-out arrangements. The depression position finder (DPF) pedestal was to be part of the floor slab. The lighting had to be carefully arranged with regard to fighting efficiency. Arrangements for counter-balancing the DPF telescope arm would be included in the plans. Shelves, cupboards, chart table, and furniture were to be constructed by the contractor. Steel window shutters were not required.

The Battery Observation Post under construction at Oxford Battery. Oxford Battery Fort Record Book.

The BOP was to be equipped with two battery commander's desks, a desk for the battery commander's assistant, five telephone operator desks, and a six foot by four foot (~1.8 by 1.2 m) chart table, as well as shelving, and cupboards.

A camouflage plan was to be included in the construction specifications, and it would be rigidly adhered to. The accommodation and gun areas were to be considered as a group and carefully coordinated from operational and camouflage viewpoints. The infantry security detachment was to be quartered at some distance from the battery to avoid over-crowding the area. Steel doors and shelters were to be eliminated wherever possible, and galvanized iron would be used instead of copper for all flashing.

The supporting radar installation should be designed as an integral part of the battery, not as an afterthought. This included its power plant, radio equipment, and accommodation.

In summary, the construction of the battery was to be as simple and economical as possible. It obviously took into account the problems at the waterlogged Devils Battery, as well as common sense consideration of the Canadian climate. It was also the first battery to be constructed to Canadian requirements, as opposed to Devils Battery that was designed to the prewar British practice. It was also the first Canadian battery to be equipped with the modern Mk 15 gun on the Mk 9 mounting.

Construction and Installation of the Guns

The E.G.M. Cape & Company, Limited, of Montreal was the lowest bidder, and was awarded the contract to construct Oxford Battery at a cost of approximately $1.2 million dollars. The excavation for the No. 1 gun emplacement started on 11 August 1943, and pouring concrete began on 25 August. Progress was slow and by 15 January 1944, the emplacement was still not ready.

The cost estimate for moving the three guns and mountings from the Sydney Mines and Florence railway stations to the battery location was $12,600. This included obtaining a trailer from Montreal and reinforcing two wooden bridges. The first shipment arrived on 24 January 1944: two rail cars with four crates weighing 30 tons in one car, and six crates weighing 29 tons in the second car.

The 36th Coast Battery stationed at Chapel Point began transferring the heavy components onto flatbed trucks and moving it to the battery site. Cranes and trailers were borrowed from the RCAF and the Sydney harbour boom defence organization, and the first shipment had been moved to the battery by 26 January.

Three more rail cars arrived on 30 January: one with two crates weighing 31 tons, the second with two crates weighing fifteen tons, and the third with two crates weighing twelve tons. The RCAF crane could not lift the crates, so a crane was again borrowed from harbour boom defence. The roller race and ammunition hoist were moved on 1 February. The weather caused delays and the roads were in very poor condition. Snow made the skidding slippery and dangerous. Unloading the rail cars and transporting equipment to the site continued at a slow pace but, by 6 February, almost 158 tons of materiel had been moved to the battery site. The gun barrels arrived at Sydney on 10 February 1944. The carriages and cradles arrived and were moved to the battery on 23-24 February. At the battery, the cradles had to be removed from the trailer manually using an artillery gyn (tripod) in sleet. Reading the notes in the Fort

Record Book, it is a wonder that nobody was injured and no equipment was damaged in the transfer. The assembly of the mountings began soon after.

On 17 July 1944, the War Office advised CMHQ that the third mounting for Oxford Battery would be delivered in six or seven months. Eventually, it would be delivered, but the battery was declared non-operational on 10 August 1944, before the installation of the first two guns was complete.

Nevertheless, work on assembling the mountings continued at a very slow rate. More than two years later, the first two guns were proof-fired. No. 1 gun (9.2-inch Mk 15 gun #L/538 on Mk 9 mounting #53) fired fifteen rounds of proof and practice shot using supercharge on 2 March 1946. The proof shot for the mounting was fired at an elevation of 34°. The following day, No. 2 gun (9.2-inch Mk 15 gun #L/543 on Mk 9 mounting #83) also fired fifteen rounds of proof and practice shot using the same procedure. Two years later, in May 1948, No. 3 gun (9.2-inch Mk 15 gun #L/547 on Mk 9 mounting #57) fired three practice shots to proof the mounting. All results were satisfactory. The spare barrel (#L/530) was never mounted. As noted in the main text, there are accounts on the Internet that claim the third gun was never installed. On the contrary, the Fort Record Book contains the report on its proof firing and a list of officers present.

For training, each gun had a 6-pounder subcalibre gun. When the battery was placed in long-term preservation, the subcalibre guns were removed and placed in storage on 26 July 1948.

In 1948, Oxford Battery was placed in reserve. All movable equipment in the battery observation post and plotting room was removed and returned to No. 15 Regional Ordnance Depot at Halifax. This included the CDX No. 1 Mk 1 Radar near the site. The sights, breech mechanisms, and other removable parts were removed from the guns and mountings and shipped to Debert, NS. The barrels and mountings remained on site, heavily greased and in long-term preservation. A caretaker remained on site as security and to run the generators.

Dismounting the Guns

With the decision in 1949 that Canada had no further requirement for the 9.2-inch guns, they were offered to NATO as mutual aid. NATO assigned the guns at Oxford Battery to Portugal, along with 1,500 cartridges and 1,000 projectiles. On 6 August 1953, NDHQ authorized the removal and shipment of the equipment installed in Oxford Battery, including spares and ancillaries, to Portugal. Supporting equipment included three 60-inch Canadian General Electric searchlights, three Gardner electric power generators, a depression position finder, a fire direction table, a battery plotting room switch, a CDX No.1 Mk. 1 radar, and a complete set of documentation and publications. Later, two remote control units, the cams for the automatic sights, the cams for the DC and ER Gears, and 4,000 ft of Magslip cable were added. At first, it was planned to ship all the equipment from Halifax, and it was proposed to move the equipment from the battery to the local railway siding. This was later changed to ship the major items from Point Edward Naval Base.

A working party under the command of Lieutenant M.J. Blackwood, RCA, left Halifax by road on 1 September 1953. They arrived at No. 221 Aircraft Warning Squadron, RCAF, at Lingan Hill that evening. The following day was employed getting settled in the new quarters, and a talk from the commanding officer of the RCAF Station. The rest of the week consisted of obtaining skidding and stores and preparing to start work on 8 September.

Due to the quantity and desirability of the stores, it was necessary to employ night watchmen at the site. They were employed in two shifts, 1615-0015 hrs and 2400-0800 hrs. Gunner W. LeBlanc, who was the permanent site caretaker, filled in from 0800-1615 hrs on non-working days.

Work got off to a slow start because of the lack of socket wrenches and other basic tools, which had to be scrounged from local units. The crane had not arrived, and the shield plates had to be removed using the RCEME recovery vehicle's crane, which was not particularly suited for this work. Finally, on 12 September, carpenter's kits, a blacksmith's chest, socket wrenches, and other tools arrived.

The first crane arrived on 21 September, and another on 25 September. After carrying out lifting tests on the spare barrel using both cranes, work moved ahead rapidly. The barrels could not be moved in wet weather, due to the danger of slipping out of the lifting harness. All hands were then employed in removing bolts and other parts, particularly below the shell pit shield. Using both cranes, No. 3 emplacement was cleared by 26 September, and No. 2 mounting was removed by 1 October. No. 1 mounting took longer, since one side of the shell pit shield had been attached to the cantilever section by rivets instead of bolts. It was also necessary to burn eight screws out of the shell pit shield, and to burn off the heads of five bolts holding the shell pit shield to the carriage body. No. 1 mounting was finally removed by 9 October.

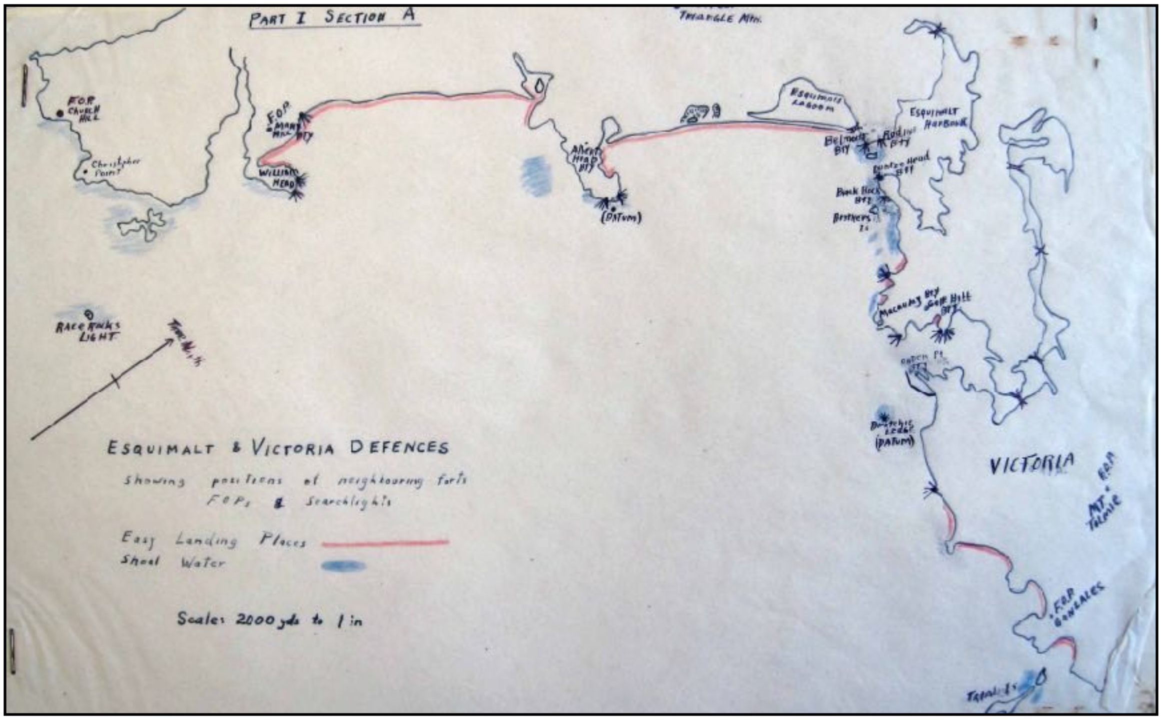
Two gun barrels were loaded onto rented trailers and transported to the Old Sydney Collieries No. 7 railway siding on 19 October. Cranes were walked to the siding, and the barrels were loaded onto flat cars. The following day, the last two gun barrels were loaded in same manner. The three carriage bodies were transported to the siding and loaded on one 50-foot flat car on 21 October. The six halves of the shell pit shields were transported to the siding and loaded into two gondola cars on 22 October.

All the other items (limited to ten tons weight due to the load limit of the road bridge) were transported to Point Edward Naval Base by road. A special permit for wide loads had to be obtained from the Provincial Department of Highways.

One crane was dismissed on 22 October. The gun barrels were off-loaded at Point Edward on 26 October. The carriage bodies were off-loaded at Point Edward onto sleighs on 28 October (this should have been done before shipment, but the material was not available). The shell pit shields were also off-loaded on the same day. The 5-ton fork lift was transported to Point Edward on 30 October. The bridge at Balls Creek was too low and the fork lift had to be off-loaded and then moved to Point Edward under its own power.

The working party returned to Halifax on 31 October. There followed several changes of plan, but in the end, the gun barrels were shipped to Halifax and loaded on the MV *Ribiera Grande* on 23 November. Three generators from Devils Battery were also loaded. The ship then sailed to Point Edward Naval Base where the rest of the stores were loaded on 25-27 November. The ship sailed for Ponta Delgada in the Azores at shortly after noon on 28 November 1953. Oxford Battery was closed.

Chapter 10 - Albert Head Battery, Esquimalt, British Columbia



The defences at Esquimalt, BC, centred on Albert Head Battery. LAC Albert Head Fort Record Book.

The chronological events leading up to the creation of Albert Head Battery at Esquimalt, British Columbia have been recounted in the previous chapters. This chapter includes more details on the construction and operation of the battery. All materiel has been sourced from the Albert Head Battery Fort Record Book, held in the Library and Archives, Canada.[24]

The Plan

Esquimalt was the Royal Canadian Navy base on the Pacific Coast, and was also strategically important because of the nearby entrance to Puget Sound and the United States Navy shipyard. The base had a large ammunition depot, a dry dock, and an ordnance depot containing mobilization equipment. Beside it, Victoria harbour was a large commercial port with oil storage tanks. Directly opposite, on the mainland, the port of Vancouver was the terminus of two transcontinental railways, and handled most of their traffic for the far east and Australia.

In his analysis, Major Treatt assumed a threat from two cruisers with 8-inch guns, two armed merchant ships, six motor torpedo boats, two minelayers, two submarines, and possibly air attack from improvised aircraft carriers. A landing by up to 250 soldiers was also possible. He recommended two counter-bombardment batteries at Albert Head and Gonzales Head, two close support batteries at Mary Hill and Fort Macaulay, and five anti-motor-torpedo-boat batteries in the harbour. A fortress rangefinding system and searchlight system would be needed.

For the counter-bombardment role in the Ultimate Plan, NDHQ decided that a three-gun battery with 9.2-inch guns on 35° Mk 7 mountings would be built on the promontory known as Albert Head, midway between William Head and Esquimalt Harbour. It would be supported by a two-gun battery of 9.2-inch guns on 15° Mk 5 mountings on Trial Island to the southeast of Victoria. The latter guns would be transferred from Signal Hill.

Three Mk 7 mountings were ordered for Albert Head Battery in fiscal year 1936/37 on War Office Requisition #7329. At the same time, the basic fire control equipment for the battery was ordered on WOR #7330. It was planned to use the three Mk 10 gun barrels from Halifax, which were being relined in Britain, on these new mountings. Northern Construction (J.W. Stewart, Ltd.) began building the new battery at Albert Head in early October 1937.

In March 1938, the War Office advised Canada that the three Mk 7 mountings would not be available until 1939/40. This was not satisfactory, and the resulting Interim Plan for Coast Defence caused the two Mk 5 mountings at Signal Hill to be moved to Albert Head. The emplacements at the new battery were designed for the Mk 7 mountings and adapters were made locally to allow the existing Mk 5 mountings to be installed.

On 25 March 1938, War Office advised Canada that the first of the three 9.2-inch Mk 10 barrels that were in the UK having their liners (inner “A” tubes) replaced had been completed. The second barrel would be ready in April, and the third one in May. Each barrel would then require a month for proof firing and inspection. Notwithstanding the War Office estimates, the guns were not shipped to Esquimalt until 2 September. As soon as the three relined barrels arrived in Esquimalt, the two barrels from Signal Hill (#L/220 and #L/242) were shipped to the UK to to have their liners replaced.

Gunners began to move the two mountings from Signal Hill to the B/2 and B/3 gun positions at Albert Head in January 1939, and the job was completed by the spring. Two of the relined barrels were used, with the third being placed in storage pending the arrival of its Mk 7 mounting. Because of the difference in height between the Mk 5 and Mk 7 mountings, the Victoria Machinery Depot constructed four foot six inch high (~1.37 m) adapters for the emplacements,. All communication cabling was laid by the Royal Canadian Corps of Signals.

In June 1939, the 56th Heavy Battery, RCA, (later renamed 56 Coast Battery) carried out their annual training by firing a series of 9.2-inch rounds using ¾-charge. On 26 August 1939, the battery were placed on active service and permanently manned the guns.

As noted in Chapter 6, on 2 September 1939, NDHQ reviewed the overall coast defence requirements in the light of the probable delivery dates of new guns from Britain. Since the War Office refused to provide additional Mk 7 mountings (beyond the three already on order for Albert Head) without the return of the Mk 5 mountings in Canada, the Ultimate Plan had to be amended. The immediate threat was to the east coast, so NDHQ recommended that the three Mk 7 mountings on order for Albert Head be re-allocated to Halifax and installed at the proposed Devils Battery. The two mountings from Signal Hill would be at Albert Head for the foreseeable future.

Mobilization and Accommodation

Before the war, one Permanent Force sergeant and eight gunners ("district gunners") occupied the battery as caretakers and maintenance personnel. On 26 August 1939, at the beginning of the precautionary period (the warning that war might be imminent), the 56th Heavy Battery, RCA, commanded by Major S.R. Bowden, took over Albert Head Battery. At the time, the Non-Permanent Active Militia (NPAM) battery had a strength of five officers and 34 other ranks. A medical sergeant and two orderlies, and a signal sergeant and one signalman were attached to the battery. On 28 and 29 August, all personnel under the age of eighteen were sent home. On 2 September 1939, the NPAM were mobilized, recruiting began and, by the end of September, the battery strength had increased to 125 all ranks.

As soon as the fort was manned, 100 rounds of armour-piercing and high explosive projectiles were fuzed and placed in trolleys on the gun platforms and in the ammunition recesses, together with the necessary charges.

On mobilization, the accommodation consisted of one barracks building with a washroom and a combined cookhouse/mess hall. Both were being used by the district gunners, so more accommodation was urgently needed. For the first weeks of the war, most of the personnel were housed in tents. A store room and scullery were added to the cookhouse/mess hall, and an open air meat house with water evaporation cooling was added. Two large barrack buildings were built, each with good heating and ventilation. A third building was added later. Another building was altered to be the sergeant's mess and living quarters. The Ashe residence (a local house) was converted into an officers mess.

Although much time had to be spent in organizing the camp, training started immediately. Besides foot and arms drill and other recruit training, a lot of time was spent on gun drills and gun laying. A qualification course for sergeants, held in October 1939, had six successful graduates. Other personnel were sent on special courses to be trained as gas instructors, physical training instructors, machine gunners, artillery transport drivers, cooks, motorcyclists, mechanics, blacksmiths, concrete mixers, signallers, army intelligence, battery commander's assistants, and artillery artificers. From 1 to 23 November, a flight sergeant and two airmen from the RCAF were attached to allow training in engagements involving co-operation with aircraft.

Even though Albert Head was on relatively high ground, there were water problems. On 8 December 1939, during heavy rains, the pump in B/3 magazine failed, resulting in the magazine being flooded to a depth of six inches (~15 cm). Hand pumps and buckets were used to clear the water, which took several hours. After that, a new 60 gallon per minute (227 litre per minute) electric pump was installed. The original pump was overhauled and placed in the B/3 power room. The propellant charges in the magazine were inspected, but had not been affected since they were on shelving about 18 inches (~0.46 m) above the floor. However, all the shells had to be dried and re-oiled as they had been standing in about five inches (~12 cm) of water. After the flood, stands were built for the shells in all the magazines. An automatic pump was installed in the tunnel between B/1 and B/2 emplacements to remove water that seeped through cracked concrete.

A 9.2-inch gun on a Mk 5 mounting camouflaged with wire and chicken feathers at Albert Head early in the Second World War. Note the shadows of the men on the right.
LAC Albert Head Fort Record Book.

Extensive camouflage was worked out to hide the guns, roads, and the fort area generally. Stumps, shrubs, and bushes were planted, and nets were used to conceal the gun positions. Blackberry vines were planted along the east, south, and west fences, both as camouflage and to serve as a security entanglement. Outside the south fence, near the shore line, two dummy guns were constructed 150 yards (~135 m) apart. These were a considerable distance from the real gun positions, and stood out clearly to mislead any raiding force. Later, the camouflage scheme was continued to the east to make the area look like a farm. The guns were painted to resemble small barns or houses. Wire and chicken feathers, painted to conform to the surrounding ground, covered the concrete floors at the rear. The circular pits behind the aprons were filled in with a framework that was bolted to the gun shields and also covered with wire and chicken feathers. These stood up well to the shock of firing.

During 1940, new buildings were built near the power house for the master gunner's office and storage. The entrances to the three magazines and the power house were roofed over to protect them from the weather and to assist in camouflage. Training continued, and on 18 March 1941, the battery again fired a full-calibre shoot using ¾-charges.

Two Bofors anti-aircraft gun platforms were constructed in June 1942. As in the east, the guns were to be manned by the coast defence gunners. An administration building consisting of a battery office, battery commander's office, and a room for the clerk's sleeping quarters was completed in August 1942.

Upgrading the B/1 Mounting from Mk 5 to C Mk 6A

A 9.2-inch gun on a C Mk 6A mounting at Albert Head late in the Second World War. The gun is the box with the pipe on top of the hill and a "farm building" has been built on the rear as camouflage. It also sheltered the rear of the emplacement from the weather. LAC Albert Head Fort Record Book.

In early summer 1942, an order was placed with the Dominion Bridge Company for the conversion of five Mk 5 mountings to the C Mk 6A standard. The first mounting, which had been removed from Fort McNab, was expected to be competed by 15 October 1942. It would then be sent to Albert Head and installed using the spare Mk 10 barrel already at that location. The plan was that it would then be thoroughly tested, probably by 1 December 1942. Someone had definitely never mounted a 9.2-inch gun.

As always, the forecast dates were optimistic. The installation of the first C Mk 6A mounting at Albert Head (#A2488 from Fort McNab) began in January 1943.

It was emplaced in the vacant B/1 gun position, and the third barrel of the first relined group (#L/264) was installed on the mounting.

With all the activity associated with the upgrade, a new fitter's (technician's) workshop and blacksmith shop were constructed on the road behind the guns in April 1943. Despite the plan to test the mounting by December 1942, it was June 1943 before the mounting was proof fired. The proofing was successful. The performance of the gun and mounting were carefully evaluated, and B/1 was placed in action pending minor alterations. The gun was fired operationally about a week later, and Albert Head was at last a three-gun battery. However, the new mounting was limited to the effective range of a Mk 5 mounting because the improved fire control instruments for the longer ranges had not been delivered. In July 1943, CMHQ were advised that they were required immediately.

Upgrading the B/2 Mounting

By the end of November 1943, the second Mark 6A converted mounting (originally from Sandwich Battery) was nearing completion at Dominion Bridge. NDHQ issued instructions that, as soon as it was shipped, the second "unmanned" Mk 5 mounting at Albert Head should be removed and the necessary parts shipped to Dominion Bridge for conversion to the C Mk 6A standard. They estimated that the converted mounting would be in transit for two to three weeks, which should allow enough time for the disassembly. This is one of the the references indicating that only two guns at Albert Head were manned. While all three guns were eventually proof fired and became theoretically operational, the number of authorized personnel for the battery only included two gun detachments. However, in an emergency, there were enough gunners in the area to find the personnel for a third detachment, although training would be required.

A significant portion of the existing Mk 5 mounting could be used in the Mk C 6A conversion. Parts included the side, bottom, and front plates, front and rear bolsters, all the transoms and bearings, the pivot plug, cradle, buffer, and recuperator, the complete elevating and traversing gear including all the shafts, gears, and bearings, and the shell pit shield brackets. The cost of disassembling the old mounting and assembling the new one was estimated to be $1,000, in addition to the "free" military labour.

The second C Mk 6A mounting (#A2300) was shipped from Dominion Bridge on 16 December. The disassembly of the Mk 5 gun in B/2 emplacement began on 27 December and was complete by 7 January 1944. Preparing the emplacement for the new mounting began the next day and the new C Mk 6A mounting was in place by 2 February 1944. The installation of gun barrel #L/224 on the new mounting began shortly afterward and the equipment was operational on 2 April 1944, although some modifications were not complete, including the installation of the water blast mechanism into the breech.

Lieutenant W.J. Jussup, the RCA Armament Officer for the Esquimalt Fortress, kept an official official diary of dismounting and re-mounting B/2 gun. An edited version is below. The work was carried out by the battery gunners, assisted by artificers from the local Royal Canadian Ordnance Corps workshop, and Royal Canadian Air Force cranes.

> Monday, 27 December 1943. All the small parts, camouflage, gearing, and brackets were removed from the Mk 5 mounting.
>
> 28 December. Skidding [heavy wood timbers], ropes, tackle, etc., were brought up from the skidding shed and arranged at the site. The 6-pounder sub-calibre gun was removed, the carriage was blocked up, the barrel and breech mechanism [weighing 62,280 pounds (28,250 kg)] was prepared for removal by being pumped back out of battery and the bands removed [see Chapter 12 for a technical description of the mounting].
>
> 29 December. The barrel was removed with considerable difficulty. Only screw jacks were available, which made the process very slow. The barrel was loaded on an oak sleigh with 12-inch (~0.3 m) rollers. The sleigh moved on 20 foot by 15 inch square (~6.1 x 0.38 x 0.38 m) timbers that had been laid down just behind the gun, and the barrel was moved just out of the cradle.
>
> 30 December. A roadway was built using 30 foot by 18 inch square (~9.1 x 0.46 x 0.46 m) timber, and the barrel was moved about 60 feet (~18.3 m) behind the emplacement. It was left on the rollers and the sleigh was blocked to prevent movement. More bolts and brackets on the mounting were removed.
>
> 31 December. The shell pit shield bolts were removed, and the shields were blocked up to make them safe. The new C Mk 6A cradle arrived in the fort and was unloaded. This took some time as only hand power, artillery gyns, and block and tackle were available. The front shield was jacked up, a roadway built under it, and the shield lowered onto rollers.
>
> 1 January 1944. The shield was raised, a roadway was constructed, and the shield lowered onto small rollers and pulled clear. As many bolts as safety would allow were removed from the shell pit shield cantilevers. Everything was prepared for the RCAF crane on Monday morning.
>
> Sunday, 2 January. Flying Officer Johnstone and Corporal Gibson from the RCAF, and some RCOC Artificers came to Albert Head to survey the job and make any necessary last minute preparations. F/O Johnstone was not sure the Lorraine crane could manage the job, but they would try to carry it out as far as possible.
>
> 3 January. The crane and operator arrived on time. The front shield was lifted clear of the roadway with no trouble. The crane was run to the edge of the gun pit on a roadway built of heavy timbers. The outriggers of the crane were securely blocked, and two 20-foot (6.1 m) timbers were laid lengthwise on the outriggers to give added stability. The operator considered that the cradle was

the maximum safe lift for the crane. The cradle was lifted to the side and turned over, to prevent possible damage to the recoil air cylinder during transit. The right and left side shell pit shields were lifted and placed on Heaney's [the civilian contractor's] trailer for transportation to the railway flat car. The front and rear shell pit shields were lifted and placed clear. The cradle was slung and placed on Heaney's truck. The truck and trailer tried to move, but bogged down. The other truck and the crane also bogged down. It took approximately two hours to clear the traffic jam. The crew worked until 1845 hrs, but it was considered a good day's work, thanks to the crane.

4 January. Unloaded small parts, crates, and boxes for the new mounting from Heaney's trailer and, as the crane could not lift the carriage body, started jacking it up. This was a very long procedure with screw jacks.

5 January. Unloaded the C Mk 6A carriage body from Heaney's trailer, which was quite a long job due to the 18-ton weight. It was unloaded behind the emplacement, as it would then not be necessary to jack it down the extra five feet (~1.5 m) had it been brought in over the apron. The Mk 5 carriage body was placed on a sleigh and rollers and started off the mounting. The crew worked as fast as possible to be ready for the RCAF crane that was expected the following day, as it was desired to complete the dismounting in order to get the RCE started on removing the adapter in the pit.

6 January. The crane arrived and was put into position and stabilized, ready to lift the roller ring, pivot plate, and pedestal. While the crane was being prepared, the Mk 5 carriage body was run clear of the emplacement and onto Heaney's trailer. The new shell pit shields for the C Mk 6A mounting arrived. The remaining pieces were lifted in the assembly order, the halves of the pedestal were placed on the gun floor - half on each side. The front and rear shell pit shields were then lifted onto the truck. This time, to prevent bogging down, a plank roadway had been constructed for the truck, trailer, and crane. The ground around the emplacement was heavy and greasy and a plank roadway had to be constructed to move any vehicles in the vicinity..

7 January. All the small parts from the old mounting were checked, listed, crated, and taken to the shipping company, ready to be sent to the Dominion Bridge Company on 10 January. The work of taking apart the steel adapter for the Mk 5 mounting started. It promised to be more of a job than was anticipated. It had taken eleven days to dismount the old mounting.

8 January. The day was spent cleaning up, repairing and squaring skidding, tackles, ropes etc.,

Installing the C Mk 6A mounting in B/2 emplacement

Monday, 10 January. Started removing the steel plates of the adapter, which was more difficult than expected. By Tuesday, the adapter plates had been completely removed and were out of the emplacement.

12 - 14 January. RCE civilian workmen removed the concrete adapter. About 15 holes were bored in it and the adapter was shattered by blasting. Special care had to be taken to prevent any debris falling on the holdfast bolts.

14 - 18 January. Removal of the concrete continued. The concrete had been reinforced with steel and was very hard and tough. The levelling nuts had to be dug out, and sufficient concrete dug out around the holding bolts to allow the pedestal to sit down on the levelling nuts. Also, two deeper pits had to be dug out to accommodate the joint plates of the pedestal. The carriage body, which had previously been unloaded 60 feet (~18 m) to the rear of the emplacement, was brought into line with a newly-constructed timber roadway leading to the emplacement. Using the monkey winch, the carriage body was brought over to the emplacement on a 20-foot x 9-inch square (~6.1 x 0.23 m) sleigh, which travelled on 12-inch (~31 cm) rollers. It was placed on the gun floor on the temporary sleigh, ready to be moved over the pedestal and jacked down into position. The RCAF crane was requested for 20 January. The RCE went to Signal Hill to dig out the joint plates of the pedestal, which had been left embedded in the concrete when the 9.2-inch guns had been moved to Albert Head.

19 January. Cleaning up and preparing for the crane on 20 January. The joint plates of the pedestal were brought out from Signal Hill and cleaned up. The pedestal and pivot plate plug were cleaned up in preparation for mounting.

20 January. The crane arrived at 0845 hours and preparations were made to lower the pedestal. A timber roadway about four feet (~1.2 m) long was built on the gun floor level to the edge of the gun pit and up to the level of the apron. This allowed the crane to back in as close as possible to the edge of the pit. This prevented having to extend the boom, which would tend to tip the crane towards the pit. [The crane was working at its extreme lifting capacity.] As a further precaution against tipping into the pit, the monkey winch was made fast to a holdfast, connected to the front towing hook of the crane, and pulled tight. The outriggers were then shored up and one half of the pedestal slung. [The next page of the record was not found].

27 January. The crane did not arrive until 1100 hours. Work started immediately. The shell pit shields were put in place by the crane and bolted together, which took about 3½ hours. The cradle was then brought over to the emplacement and lowered into place. The cap squares were bolted on and blocked up. The crane returned to Patricia Bay RCAF Station at 1700 hrs.

28 January. Squared up the skidding, ropes, and equipment in general. RCOC technicians fitted various small parts. Captain A.E. Lower, from the Directorate of Mechanical Maintenance arrived from NDHQ to inspect the work.

> 29 January. The cross-beam of the rear sighting platform, the connecting beams, and the ammunition hoist upright beams were put in place. This was all done manually as the crane was not available.
>
> 31 January. A roadway was built to the emplacement, and the barrel was brought over to edge of the pit on rollers. The RCE started to fill in under the pedestal with concrete. The barrel had to wait for the concrete to dry before being put into position.
>
> 1 February. Fitting of sighting platforms, gears, elevating motor, and other parts continued.
>
> 2 February. The side and front shields were placed in position and bolted up. Prepared for the barrel, which will be put in position on 3 February. [The account ends here.]

As can be seen, changing the mountings was a long process. Nor was the installation of all the heavy items the end of the story. Linkages had to be tested, hydraulic lines installed to the pump rooms, hydraulics tested, etc. It was another six weeks before the gun was ready to be proof fired. Recall also, that this was the second C Mk 6A mounting to be installed at the battery, which presumably took advantage of the experience in mounting the first gun, although removing the adaptor was an additional task.

Gun B/2 (#L/224 on mounting #A2300) was proof-fired on 22 March 1944. One ¾-charge, two normal full charges, and four supercharges were fired at elevations from 1° 38’ depression to 30° 4’ elevation. The performance was considered satisfactory although, at the highest elevation, the gun twice failed to completely run back out into the firing position.

The results of the proof test highlighted several problems and suggested several improvements. The cradle fouled the carriage body on the right side of the mounting at about 4° elevation. The upper elevating hand wheels need to be larger. Considerable effort was needed to operate the power elevation controls, and a better method of controlling the gun elevating motor was essential. The power elevation motor was excessively noisy, even though it had been mounted in a soundproofed cabinet. The power traverse motor was adequate to keep the gun aligned on a moving target, but was insufficient to rapidly traverse the gun to a new target. The high and low speed gears for the ammunition hoist needed to be replaced with a single intermediate-sized gear. A safety guard was needed in front of the ammunition hoist. Power ramming was essential, because the plastic armour supports over the emplacement fouled the hand rammer stave. Eavestroughs needed to be placed around the shell pit shield to keep water out of the emplacement pit. Nevertheless, these problems were considered minor and could be solved by the local RCOC armament artificers.

During the spring of 1944, the battery took over two buildings in the infantry camp northwest of the battery area. One was converted to a quartermaster stores, and the other was used as living quarters for the battery observation post and battery plotting room personnel.

Upgrading the B/3 Mounting and Closure

The third mounting from Dominion Bridge arrived in early spring of 1944. Dismounting the last gun (B/3) began on 13 April, and was completed during the summer when gun #L/286 was remounted on C Mk 6A mounting #A2301. Even though NDHQ declared the battery non-operational on 4 August, work on the installation continued, and the mounting was proof fired successfully on 7 September, which was the last act for the battery.

Orders were received on 25 August to put Albert Head Battery in maintenance.[25] A caretaker detachment of 23 men under the command of Master Gunner M.A. Rycroft was authorized. They officially took over the equipment on 4 September, but practically after the proof firing. The battery commander left the following day, and the rest of the battery personnel were reassigned.

As noted in Chapter 7, in 1954 NATO allocated the last eight 9.2-inch guns to Turkey as mutual aid. The guns and mountings at Albert Head were dismounted and removed between 22 November and 12 December 1954 and shipped in October 1955.

A rare colour photo of a C Mk 6A gun mounting at Albert Head after the Second World War. The slabs from the "plastic armour" can be seen clearly. 15 Field Regiment Archives.

Chapter 11 - Operating the 9.2-inch Gun (Gun Drill)[26]

Introduction

Every type of gun used by the Royal Regiment of Canadian Artillery had a gun drill handbook, which detailed the procedure for carrying out every task on the gun. It defined the specific duties of each man while preparing for action, loading and firing, carrying out tests and minor maintenance, dealing with misfires, and many other activities, including destroying the gun to prevent it from falling into enemy hands.

For the 9.2-inch coast defence gun, each Mark of gun and mounting was different and had its own gun drill handbook. For example, the Mk 5 mounting was basically manually operated. Power for the hydraulic hoists was provided by a spring accumulator that was charged by the recoil energy from the gun, or by hand pumps. To load the gun, the projectile would be hoisted from the pit floor to a small trolley attached to the underside of the shell pit shield. The trolley was then pushed around and centred under the breech. A second hoist lifted the projectile through the gun platform floor into line with the breech. From there it was pushed into the breech ("rammed") by two or more men using a long rod with a rammer/brush combination head on it. The two propellant charges were then brought up from the pit and pushed individually into the breech, which was then closed. In contrast, the Mk 7 mounting was hydraulically powered with pressure supplied by a gasoline or electric motor. The shell and two charges were loaded into a hoist in the pit, which was then raised to the gun platform. The charges were then transferred to a tube behind the breech, and the projectile rolled onto a loading tray behind the breech. Hydraulic power rammed the shell and then pushed the two charges into the breech. The drill to be followed in each case was quite different. Different loading procedures would be used on each mounting if, for example, the hoists were not working.

The Gun Detachment

The gun was served by a "detachment" of men (gun crews in the RCA are called detachments). Each member of the detachment was assigned a number that defined his duties for each activity, such as loading and firing the gun. To compensate for casualties, all members of the detachment were cross-trained to perform the duties of any gun number. However, before undertaking an activity, the detachment would form up and "tell off". Each man would then call out his assigned number in a loud, clear voice, so there would be no confusion in the drill.

For the 9.2-inch Mk 10 gun on a Mk 5 mounting, a detachment consisted of a senior non-commissioned officer (NCO - normally a sergeant) and fourteen junior NCOs and gunners. (A junior NCO was a bombardier - equivalent to a corporal in the infantry). The lowest rank in the artillery is a "gunner", equivalent to "private" in the infantry. The number of men varied slightly, depending on the mark of the gun - the C Mk 6A mounting had a senior NCO and fifteen junior ranks.

In addition, another nine men were employed in preparing ammunition in the magazine and moving it to the gun. The gun pit in each emplacement had a shelf for projectiles, and one or two cartridge recesses (small enclosures protected by blast doors) for several rounds of ready-use ammunition. These were kept filled by the magazine ammunition handlers. The gun detachment were responsible for handling the ammunition once it arrived in the emplacement.

As an example, the following paragraphs are an extremely simplified list of the major responsibilities of each man in a detachment on a Mk 5 mounting while loading the gun:

- Number (No.) 1 (sometimes called the gun captain, normally a sergeant) commanded the gun, and was responsible for all aspects of its safe operation. In action, he moved around to be in the best position to supervise the detachment.
- No. 2 opened and closed the breech and was responsible for inserting and removing the vent primer tubes into the breech screw. His position in action was to the right of the gun facing the breech.
- No. 3 operated the projectile loading tray, which bridged the gap between the rear projectile hoist and the entrance to the breech. Together with No. 4 and No. 5, he pushed the projectile into the breech until the copper driving band hit and engaged in the rifling at the front of the chamber ("rammed home"). He then loaded the first of the two ½-charges into the breech. If the hoist was not working, he assisted in raising the projectile bearer into position (this was a semi-circular carrier lifted by four men into position behind the breech so it could be manually rammed). His position in action was to the left of the gun facing the breech.
- No. 4 kept the rammer head wet (to prevent any smouldering propellant from the last round in the breech from igniting the new charge) and rammed the projectile with No. 3 and No. 5. His position in action was to the left of No. 2 (behind the breech).
- No. 5 assisted No. 2 in opening and closing the breech, and rammed the projectile home with No. 3 and No. 4. He loaded the second ½-charge into the breech. His position in action was to right of No. 3 (behind the breech).
- No. 6 (with No. 8) supplied cartridges to No. 3 and No. 5 on the gun platform, usually by carrying them up the external stairs from the pit to the gun floor (the emplacement for the Mk 5 gun was completely open at the rear with concrete steps between the levels). When not in transit, his position in action was outside the cartridge recess in the wall of the pit.
- No. 7 (with No. 9, 10, and 11) handled the projectiles. No. 7 and No. 9 worked at the front hoist that raised projectiles onto the trollies under the shell pit

shield. No. 7 operated the front hoist, and was responsible that the straps holding the projectile to the trolley were properly fastened before lowering the hoist. His position in action was at the front hoist in the pit.

- No. 8 (with No. 6) supplied cartridges to No. 3 and No. 5 on the gun platform, usually by carrying them up the external stairs from the pit to the gun floor. When not in transit, his position in action was outside the cartridge recess in the wall of the pit.
- No. 9 (with No. 7, 10, and 11) handled the projectiles. He assisted No. 7 at the front hoist to raise projectiles onto the trollies under the shell pit shield. His position in action was at the front hoist. Once the projectile was on the trolley, he moved the trolley around the track and positioned it under the breech. Later, he moved the empty trolley back to the front hoist.
- No. 10 (with No. 7, 9, and 11) handled the projectiles. With No. 11, he removed a projectile from the projectile shelf, placed it on the wheelbarrow, and moved it to the front hoist. His position in action was at the front hoist.
- No. 11 (with No. 7, 9, and 10) handled the projectiles. With No. 10, he removed a projectile from the projectile shelf, placed it on the wheelbarrow, and moved it to the front hoist. If necessary, he fuzed the projectile. His position in action was at the front hoist.
- The autosight layer operated the automatic sight. His position in action was to the right of the cradle at the automatic sight. He laid for elevation when "Autosight" was ordered and for bearing at Case 1, 2 and 3 (see Laying and Firing the Gun below).
- The rocking bar sight layer operated the rocking bar sight. His position in action was to the left of the cradle at the sight mount. He laid for bearing when "Autosight" was ordered and laid for elevation at Case 1, 2, and 3 (see Laying and Firing the Gun below).
- The setter for range set the elevation on the gun or operated the range dial in the pit for Case 3. His position in action varied depending on which Case was ordered for the engagement.
- The setter for training (bearing) assisted the layers and operated the training dial in the pit for Case 3. His position in action varied depending on which Case was was ordered for the engagement.

In addition to the gun detachment, nine additional gunners were required to man the magazine and work the hoists from the magazine to the emplacement floor. If there was only one hoist, they carried cartridges in cylinders to the cartridge recess, the hoist being reserved only for projectiles.

Loading the Gun

This is a very simplified outline of the loading procedure for the Mk 5 mounting. At Sandwich and McNab Batteries, the emplacement was completely open at the rear. Projectiles were moved from the emplacement pit up to the gun platform using the front and rear hoists under the shell pit shields, while gunners carried individual cartridges up to the platform using the external rear stairs. The mountings had no overhead cover and manning the guns must have been interesting during the Canadian winter.

The gun could be loaded only between -5° and +5° elevation. If necessary, the gun would be lowered from the firing elevation into the loading zone after each shot. The gun captain (No. 1) was responsible that the gun was at the proper elevation for loading.

When ordered by the section commander, the gun captain ordered his gun to load. No. 2 opened the breech, then grabbed the handle of the control lever of the rear projectile hoist, and looked towards the gun captain. No. 3 swung the loading tray around in rear of the breech. No. 9 ran a shell trolley around its track and aligned the projectile over the rear hoist.

The gun captain raised his right arm as a signal to No. 2 to raise the projectile hoist, and when the hoist was high enough, he lowered his arm. No. 2 used the control lever to raise the projectile into alignment with the breech. He had to be careful not to raise the projectile too quickly, or the hoist tray could impact the loading tray and damage the ram and hoist. If necessary, No. 3 then removed the safety pin and cap from the fuze.

No. 4 placed the water-saturated sponge cloth over the mushroom head of the breech block. He then picked up the brush-rammer-and-sponge, and placed the head against the base of the projectile. The stave of the rammer was pushed forward by No. 3, No. 4, and No. 5, thus sliding the projectile into the chamber until its driving bands engaged in the rifling ("rammed home"). No. 4 then withdrew the brush-rammer-and-sponge, dipped the sponge head in water, and stood ready to ram the next round. It was very important that the sponge head was thoroughly saturated with water after ramming each round.

The gun captain then signalled No. 2 to lower the hoist. No. 2 then reamed out (cleaned) the vent, and inserted a new vent tube primer into the firing lock.

While the projectile was being loaded, No. 6 and No. 8 each withdrew a cartridge from a storage cylinder in the pit, and carried them up to the gun platform. There, they passed them to No. 3 and No. 5. (Because of the weight of the full charge, the propellant was loaded in two cartridges, each of which could be a ½-charge or a ¼-charge, depending on whether full or ¾-charge had been ordered). No. 3 placed the first cartridge in the chamber, and then swung the loading tray clear. No. 5 placed the second cartridge into the chamber, and then removed the sponge cloth from the breech, and dropped it into the water bucket.

No. 2, assisted by No. 5 as necessary, then closed the breech. If using percussion vent tubes, No. 3 then hooked the lanyard and stood ready to fire. When everyone was clear of the recoil, No. 2 moved outside the side shield, put over the contact lever (for electric firing), and reported "Ready" to the gun captain. When using percussion tubes, No. 2 reported "Ready" when No. 3 had hooked the lanyard and everyone was clear of the recoil. When No.1 ordered "Fire", one of the layers fired the gun (see "Laying and Firing the Gun" below).

Preparing to ram on a Mk 5 barbette mounting at Albert Head. No. 4 is supporting the head of the rammer-brush-and-sponge against the base of the projectile as others prepare to ram the projectile home. The fuzzy part in front of the brush is the sponge, which was kept wet to ensure that no propellant remnants were smouldering. The projectile is on the rear hoist, seen coming up through the flap doors in the shell pit shield. In this case, four gunners are on the rammer, but three would be more normal. City of Vancouver Archives.

No. 10 and No. 11 kept No. 7 supplied with projectiles at the front hoist. No. 9 always kept a projectile positioned over the rear hoist when the hoist was in the lowered position, except when the hinged doors in the gun floor were open (when the elevation of the gun was greater than 7°). He also pushed the empty trolley back around to the front hoist. Trolleys were always moved clockwise. In the pit, everyone had to be careful to keep clear of the lower elevating hand wheel, as it was liable to spin around when the gun was fired.

Ammunition was normally supplied from the projectile shelf and cartridge recess, with the magazine detachment keeping six to ten rounds ready. Each gun emplacement had an underground magazine with a projectile room and a separate cartridge room. The nine gunners working in the magazine kept the ready-use ammunition in the pit resupplied from the magazines.

When ammunition was supplied directly from the magazine (bypassing the ready-use shelf and recess), No. 6, No. 7, No. 8 and No. 9 worked in a similar manner. No. 10 and No. 11 rolled the projectile from the magazine lift onto the wheelbarrow, removed the grummets protecting the driving band (if not already done), fuzed the projectile and took it directly to the front hoist. The lids of the cartridge cylinders were removed at the bottom of the cartridge lift in the magazine before sending them up. In the pit, empty cylinders were stacked by No. 6 and No. 8 without obstructing the working numbers at the gun.

Laying and Firing the Gun (on the Mk 5 Mounting)

To engage a target, one of four different methods of gun laying could be ordered, defined as "Automatic Sights", "Case 1", "Case 2", and "Case 3". The automatic sights (autosights) were used at relatively short range when the target could be clearly seen from the gun. The sight on the gun mounting was accurately surveyed with respect to its height above mean sea level. The autosight layer on the right of the Mk 5 mounting applied a correction for the state of the tide, and simply aimed his sight at the waterline at the bow of the ship. The sight was connected to the gun mounting and a special cam on the sight automatically set the correct elevation for the range. If the ship was moving away, the aiming point was the waterline in the centre of the stern. In effect, the sight incorporated a depression rangefinder. The effective range of the automatic sight depended on the height of the gun mounting above sea level but, based on the fort record books, it was about 6,000 yards (~5,500 m). This would be reduced in poor visibility. The rocking bar sight (RBS) layer on the left of the mounting also tracked the target and could input corrections for deflection (leading a moving target). When using an electric primer, after the section commander and gun captain had ordered "fire" and the gun was laid on the target, the gun was fired by the autosight layer. When using a percussion primer, the autosight layer reported "On" when the target was in his sight, and No. 3 fired the gun. At night, with electric firing, the autosight layer called "On" just before he fired, to warn the detachment to stand clear.

In Case 1, the target could still be seen and tracked from the gun platform, but the range was too great for the automatic sight to set the elevation. In this case, the autosight layer (on the right) laid on the target for bearing and traversed the gun. The range setter set the elevation corresponding to the required range on the range scale on the sight (see Sights in the Technical Description in Chapter 12). The RBS layer then elevated or depressed the gun until the target was in his sight, thus setting the required elevation on the gun. In this case, the RBS layer fired the gun when using electric primers, or ordered “fire” when using percussion primers.

In Case 2, the target could be seen from the gun platform, but was too far away for the range to be set on the sight. The range to the target was determined by instruments in the observation post and passed to the gun electrically. The autosight layer laid on the target for bearing and traversed the gun. He remained on the gun platform. The RBS layer moved down into the gun pit and set the elevation using a hand wheel on the pedestal. The range setter (also in the pit) observed the range dial that was connected to the battery plotting room by electric cables and ordered the range to the RBS layer. When the gun was elevated to the ordered range, he reported “On”. As before, on the order of the gun captain, the autosight layer fired the gun when using electric primers, or ordered “fire” when using percussion primers. There were variations in the procedure with different mountings.

In Case 3, the target could not be seen from the gun, and the bearing and range were determined by the battery observation post. Bearing and elevation were passed from the battery plotting room by Magslip to the dials in the pit, which were read by the range and training (bearing) setters. The RBS layer elevated the gun and reported “On”. The autosight layer traversed the gun to the ordered bearing and fired the gun on the orders the gun captain. The training setter would fire the gun if the autosight layer could not reach the trigger grip in the pit. As in Case 2, there were variations in the procedure with different mountings.

Chapter 12 - Technical Descriptions

General Introduction

The 9.2-inch gun was used by the Royal Navy as well as the British and Dominion coast artillery. A total of 112 guns were made for the navy, (twelve were later transferred to the army), and a further 170 guns were built for the army.[27] The navy considered the gun to be an accurate weapon, except at certain states of wear. On the other hand, they noted that the gun suffered from "steel choke" and used too large a propellant grain, although the army eventually adopted a smaller grain.

During the 50-year career of the 9.2-inch gun in Canada, the system had many modifications and upgrades. Being a British system, changes and modifications were announced in the periodic "*List of Changes in War Materiel and of Patterns of Military Stores Which Have Been Approved and Sealed With Instructions Relating Thereto*". However, it was the responsibility of the owning country to implement the changes and, with the Canadian approach to spending money on defence in peacetime, recommended changes were not always actioned.

This chapter is intended to be a general overview. If more detail is needed, the reader should refer to the appropriate handbook, which is listed in the sources, and several of which are available on the internet. The handbooks were republished every few years, incorporating changes up to the date of publication, so there are minor differences between versions of the handbooks.

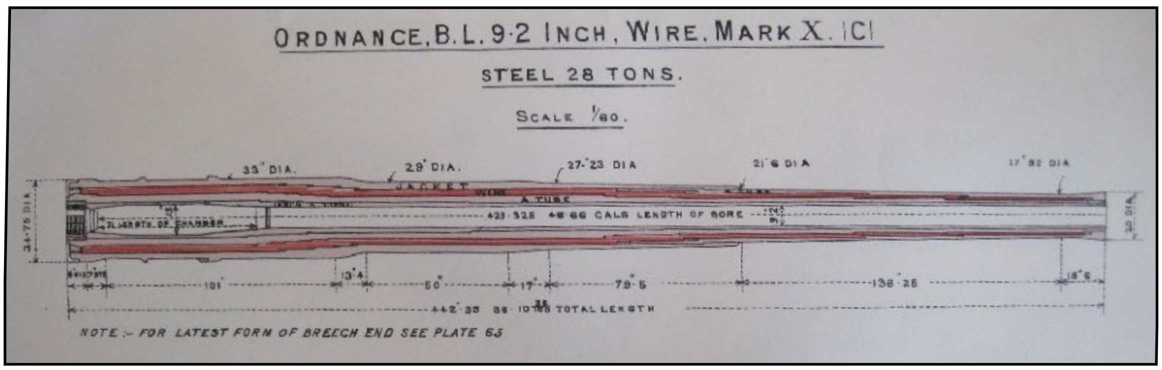
Assembling the gun on its mounting was not a trivial task, given the weight of the components. In later times, a power crane and/or a recovery vehicle's crane were used, but the early guns were installed using "manual means". This involved using an artillery "gyn" - essentially a large tripod assembled over the mounting with a hook and block and tackle. Cables and chains were suspended from the hook and the parts were hoisted and placed in position using manual labour. It could be a long, slow process.

9.2-inch Mk 10 Ordnance (Barrel and Breech Mechanism)[28]

In contemporary British terminology, the "ordnance" (sometimes called the "piece") included the gun barrel, breech, breech screw, and breech opening mechanism. Because a barrel could be installed on several different carriages or mountings, the latter were defined separately. The official definition would then appear as *The 9.2-inch Gun Mk X on Carriage, Garrison, Barbette, Mk V, Land Service.* The ordnance and mounting together were called the "equipment".

Two types of 9.2-inch ordnance were used in Canada: the Mk 10 that was used in all mountings except those at Oxford Battery, and the Mk 15 at that location. According to the British War Office, the two types of barrels were interchangeable (sort of - they used a different size of vent primer tube to ignite the propellant).

The 9.2-inch Mk 10 ordnance was designed about 1895 and entered service about 1899. It was constructed of steel, and consisted of (from the inside out) an inner “A” tube, an “A” tube, tightly-wound layers of steel wire, a “B” tube, and a jacket (see Annex B for manufacturing details). The inner “A” tube was also called the “liner” and contained the rifling (spiral grooves in the barrel). It was inserted into the “A” tube using hydraulic pressure, and held in place longitudinally by shoulders at the front and by a steel bush that screwed into the rear of the “A” tube. The inner “A” tube could be replaced at the factory (“re-lined”) if the rifling wore out. Radial strength was increased by winding layers of flat steel wire around the “A” tube, with the ends of the wire attached to steel rings. The “B” tube was then fitted over the wire, covering from the muzzle to roughly half way to the breech. The jacket covered part of the “B” tube, and the wire for the rest of the barrel to the breech. The jacket was held in place by shoulders on the “B” tube at the front, and a screwed steel collar over the “A” tube at the rear.

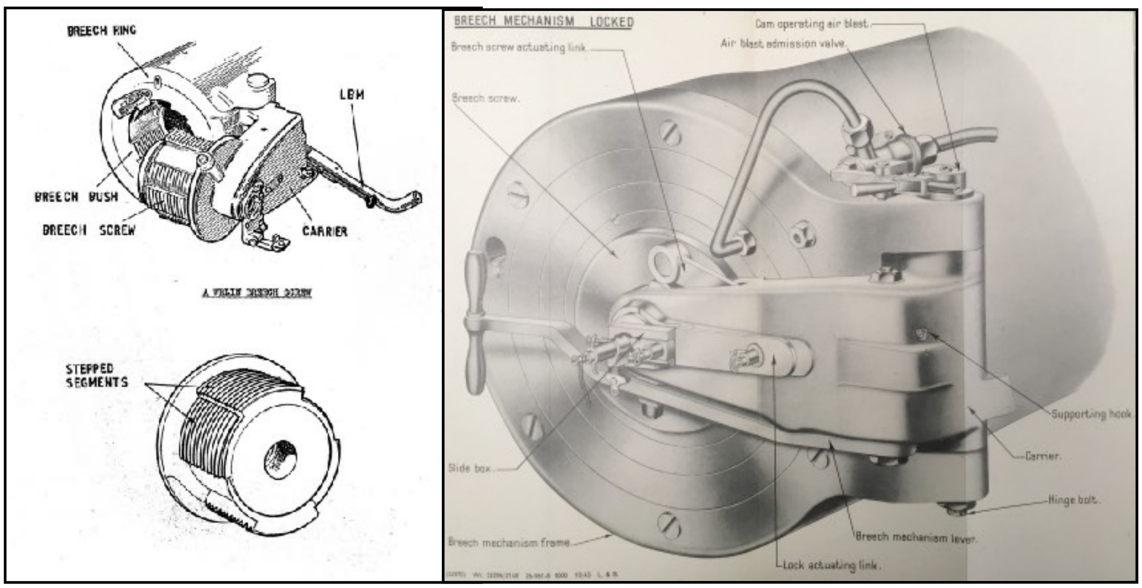


A schematic showing the general construction of the Mk 10 wire-wound barrel. 1906 Handbook.

The gun had no trunnions and was mounted in a cradle on the mountings (see the description in the relevant mounting). The propellant chamber was cylindrical with a curved slope at the front. Later production (and relined) barrels had a cone at the front to improve the centring of the projectile when it was rammed into the breech. The total length of the barrel was 442.35 inches (~11.24 m) and, with the breech mechanism, it weighed nominally 62,720 pounds (~28,449 kg) - about 28 tons.[29]

As the projectile moved up the barrel, a copper band near the base (the “driving band”) engaged in the rifling. This caused the projectile to spin, which stabilized it in flight. The rifling of the 9.2-inch gun was “polygroove with modified plain section”, which defined the shape of the cross section of the grooves. For the early Mk 5 barrels, the rifling was straight (no twist) from the breech for the first 138.75 inches (~3.52 m) of the barrel, and then the twist gradually increased from zero to one turn in 30 calibres at the muzzle. (Rifling with one turn in 30 calibres would complete one complete rotation in 30 x 9.2 inches = 276 inches (~7.01 m)). The original five Canadian barrels had rifling with 37 grooves. The three barrels purchased in 1921, and the original five after they were relined in the late 1930s, had 46 grooves. The newer barrels also had a uniform twist of one turn in 30 calibres starting from just forward of the chamber and continuing up to the muzzle. The difference in the number of grooves caused problems with lapping and milling the original guns at Sandwich and McNab Batteries during the First World War, because the British War Office sent the wrong cutters.

The guns were fitted with a “single motion breech mechanism”. One continuous pull on a lever rotated and unlocked the breech screw, withdrew it from the chamber, and swung it to the side so the gun could be loaded. After loading, one push on the same lever closed the breech, and rotated the breech screw into the locked position.



Left: diagram of a generic Welin type breech screw. Note the stepped threads in the screw. The Obturator Pad is not in the drawing. Right: a Mk 15 gun breech mechanism. Note the fittings for the air blast, and the Asbury type opening mechanism. A pull on the lever unlocks and rotates the breech screw, which can then be swung out to the side. 1944 Handbook.

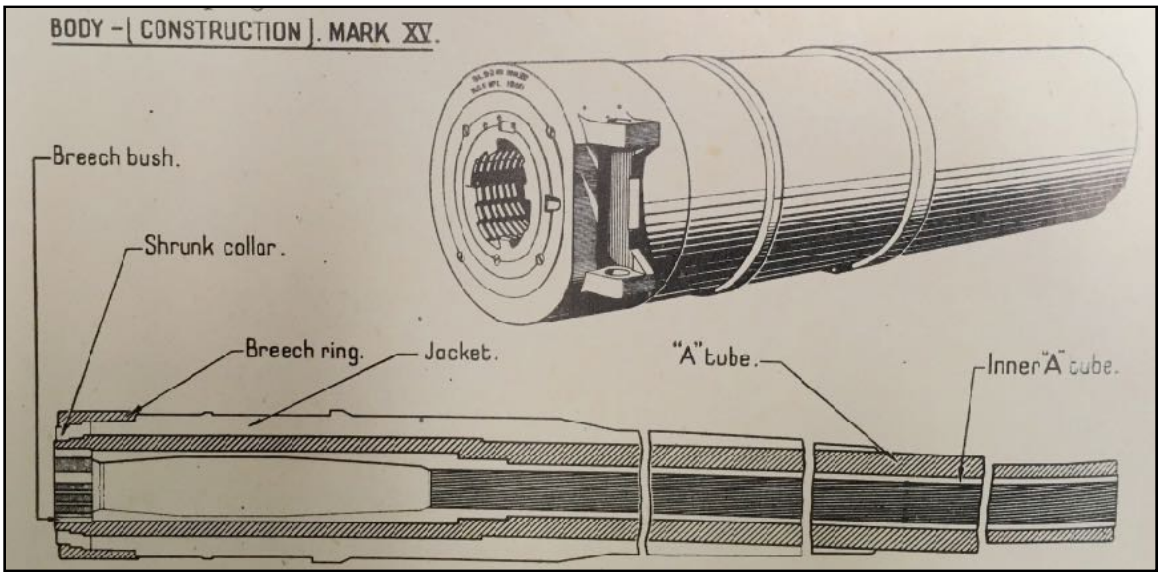
The breech screw was a Welin type stepped screw, with segments cut out to allow the screw to fit into the breech block without engaging the threads, after which the screw was rotated and the threads engaged in the locking position. The screw was mounted in a manganese bronze carrier that was hinged to a frame on the right side. A lever on the underside of the carrier was used to open or close the breech.

The De Bange design obturator sealed the breech to prevent the propellant gas from escaping on firing. Originally, this was an asbestos and mutton-suet pad that was sandwiched between two steel plates. An axial vent with a mushroom-shaped head passed through the breech screw and the obturator, with the rear of the head pressing on the front plate of the obturator. When the gun fired, the pressure forced the mushroom head to the rear and squeezed the plates together, forcing the asbestos pad out the side and sealing the breech.

The rear of the axial vent was machined to take a firing lock that contained a vent tube primer (it looked like a large rifle cartridge without the bullet). The primer could be either a percussion tube (ignited by a mechanical striker) or an electric tube that was ignited from a battery.

9.2-inch Mk 15 Ordnance (Barrel and Breech Mechanism)[30]

The 9.2-inch Mk 15 ordnance was approved for production in April 1940. It was a simplified version of the Mk 10 barrel. The War Office maintained that the two barrels were ballistically similar and interchangeable in all the mountings used in Canada. However, it used a different size of vent tube primer, which could be a minor problem if a battery had mixed barrels. In Canada, the Mk 15 ordnance was used only at Oxford Battery at Sydney, NS.



Sectional view of a Mk 15 gun. The gun was built-up (solid) construction, with the components being shrunk on as opposed to the wire-wound construction of the Mk 10 gun. In Canada, Mk 15 guns were used only at Oxford Battery. 1944 Handbook.

The general layout of the Mk 15 ordnance was similar to the Mk 10. The Mk 15 gun body was steel and used a built-up construction method. Basically, successive steel cylinders were heated (causing them to expand) and then slid over the previous layer. As the cylinder cooled, it shrank over the inner tube, placing it in compression and adding strength to the barrel. There was no wire winding. The layers consisted of an inner "A" tube, "A" tube, and jacket. These were held in place by a breech ring, shrunk collar, and a breech bush. With the breech mechanism, the barrel weighed approximately 62,500 pounds (~28.35 tonnes).

The inner "A" tube was slightly tapered externally throughout its length for easy insertion into the A-tube. The inner "A" tube included the obturator seating, the chamber, and was rifled from the chamber to the muzzle. The rifling design was polygroove plain section, with a uniform twist of one turn in 30 calibres. There were 48 grooves.

The “A” tube extended from the face of the breech to the muzzle. The jacket was shrunk on the rear of the “A” tube, and was screw-threaded externally to hold the breech ring. An oblique hole was drilled in the breech face for attaching the air blast pipe (see below). The breech ring was heated, and then shrunk and screwed into position. The right side had two lugs, with holes for the breech screw carrier hinge pins and roller bearings. A machined surface for the clinometer (that measured elevation) was on the upper side.

The breech mechanism was an Asbury design, single motion breech. A single pull on the locking lever rotated and unlocked the breech screw, which could then be swung to the side. The breech mechanism also included a fitting that allowed high pressure air to be forced into the chamber after firing ("air blast”). This extinguished any unburnt remnants of propellant, and forced any residual gases out of the muzzle before the breech was opened. This also helped keep fumes out of the enclosed gun house.

Carriage, Garrison, Barbette, Mark 5[31]

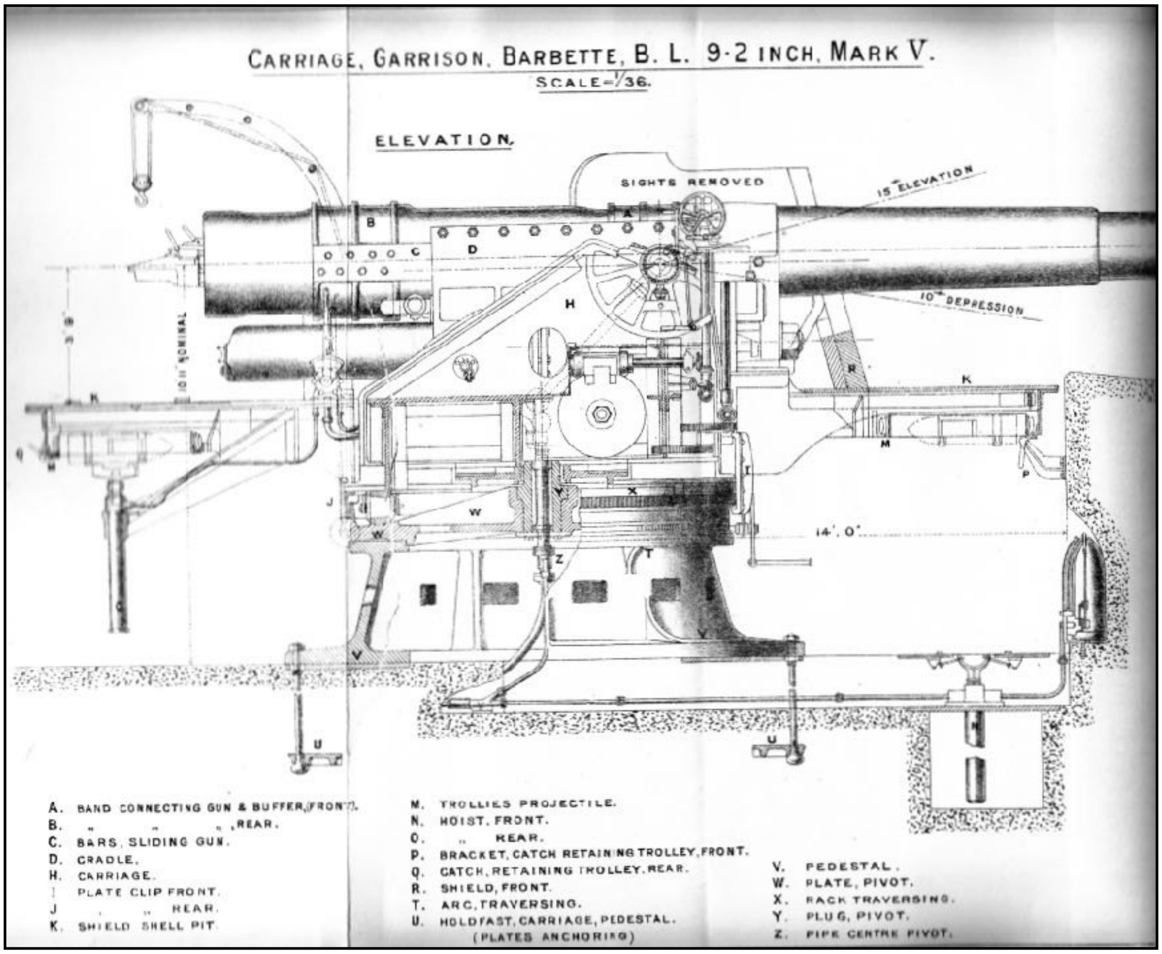
About 1904, the British installed two Mark 5 Barbette Mountings at Sandwich Battery and one at Fort McNab in Halifax, which were taken over by Canada in 1905. Two others were installed at Signal Hill in Esquimalt just before the First World War, and were moved to Albert Head Battery in the late 1930s. All five were converted in Canada to C Mk 6A Mountings during the Second World War.

The Mark 5 Barbette Mounting was open-topped, and designed to fire from a concrete pit with the barrel just protruding over a parapet. The pit was 28 feet (~8.53 metres) in diameter and 8.75 feet (~2.67 metres) deep. A horizontal steel “shell pit” shield surrounded the gun and protected the lower emplacement and the supporting pedestal for the mounting from enemy fire. It also formed a working platform for operating the gun.

The mounting was anchored by a steel holdfast embedded in the concrete floor. A circular steel pedestal was bolted to the holdfast, with a roller bearing race on top. The gun carriage sat on the roller bearing race, and revolved around a central pivot, which allowed 265° traverse. The carriage included traversing and elevating gears, and an elevation indicator. Traverse and elevation were manual operations using hand wheels. The gun could be elevated from -10° to +15° from the horizontal, although it had to be in the range from -5° to +5° elevation for loading. The weight of the carriage on the bearing race was 74.86 tons (~76.1 tonnes).

A sliding cradle on the carriage supported the Mk 10 ordnance (barrel, breech and firing mechanism). The cradle was connected to the carriage by a recoil-absorbing mechanism consisting of a hydraulic buffer, air cylinder, and intensifier. The normal length of the recoil was 42 inches (~1.06 metres). The Mk 10 ordnance nominally weighed about 28 tons (~28.45 tonnes).

The maximum elevation of +15° limited the range to 15,000 yards (~13,700 m) when using a two calibre-radius-head (c.r.h.) projectile (a rather stubby nose). The range increased to 17,600 yards (~16,000 m) when using a more streamlined four c.r.h. projectile (see Chapter 12 - Ammunition for a description of c.r.h.).



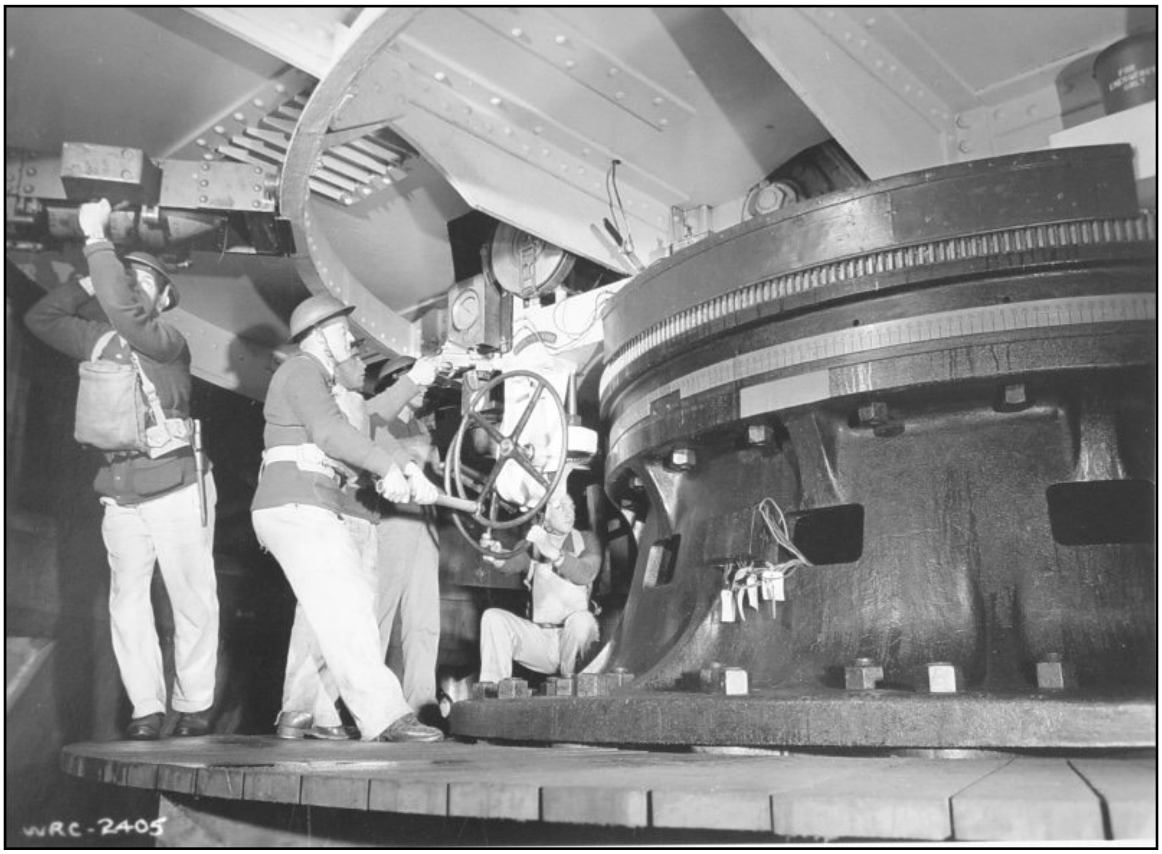
Schematic of the Mk 5 mounting. 1923 Handbook.

Pedestal Assembly

The holdfast consisted of 13 steel anchoring plates and 52 bolts, which were 9 feet 11 inches (~3.02 m) long. The plates and bolts were embedded in the concrete floor of the pit, passed though the flange on the pedestal and were secured by nuts. The holdfast weighed 4.6 tons (~4.67 tonnes). Some references mention the existence of levelling bolts, which would compensate for an uneven concrete floor.

The pedestal was secured to the floor of the concrete pit by the holdfast bolts. It was a hollow iron casting, cast in two halves, which were bolted together when the pedestal was placed in position. The top and inside surfaces of the pedestal were machined to mount the pivot plate. It weighed 16.8 tons (~17.1 tonnes).

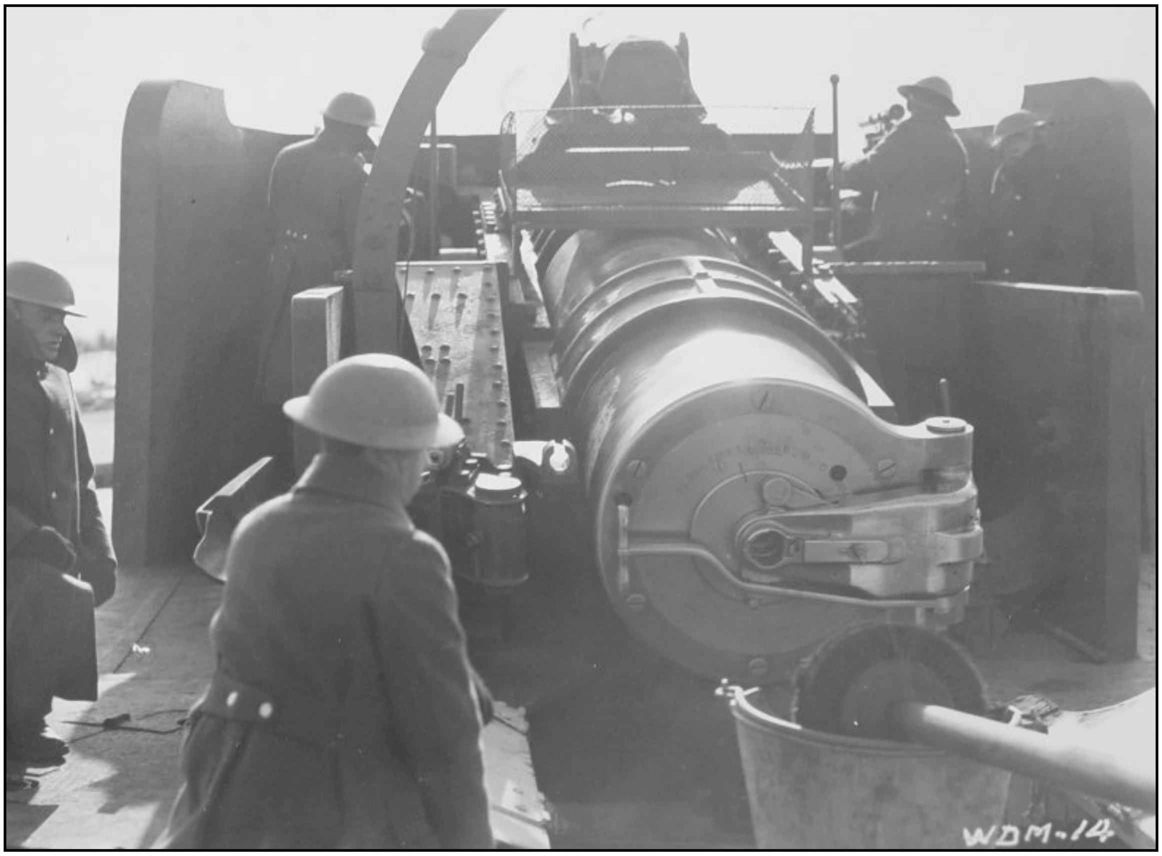
The cast steel pivot plate supported the roller bearing race (that allowed the carriage to traverse) and pivot (that kept the carriage centred). The pivot plate was attached to the top of the pedestal by 30 bolts on the outside and 16 bolts on the inside of the bearing race. In the centre of the plate, a copper-bushed hole with a shoulder supported the pivot plug. The traversing rack (above the bearing race that supported the carriage) was secured above the pivot plate by screw bolts. The steel pivot plug had a flange that rested on the shoulder of the hole in the pivot plate. The plug was hollow to allow the pipes of the hydraulic gear to pass though.



In the gun pit of a Mk 5 mounting. The bolts of the holdfast can be seen at the bottom of the pedestal. The pivot plate is bolted to the top of the pedestal with the roller race above it. The slight gap is the demarkation between the upper traversing section on top of the rollers, and the stationary lower support for the rollers. The toothed track on the outer plate is the gear rack for the traversing mechanism. The lighter band in the lower section is the brass traversing arc. One of the trollies with a projectile and part of the inner circular trolley track can be seen at the upper left. The dials of the elevation receiver can be seen above the hand wheel. The “ceiling” is the underside of the shell pit shield. The gunners provide a sense of scale. LAC 399188.

Carriage

The steel carriage sat on the upper plate of the roller bearing race. It consisted of two vertical side plates connected by two front, two intermediate, and two rear crosspieces (transoms). Two other box transoms, one front and one rear, on the underside of the carriage sat on the top of the rollers. Wood covers kept dirt and grit from the roller ring. The carriage was connected to the pivot plate by plates between the box transoms with a hole in the centre to take the pivot plug. The rear transom was fitted with a metal flange that limited the maximum elevation of the barrel. Castings on the outside of the top of the vertical side plates supported bearings for the cradle trunnions. Steel cap squares secured the trunnions in their bearings.



The rear of the Mk 5 mounting. The left shield can be seen just above the left of the helmet of the gunner in the foreground, and the left side of the cradle is just above the right side of his helmet, with the trunnion bearing beyond it. Above the barrel, close to the breech, is the rear band holding the ordnance to the carriage. The loading tray is swung to the side and is visible just over the left shoulder of the gunner. The breech operating lever is closed, but the firing lock is not in the breech. The two gun layers and the elevation setter can be seen in the background by the front shield. The right shield is the square slab to the right side of the mounting. LAC 399168.

The ordnance was supported by a cradle. It consisted of two steel sides, connected at the front and rear by transoms. A trunnion on each side rested on the side of the carriage. There were large grooves on the inside of the cradle for the sliding bars on the bands attached to the gun barrel (see below). The piston rod of the hydraulic recoil buffer was attached to the front transom, and the air cylinder to the rear transom. The geared elevating arcs were bolted to the front of the cradle.

The barrel was held in the cradle by two “bands”. The front band was in three pieces, bolted together around the barrel at its centre of gravity. The rear band was in halves, bolted together around the gun near the breech. A key on the barrel fitted a slot in each band to prevent the barrel from rotating. The bands had projections on their side for sliding bars, which fitted into corresponding sliding surfaces in the cradle. Each bar was provided with a metal anti-friction bearing plate.

Elevating Gear

To decrease friction while elevating the gun, a ring of ball bearings was fitted around the outer end of each trunnion where it met the cradle. Two hard steel bearing rings around each trunnion formed a groove to guide the ball bearings, with the outer ring held in place by a metal nut that screwed onto the trunnion. Around the outside of the ball bearing race was an outer steel band. A socket below the band fitted around the stem of an adjusting screw, which was supported on disc springs. To prevent damage to the ball bearings on firing, the disc springs compressed slightly and allowed the shock of the discharge to be taken by the main trunnions rather than the bearings. Leather washers and steel plates prevented dust and dirt from getting into the bearings. The left trunnion was hollow to allow passage for hydraulic pipes that charged the accumulator of the hydraulic loading gear. A flat surface for the clinometer (for the precise measurement of elevation) was precisely machined on the top of the cradle on the right side.

The elevating gear consisted of two geared arcs bolted to the underside of the sides of the cradle. The arcs were connected and strengthened by a crossbar. The elevating gear consisted of worm and bevel gears, working on two arc pinions that meshed with the gears on the elevating arcs. The elevation of the barrel was controlled by three interconnected hand wheels: one on each sighting platform attached to the carriage, and the third in the emplacement pit on the left side of the carriage. Friction plates prevented damage to the teeth of the worm gear during the shock of firing. The gun had a tendency to elevate on firing, which spun the hand wheels. To overcome this, a brake was fitted to the rim of the upper elevating hand wheels. The brake was operated by a foot lever from the sighting platform, or by a rope from the shell pit near the lower elevating hand wheel.

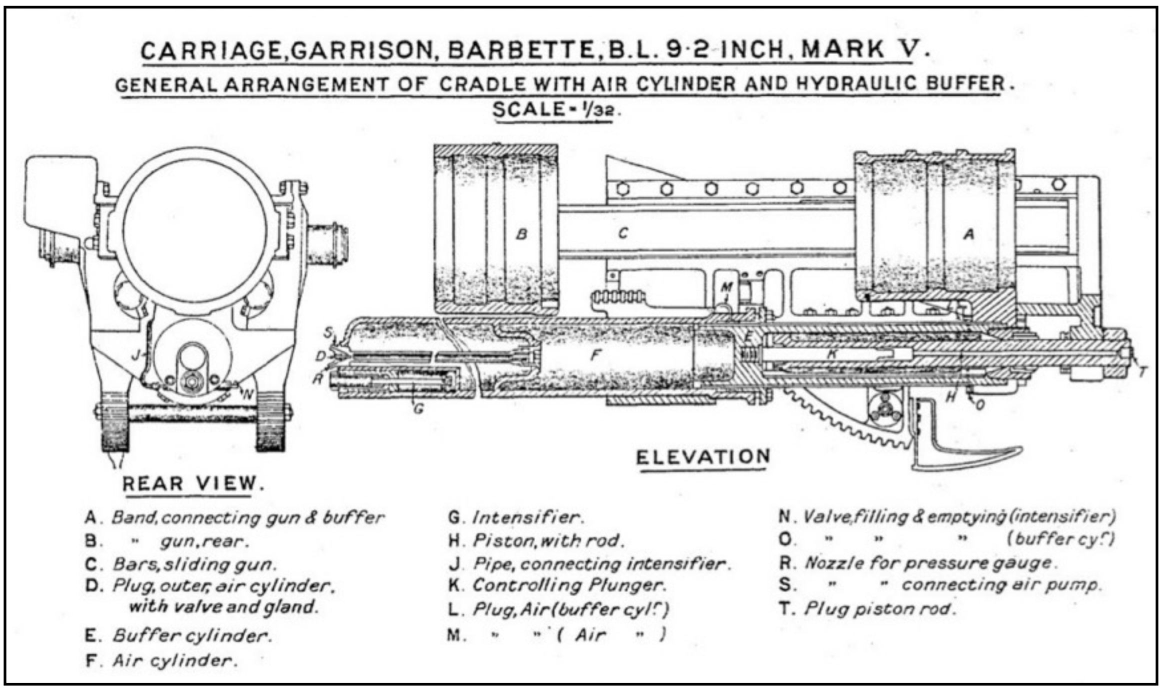
An elevation indicator was attached to the front of the elevating arc on the left side of the carriage. It had a scale plate, with the range engraved in yards, that was attached to a cam on the outer end of the cross-shaft between the arcs. A pointer over the graduations indicated the range, which was converted to the required elevation of the barrel by the cam. Other scales on the indicator permitted a correction for the actual muzzle velocity of the gun compared to the standard muzzle velocity for each charge, and also for the temperature of the propellant charge, both of which affect the external ballistics. The scale plate was reversible, with one side engraved with ranges for use with full propellant charges, while the back was engraved for use with ¾-charges. There was a separate scale plate for use with the 1-inch aiming rifle and the 6-pounder sub-calibre gun used in training.

Traversing Gear

The traversing gear consisted of a rack and pinion gear at the front of the mounting. The gear was actuated by any of three interconnected hand wheels located beside the hand wheels for the elevating gear. The upper hand wheels, (one on each side of the carriage) worked slow-motion gears, and the lower hand wheel in the pit operated a quick-motion gear. In very general terms, the quick-motion gear was used to quickly bring the gun onto line with a new target, while the slow motion wheels were then used by the gun layers to continuously track the target as it moved. Stops were provided to limit traverse for terrain or safety reasons.

The brass traversing arc indicated the current bearing of fire, and was fastened around the outer face of the bearing race below the clip ring. The full degree numbers were engraved on the upper section, and the degree sub-divisions (minutes) on the lower one. It The traverse angle was indicated by a pointer fixed to the carriage.

Recoil Mechanism



Schematic of the Mk 5 carriage cradle and recoil mechanism. 1923 Handbook.

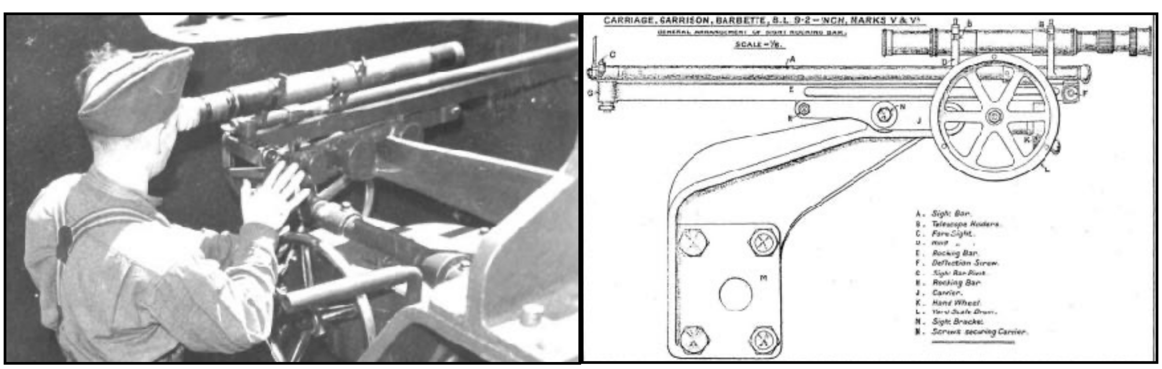
The recoil energy of the barrel on firing was absorbed by a hydraulic buffer and a compressed air accumulator. The hydraulic buffer was a steel cylinder with a piston, piston rod, valve key, and controlling plunger. The piston also formed the ram of the compressed air accumulator. The cylinder was fastened to the barrel by a band. The piston rod was connected to the front transom of the cradle. The manganese-bronze valve key regulated the flow of liquid from one side of the piston to the other during recoil. The air cylinder was divided into two chambers by a diaphragm. The rear end of the buffer cylinder passed into the front chamber through a packing gland, which forced the air through the diaphragm into the rear cylinder, compressing the air.

On firing, the ordnance with its supporting bands with the sliding bars, and the buffer cylinder recoiled together. The piston rod was fixed to the carriage and, as the cylinder moved to the rear, hydraulic fluid was forced from one side of the piston to the other through the port. Also, as the buffer cylinder recoiled, it forced air through a diaphragm valve and compressed the air into the rear chamber of the cylinder, to a maximum pressure about three times the initial pressure. Together, the resistance of forcing the oil through the buffer and compressing the air stopped the recoil.

When the recoil was complete, the diaphragm valve closed and the compressed air pushed the buffer (and barrel) back into the firing position ("into battery"). Just before the gun reached its forward position, a controlling plunger entered a small cavity and the resistance of displacing the hydraulic fluid in the cavity brought the gun slowly to rest.

Rocking Bar and Automatic Sights

To hit a target, the gun must be laid (aimed) horizontally, and the barrel must be raised to a suitable elevation depending on the range to the target. Other factors must also be considered, such as compensating for a moving target or ballistic factors affecting the projectile in flight. Laying a 9.2-inch gun was a two or three-man operation. On the left side of the mounting was a "rocking bar sight", which could track the target and manually input the elevation. On the right side of the mounting was an "automatic sight" which could also track the target, but which set the elevation to the target automatically using a cam connected to the gun. The two sights were used together, with the exact procedure depending on how the range to the target was being established (see Chapter 11 - Laying and firing the Gun).

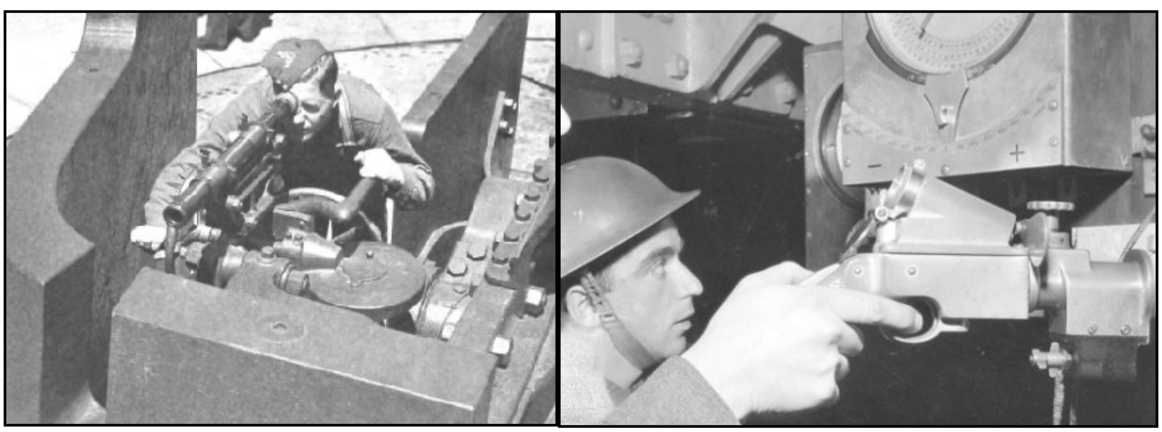


Rocking bar sights on the Mk 5 mounting, fitted with a telescope. This sight bracket could be offset to apply a correction for the speed of the target ship. LAC 399299 and 1923 Handbook.

The rocking-bar sight, although simpler, was still a complex mechanism. It was mounted on a carrier on a metal bracket attached to the front crosspiece of the cradle on the left side of the mounting. The front of the rocking bar was pivoted on the carrier to allow the rear of the rocking bar to be raised or lowered to set the range. A sight bar was attached to the rocking bar by a front pivot that allowed the rear of the sight bar to be moved horizontally to apply an offset of up to two degrees of deflection. On the sight bar, the foresight had a permanent conical point, as well as a sighting blade that could be turned down when not required. The rear sight was a V-notched leaf. Two brackets with hinged caps near the rear of the sight bar could hold a sighting telescope.

The steel carrier was screwed to the arm of the supporting bracket. The rear end of the carrier had a worm wheel and pinion gear that meshed with a toothed arc at the rear of the rocking bar. The wheel and pinion actuated a 6-inch range drum with a brass scale graduated to 14,000 yards (~12,800 m) range for full charge at its standard muzzle velocity (MV) of 2,643 feet per second (fps) (805 metres per second (m/s)). There was also a 4-inch drum with a scale engraved to 12,000 yards (10,970 m/s) that was used with a ¾-charge at its standard MV of 2,196 fps (~670 m/s). A separate range scale could be mounted for use with the aiming rifle during training.

A spinning projectile tends to drift in the direction of the spin during flight, which can be a cause of inaccuracy at longer ranges. The rocking bar sight compensated automatically for drift partly by the construction of the sight, which caused the rocking bar and sight bar to move through an angle of 3° left inclination to the vertical plane as the sight was elevated or depressed, and partly by the sight bar being set with a permanent angle of 6.5 minutes right deflection. Their combined effect gave a very close correction for drift at all ranges.



Left: the automatic sight fitted with a telescope. A cam attached to the sight bracket ensured the gun was at the correct elevation for the range when the telescope was laid on the waterline of the ship. Note the deep cut out in the forward shield for the sight. Right: The electric firing gear on a Mk 5 mounting. The bearing dial that was connected electrically to the battery plotting room can be seen in the upper right. LAC 399186 and 399242.

The automatic sight, so named because it was connected to the gun though a cam that automatically set the correct elevation for the range to the target, was on the right side of the mounting. With this sight, the gun layer used a hand wheel to keep the sight laid on the target, and a cam connected to the hand wheel elevated or depressed the gun to set the correct range. Another gear was connected to the traversing mechanism to adjust the auto-sight cam with respect to the axis of the cradle trunnions and correct for any inclination there might be in the pivot. (If the gun mounting was not absolutely level, it would affect accuracy when shooting).

The cam was uniquely designed and manufactured for a specific mounting in a specific location, and the height above sea level of the sight bracket was surveyed to a high level of precision. If the mounting was moved, a new cam had to be made. There were separate cams for full and ¾-charges. A small lever on the cam could input a correction for the current height of the tide.

Electric Firing Gear

The electric firing gear allowed the gun to be fired from either the left or right sighting platform, or from the gun pit. It consisted of a battery, three pistol grip connectors, a pistol grip, junction box, sliding contact, and a series of cables.

The pistol grip was used to both test the primer tube and circuit immediately before firing, and to fire the tube. If a primer tube was in the gun, or if the needle of the striker was electrically grounded, then depressing the contact lever of the pistol grip completed the circuit and a good connection was displayed in the glass indicator. Pulling the trigger cut the indicator out of the circuit and fired the tube, igniting the propellant charge. When the gun was fired, the circuit was broken and remained so until manually activated when the gun was again ready to fire. This kept control in the hands of the gun captain, who would not complete the circuit until the rear hoist was clear of the gun's recoil and the detachment and equipment were in their proper positions for safe firing.

Shields

The mounting had four steel shields: the horizontal shell pit shield, the curved front shield, and two side shields. The shell pit shield protected the concrete pit and also served as a working platform to operate the gun. Knee brackets were attached to the carriage and steel plates were riveted on top of the girders to form a platform. There was a grating on each side at the front, and openings at the rear for the projectile hoist and loading gear. These were covered by hinged cover plates (doors), with the opening between the doors for the rear hoist covered by flaps that were opened and closed automatically by the hoist. Guards were fitted to prevent the flaps fouling the tray when it was being lowered. The hinged doors had to be left open when firing at high angles of elevation to allow the gun to recoil without hitting the shield. Plates of sheet lead were fitted on the top of the shield in order to give the gun detachment a secure footing. A sighting platform was erected at each side of the carriage on top of the shield.

The front shield was made in halves and fitted together by a steel butt plate and screws on the inside. The shield was winged to the rear and splayed outwards at the bottom. It sat on the shell pit shield and was secured to the carriage by steel elastic stays with disc springs. The front was cut away for the gun barrel and the sights. Two steel stops to limit depression were secured to the stays carrying the front shield.

The side shields were secured to the carriage by steel elastic stays and disc springs. They rested on top of the shell pit shield. The right hand side shield was fitted with a bracket to carry the primer tube box.

Loading and Ramming

Practising loading B/2 gun #L/224 at Albert Head Battery, before the conversion of its Mk 5 mounting to a C Mk 6A mounting. The projectile is resting on the rear hoist and the loading tray is in front of it, protecting the threads of the breech screw from the projectile. Ramming was a manual operation. In training, the projectile would not be fully rammed so that it could be extracted. The projectiles to the left of the side shield are obsolete projectiles used for ramming practice. Live rounds would never be exposed to enemy fire until they came up the hoist just before ramming. 15 Field Regiment Archives.

The loading gear consisted of a steel arm with a loading tray, a spring accumulator with valves, front and rear hoists, and projectile trollies. If the hoists were not working, a derrick and block and tackle could be used to lift the shell out of the pit (with drastic effects on the rate of fire).

A steel arm was bolted to a projection on the left rear of the cradle. The loading tray was pivoted on the outer end of the arm, with two locking catches to hold it in the correct position. When swung into the loading position, the front of the tray fitted in a hole in the rear face of the gun. The tray then protected the threads of the breech screw when the projectile was rammed into the breech. After the cartridges were loaded, the loading tray was swung back to the side.

There were two projectile hoists, at the front and rear of the gun. Each hoist was fitted with a ram with a curved tray to hold a projectile. The front hoist was fixed in the floor of the emplacement, and raised the projectiles from the custom wheelbarrow to the trollies on the circular railway under the shell pit shield. The front hoist could be worked at any time, so that several projectiles could be ready to run around the track to the rear hoist.

The front hoist. The wheelbarrow is on the floor of the gun pit, placed over the hoist. The projectile has been raised on the hoist to the trolley on the circular track that ran around the outer edge of the pit shield. The gunner in the centre has his hidden hand on the control to raise and lower the hoist. The rope loops are to move the trolley after the projectile is secured to the trolley. LAC 399233.

The rear hoist was secured to the rear of the mounting and traversed with it. It was used to raise projectiles from the trollies, through the pit shield, to the loading tray behind the breech. The rear hoist tray was fitted with a lanyard, which could be pulled to help lower the tray after the projectile had been rammed.

The hoists were hydraulically operated. Power for the hydraulics was provided by the recoil of the gun, which stored liquid under pressure in a spring accumulator. When the gun fired, a ram forced the liquid into the accumulator under pressure, which compressed the spring. The spring then provided the energy to pressurize the hydraulic pipes connected to the hoists. A hand pump was provided to obtain the initial pressure in the accumulator, or to restore any loss of pressure.

Up to six trollies ran in a small circular track attached to the outer edge of the underside of the pit shield. The trollies carried the projectiles on their sides from the front hoist in the pit to rear hoist. Each consisted of a steel frame mounted on four flanged rollers. A strap secured the projectile to the trolley during transit.

A projectile would be brought in a two-wheeled wheelbarrow (hand cart) from the magazine lift or from the projectile shelf, and placed over the tray of the front hoist. A reversible steel plate on the floor covering for the hoist indicated the correct position of the wheels of the wheelbarrow for the different types of projectile. The hoist was operated and the projectile was raised to and secured in the projectile trolley. On the order to load, the trolley was run around the railway to the rear hoist. The hoist was raised and the projectile was transferred to the loading tray, which had been swung into position in the breech before the hoist was raised. The gun could be loaded at any elevation between -5° depression and +5° elevation and at any position of traverse. The projectile was manually rammed into the breech (see Chapter 11).

If the rear hoist was not operable, a small crane or derrick to the left of the breech could be used. The derrick was made of two steel curved plates, connected by collar bolts and secured to a pivot. The upper portion could be folded down when the derrick was not in use. The pivoting arm was fitted for a steel wire rope 44 feet (~13.4 m) long with a sheave block with hook and thimble. One end of the wire rope was spliced to the shackle at the top of the derrick, the other end was rove through the sheave block, down through the hole in the pivot piece of the derrick and then secured to a windlass. The windlass was a cast-iron drum with a ratchet and band brake that was attached to the underside of the rear box transom of the carriage immediately below the derrick. When using the derrick, the projectile was brought to the rear of the mounting in a wheelbarrow, and then raised from the pit up through an opening in the shell pit shield to the loading tray, which was then swung round to the breech of the gun.

British Carriage, Garrison, Barbette, Mk 6 and Mk 6A[32]

The British Carriage, Garrison, B.L. Barbette, 9.2-Inch, Mk 6 was an interim development between the Mk 5 and the Mk 7 mountings. The aim was to increase the range and improve the rate of fire. The Mk 6 mounting was introduced during the First World War, but few were produced. The British did not consider it to be completely successful and went on to develop the Mk 7 mounting after the war.

At the same time, they developed the Mk 6A mounting. This modified an existing Mk 5 mounting to achieve a longer range by increasing the maximum elevation to 30º, although it did not significantly increase the rate of fire. This increased the maximum range to 27,900 yards (~25,500 m), which was about 1,800 yards (~1,650 m) less than the later Mk 7 mounting. However, this was balanced by the lower cost and use of existing parts.

Canada never used either the original Mk 6 or Mk 6A mountings. However, the five Mk 5 mountings in Canada were converted to a Canadian version of the Mk 6A (the C Mk 6A) during the Second World War. The original British Mk 6 and Mk 6A mountings are briefly described below.

The British Mk 6 mounting resembled the Mk V, but without its hydraulic gear, accumulators, hoists and pipes, and the projectile trollies and tracks under the shell pit shield. The carriage consisted of the body, cradle, hydraulic buffer, elevating gears, traversing gears, loading equipment, shields (front, side and shell pit), sighting platform, and elevation indicator gear.

The Mk 6 still used the Mk 10 ordnance. It had all-round traverse and could be fired between -10° depression and +30° elevation. The maximum loading angle remained +5° elevation. The sides of the carriage body holding the trunnions were extended upwards to raise the trunnions and allow the increased elevation. There were minor changes to the cradle, hydraulic buffer, and air recuperator. The traversing gear was similar to the Mk 5 mounting.

The elevating gear was similar to the Mk 5, and was operated from the same positions. However, the gun could also be elevated or depressed using hydraulic power. A gasoline engine in a frame attached to the right side of the mounting powered a pump driving a hydraulic motor connected to the elevating gear. A clutch disconnected the lower elevating hand wheel when the motor was in gear.

The motor was operated by a lever on a bracket on the underside of the shell pit shield. When using power elevation or depression, the detachment had to keep clear of the upper elevating hand wheels, which would spin as the gun elevated.

The hydraulic loading gear used the same pump. A tackle attached to the ram of the hydraulic system passed over guide pulleys on a derrick pivoted on the top of the shell pit shield on the left side, with the end of the rope attached to the shell grab. A circular railway was laid in the emplacement floor. Two trollies, each holding two projectiles, carried the projectiles to a point immediately under the loading derrick. A guide kept the projectile in correct alignment for passing through the opening in the shell pit shield, even if the mounting was being traversed. The tackle on the derrick was lowered until the grab locked on the projectile, which was then raised up through the opening in the shell pit-shield. The projectile was lowered into the loading tray and the latter swung round into the breech opening where the projectile was rammed home. If the hydraulic gear broke down, the projectile could still be raised manually using a winch on the derrick. It is a bit difficult to see how this would have increased the rate of fire from the two hoist system of the Mk 5 mounting, especially if several trollies were loaded and ready to be moved to the rear hoist.

The front shields were armour-plate, and higher in order to give the necessary protection to the higher carriage. A loading platform, on which the detachment stood for ramming home, was fixed to the top rear of the shell pit shield. The Mk 6A mounting differed from the Mk 6 only in that the carriage body was a Mk 5 carriage body converted to allow increased elevation for the gun.

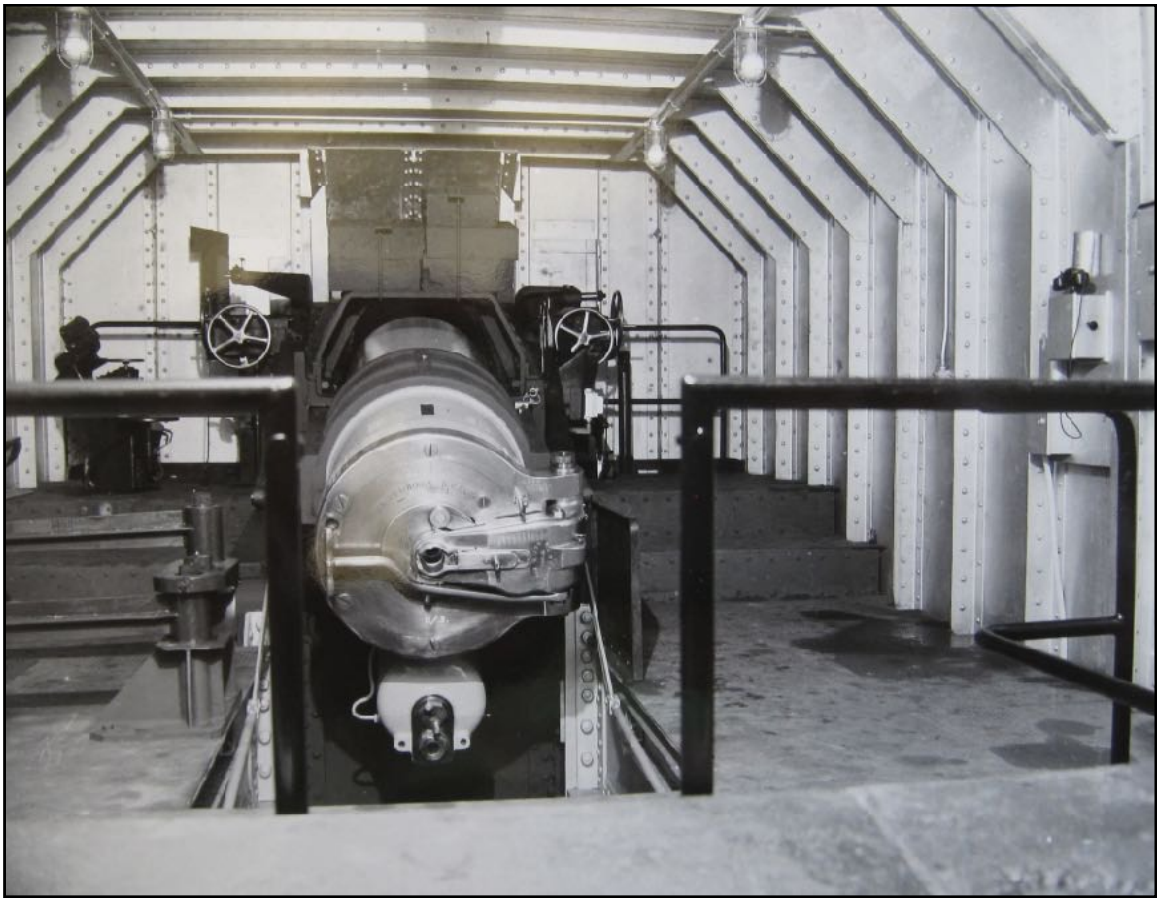
Mounting, Canadian, C Mk 6A (Albert Head Battery, Esquimalt, BC)[33]

The C Mk 6A mounting was a Canadian conversion of the 9.2-inch Mk 5 mounting that was generally based on the British Mk 6A mounting. As noted in Chapter 6, production drawings were obtained from Britain, and an order was placed with the Dominion Bridge Company to convert the five Mk 5 mountings in Canada. By August 1942, work was underway on the first mounting, which had been removed from McNab Island in Halifax. When completed, it was sent to Albert Head and the third of the Mk 10 barrels that had been relined in 1938 was installed on it. Late in 1942, the two 9.2-inch mountings at Sandwich Battery were removed and sent for conversion. They were then sent to Albert Head. The two Mk 5 mountings at Albert Head were then returned to Dominion Bridge for conversion. In their case, the work was completed too late for their installation during the war, and they were placed in reserve.

A C Mk 6A mounting in place at Albert Head battery. The Canadian version of the design replaced the open barbette style mounting with a slab-like gun house. 15 Field Regiment, RCA, Archives.

The C Mk 6A mounting allowed the gun to be fired between -5° and +30° elevation. This increased the maximum range to 27,900 yards (~25,500 m) or slightly more if using supercharge. The mounting was capable of all-round traverse, although normally a stop was used to limit traverse to a little less than 360°. The gun could be elevated using hydraulic power or manually. Ammunition was hoisted from the pit to the gun working platform using hydraulic power or an auxiliary manual hoist. Ramming remained a manual operation. The detachment were protected by a plastic armour splinter shield that was open only at the back.

The C Mk 6A had vertical extensions added to the carriage sides which were supported by a new front plate and new transoms. This raised the height of the trunnion bearings by three feet (0.91 metres). The sighting platforms on each side of the mounting were also raised, to keep the same height, relative to the trunnions, as in the Mk 5 mounting. To the rear, a loading and ramming platform extended 20 feet 3 inches (6.17 metres) from the centre of the mounting. One floor panel was controlled automatically by the cradle, so that it rolled back to clear the gun recoil at high elevation. The platform was covered with lead for traction. The two rear side brackets and two rear brackets of the shell pit shield were strengthened to support the additional weight of the splinter shield, ammunition hoist, loading platform, and loading tray. The inner projectile trolley track and rear ammunition hoist brackets of the Mk 5



The interior of the B/2 gun house with gun #L/224 at Albert Head battery. Compare this to the photo of this gun on its earlier Mk 5 mounting on the cover of the book. LAC Albert Head Fort Record Book.

mountings were removed from the underside of the shell pit shield.

The cradle was modified to add a mild steel mantlet to cover the gun slot in the front of the splinter shield. The mantlet had attachments for limit switches to control the elevation and depression of the gun. The Mk 5 loading tray bracket was removed from the cradle.

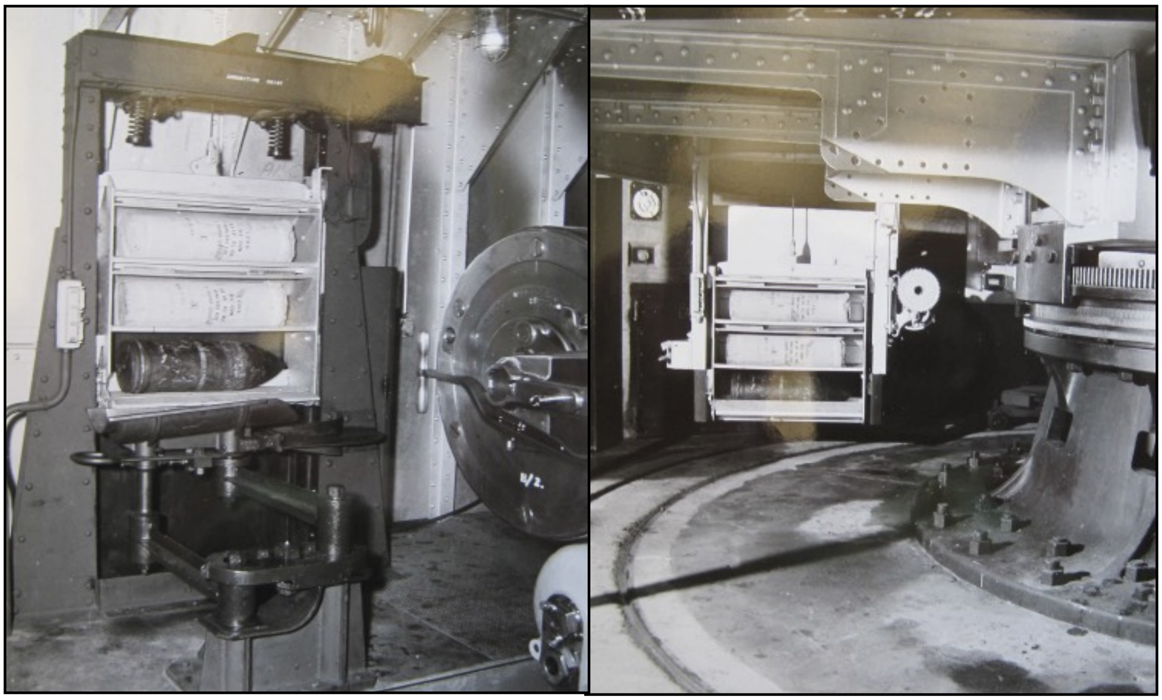
Th manual elevating mechanism of the gun was the same as in the Mk 5 mounting, except for the extension of the shafts and the addition of clutches at each hand wheel. Power elevation used a 10-horsepower gasoline engine driving a hydraulic pump. The engine and hydraulic components were hung from the shell pit shield and controlled from the emplacement floor. Elevation stops were provided at -5° depression and +30º elevation. Limit switches stopped the motor as the gun approached these stops. It could then be “inched back” by the motor starting button. The elevation arcs were extended to accommodate the increased elevation. The elevation indicator gear was operated by a gear rack attached to a bracket on the cradle instead of the geared arc extending from the elevation arc. The range scale plate and the muzzle velocity and charge temperature scales were modified. During the conversion, the ball bearings in the trunnions were found to be “brinnelled” (the balls had worn indents into the bearing race). The bearing race was re-ground and new ball bearings were installed.

The traversing gear was unaltered except for lengthening some of the connecting shafts. In the recoil mechanism, the air pressure in the recuperator was increased from 200 pounds per square inch (9,576 Pascals) to 320 psi (15,321 Pascals). The automatic and rocking bar sights were modified to accommodate the greater elevation, as well as other changes required by the greater trunnion height and the fact that, at Albert Head, the cam of the autosight was based on the height of the base of the pedestal, not the sight bracket.

The front and side shields of the Mk 5 mounting were replaced by a splinter shield of precast plastic armour. Plastic armour consisted of small, evenly-sized rock gravel in a tar matrix, similar to asphalt concrete, with a steel backing plate. It had been developed to replace concrete armour on merchant ships early in the war. It was effective because the stone would deflect bullets and splinters, which would then be stopped by the steel plate. The armour was bolted to a structural steel framework covered by a 5/16 inches (~8 mm) thick steel shell. This “gun house” was supported by the shell pit shield brackets. The plastic armour panels were 2½ inches (6.35 cm) thick with 3/16-inch (~4.7 mm) mild steel on the outer surface. Flux-filled bolts were welded to the shell through prepared holes in the armour panels. Field joints were provided for dismantling the splinter shield. The centre bolts of each plastic armour panel protruded far enough that masts for camouflage nets could be attached. The front of the shield had two sighting holes with covered flaps. Exhaust fans were installed in the sides of the splinter shields at the front near the roof. Sheaves (for a block and tackle) were provided in the roof so that the auxiliary hand hoist could be used for repair and maintenance work at the breech of the gun. Six 100-watt light bulbs were mounted in the roof of the splinter shield, with one 110-volt 60-watt electric outlet on each side of the mounting. Compared to the Mk 5 mounting, it was quite cozy.

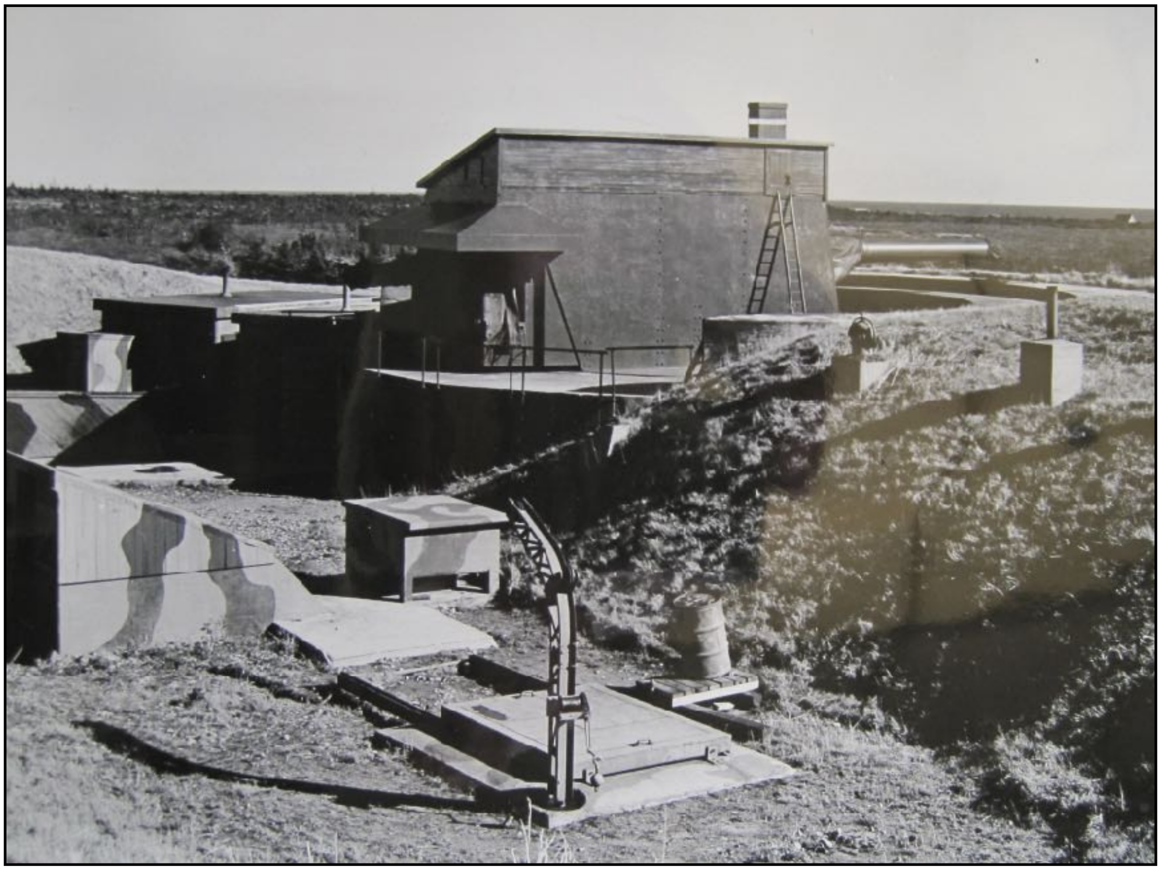
There were major changes in the loading system. The Mk 5 hoists and trollies were removed and an ammunition lift installed at the left side of the breech. Three trolleys, each with two projectiles, moved around circular tracks in the emplacement floor. They transported shells from the projectile enclosures to the lift. One projectile and two ½-charges were then loaded into a three-shelf skip in the lift, and a Sheppard-Niles 7½ horsepower (~7.6 metric horsepower) motor lifted the skip up to the working platform. Limit switches were installed at the top and bottom of the lift, and there were "start", "stop", "inch up”, and "inch down" buttons in both locations. The ammunition lift was protected against flash and blast. An auxiliary hand-operated hoist could be used if the power failed. Shells were moved from the hoist to the breech by a bronze loading tray which swung on a pedestal beside the breech. Projectiles were hand-rammed and the cartridges were loaded by hand into the breech, as in the Mk 5 mounting.

When the target could not be tracked from the gun, a modified Magslip "follow-the-pointer" fire-control system was installed. At the battery plotting room, a gun angle computer corrected the bearing for the separation from the pivot gun and drift (spin) of the shell. The range, corrected for the height of the site, muzzle velocity, and charge temperature, was converted to an elevation. The Magslip then transmitted the data to the No. 3A Range and Bearing Receivers on the guns, and the gun layers manually applied the bearing and elevation. There was no automatic input to the gun.



The ammunition cage in the C Mk 6A mounting. Left: the white skip is in the upper position and carries a projectile and two ½-charges. The loading tray can be seen just this side of the shell, with the mechanism that would swing the tray in front of the breech for ramming. Note the 5º up-angle of the tray to match the loading angle of the gun. Right: the skip is in the lowered position in the emplacement pit. The trolley tracks can be seen and the outer edge of the pedestal. LAC Albert Head Fort Record Book.

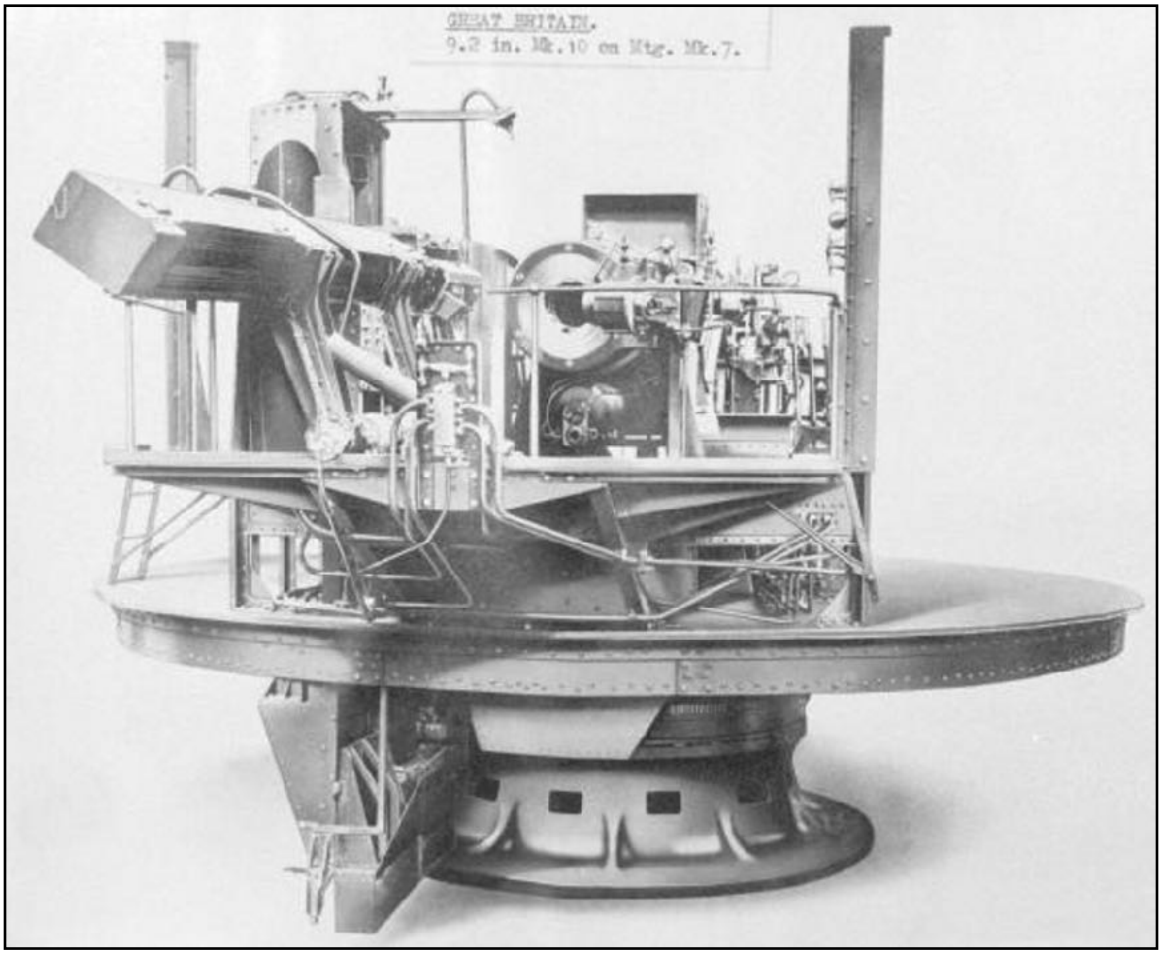
Mounting, B.L., Mk 7 (Devils Battery, Halifax, NS)[34]



9.2-inch Mk 10 gun on Mk 7 mounting at Devils Battery in Halifax during the Second World War. The gun is camouflaged as a house. The entrance and hoist to the magazine is in the foreground. Devils Battery Fort Record Book.

The British did not consider the Mk 6 mounting to be a success and began designing the Mk 7 mounting during the 1920s. This had 35° maximum elevation, power traverse and elevation, hydraulic loading gear, and a high pressure air blast to purge the breech after firing. It was also much more complex than the Mk 5 mounting. The gun shield was an enclosed rectangular gun house with an open back. The mounting, together with the new 4 c.r.h. ammunition extended the range to 29,600 yards (~27,060 m)[35]. Three Mk 7 mountings were installed at Devils Battery in Halifax in late 1941.

The ordnance was a Mk 10 barrel with the breech modified for air blast and wash-out. Fittings on the mounting forced high pressure air into the chamber after firing in order to minimize the possibility of unburnt propellant flashing back as the breech was opened. A wash-out gear, consisting of three nozzles, was also fitted to throw cooling jets of water on the mushroom head, obturator, and into the chamber when the breech was opened after firing. The Mk 10 gun could fire supercharge ammunition, but the charges would not fit in the Mk 7 ramming tube and the mounting never reached its full potential at Devils Battery (see the Supercharge Saga in Chapter 6).

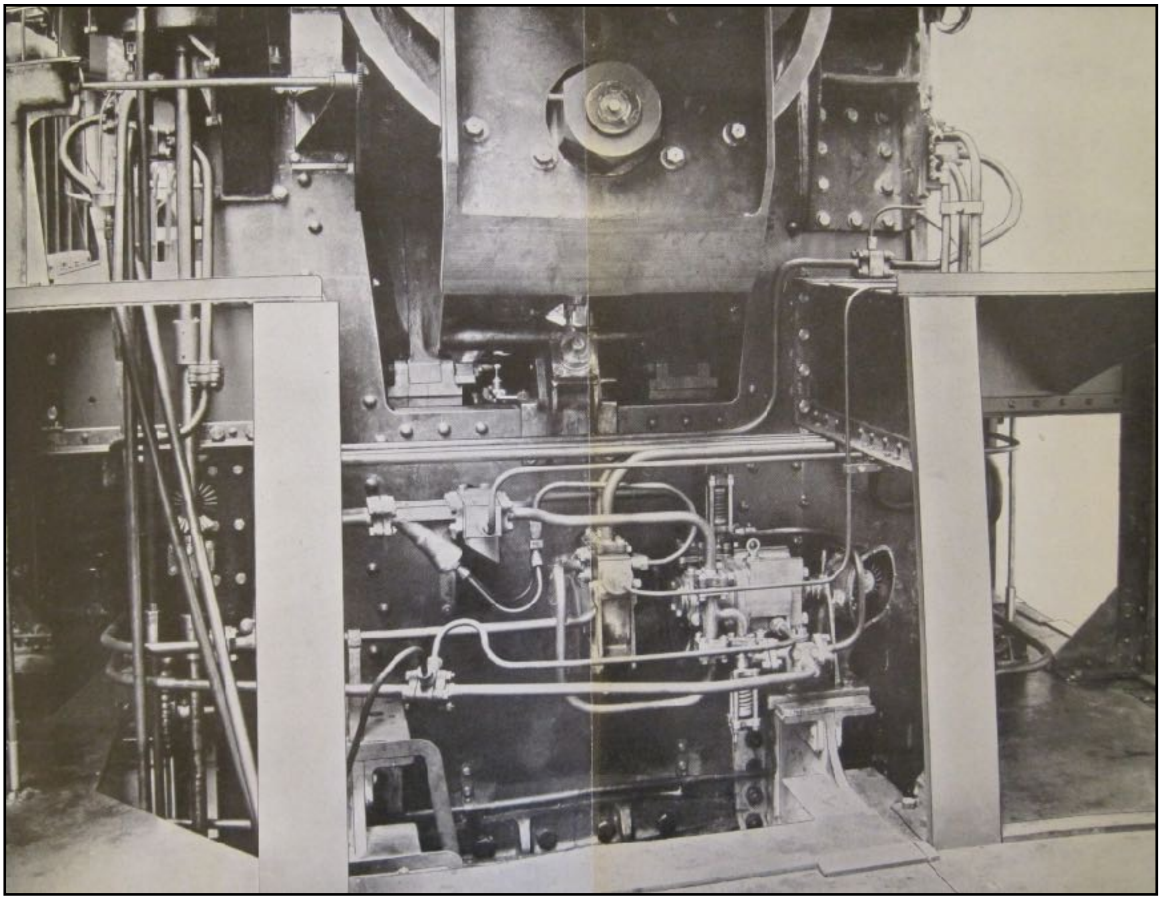


View from the rear of a British Mk 7 mounting with the shields removed. The large box-like structure overhanging the rear of the mounting is the hydraulic rammer in its resting position. To ram the projectile, the rammer is rotated to the right into alignment with the breech. The tower to the left front of the rammer is the ammunition hoist, which extends to the bottom of the pedestal. Note that the shell pit shield is no longer the working platform for the gun.

The Mark 7 mounting was installed in an emplacement approximately eight feet (2.4 m) deep. It was capable of all-round traverse and the gun could be fired from -5° depression to +35° elevation. The loading angle was +5° elevation and the maximum recoil (metal to metal in the buffer) was 42 inches (~1.07 m) with normal recoil being 40 inches (~1.02 m). The mounting weighed 147,640 pounds (~66.97 tonnes), exclusive of the ordnance.

Pedestal Assembly and Gun Carriage

The basic structure of the pedestal was similar to the Mk 5 mounting, with the addition of the fittings, pipes, and controls for the air blast, washout, power elevation, traverse, and loading, as well as access panels, some of which allowed a man to get inside inside the pedestal.



The Mk 7 mounting from the front with covers and shields removed. Note the complexity of the mounting. 1936 Handbook.

The steel carriage body consisted of left and right sides connected by front, centre, and rear transoms, and strengthened by two transverse bolsters fitted below the front and rear transoms. As with the other mountings, it sat on a bearing race and rotated about the pivot plug between the bolsters. This was supported by the inner flanges of the bolster and a steel strengthening plate. The plug supported the centre pivot. Manganese bronze brackets, fitted with steel cap squares, were fastened to the top of each side of the body to support and secure the cradle trunnions. A projection on each bracket was screw-threaded and fitted with an adjusting screw for the trunnion ball bearings. The carriage body had attachments for the shell pit shield, and other equipment. There were holes in the plates where necessary to allow passage of various shafts, rods, pipes, and fittings.

Elevating and Traversing Gear

The elevating gear could be operated from the normal position in front of the trunnion on the left side of the carriage (note the change of side from the Mk 5 mounting), or from a manual auxiliary position in rear of the trunnion. The forward position had the power elevation controls as well as a hand wheel for manual operation. These turned a worm gear connected to two geared arcs attached to the cradle. Power was provided by a hydraulic motor mounted on the front cantilever that supported the shell pit shield. The auxiliary rear hand wheel provided a completely mechanical manual backup. It could be disconnected from the worm gear by a clutch lever.

The traversing gear could be operated from the normal position in front of the trunnion on the right side of the carriage, or from a manual auxiliary position to the rear of the trunnion. The forward position had power and manual controls, with power supplied by a hydraulic motor mounted on the bolster. A clutch below the horizontal hand wheel selected power or manual operation. The traversing gear was a toothed rack that wrapped around and was attached to the pivot plate. A rack pinion meshed with the gear. The auxiliary position to the rear of the trunnion bearing had a manual control hand wheel, which could be de-clutched from the mechanism.

Recoil Mechanism

The operation of the recoil mechanism was essentially the same as the Mk 5 mounting, but the detailed design and materials were updated. By the time the Mk 7 mounting was designed, the British had the full experience of the First World War behind them and had pretty well standardized on a hydro-pneumatic recoil system design that was adapted to each new gun and mounting.

Sights

The direct laying (visual tracking) sights consisted of an automatic sight on the left side and a direction sight on the right side of the cradle (note that this is reversed from the Mk 5 mounting). The functioning of the automatic sight was similar to the Mk 5 mounting in that the gun layer laid the sight on the water line of the ship and a cam provided the correct elevation to the gun. Because of the low height of Devils Battery, the automatic sights at that location were limited to about 4,500 yards range (~4,100 m).

The No. 1 Direction Sight on the right of the mounting was used to track the target for bearing and correct the sight line for the drift of the projectile. The sight was pivoted so that the sight line was independent of the elevation of the gun, which enabled the gun layer to continue to track the target while the gun was being lowered to the loading angle and reloaded. The sight could be offset up to ten degrees right or left in ten minute increments to compensate for the estimated speed of the target.

If the target was beyond effective visual range, data was calculated at the battery plotting room and passed electrically to the No. 3 Range Receiver, and No. 3 Bearing Receiver on the gun using a Magslip system. The receivers were fitted to the left and right sides of the mounting respectively beside the sights. At Devils Battery, the receivers were linked to the battery plotting room and the guns could use the “follow the pointer” method of laying, with the gun layers aligning the Magslip and gun elevation and traverse pointers in the receivers.

Shields

The gun detachment and vulnerable parts of the mounting were protected by a shell pit shield and an overhead shield. The horizontal steel shell pit shield was circular with a central longitudinal opening. It covered the emplacement between the body of the mounting and the wall, and also supported brackets and fittings for the main shield, working platform, hydraulics for the loading gear, the drain tank of the gun wash-out, and other equipment. It also served as a working platform outside the main shield. A rectangular hole, fitted with transverse bars to form a grating, was on the floor on each side at the front of the shell pit shield. Another rectangular hole towards the left rear provided clearance for the ammunition lift. The hydraulic ram cylinder for the ammunition lift was secured to the underside of the shield towards the left rear, and the elevating gear engine was mounted on the left top of the front cantilever. A short steel ladder, fastened to the shield in front of the body, allowed access to various fittings from the pit.

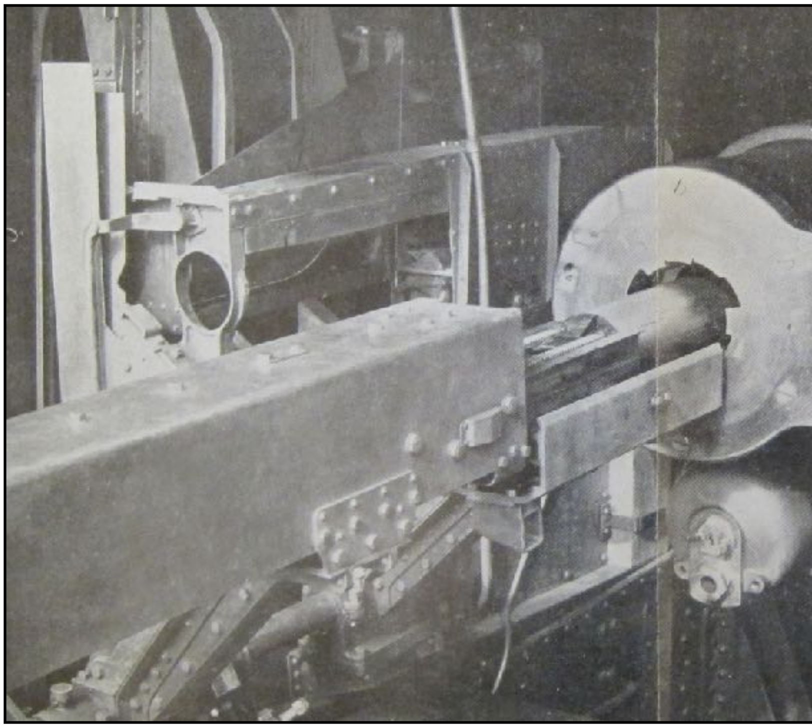
The overhead shield (gun house) was supported on the shell pit shield and enclosed the front part of the fixed platform. The rear opening was unprotected. The shield consisted of steel plates that were fastened together to form the front, sides, and roof. They were strengthened by steel girders that supported a runway beam for a lifting tackle. The front of the shield had an elongated gun port so the gun could be elevated. The port was protected by a blast plate above and below the barrel. There were sight ports with hinged flaps on either side of the barrel.

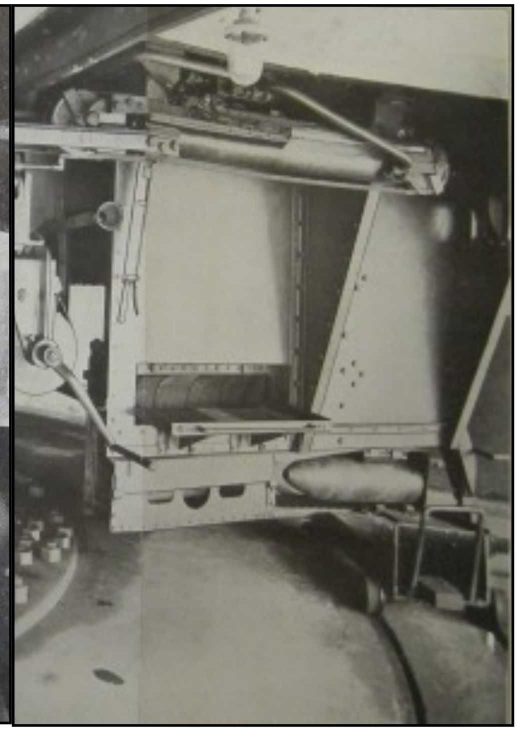
The Working Platforms

Unlike the Mk 5 mounting, the gun was operated from a working platform and not from the shell pit shield. A steel platform was supported jointly by the body and shell pit shield, and extended along the sides of the body and across the rear of the carriage. The rear end of the platform had a hole to allow clearance for the gun on recoil. The platform stepped up half way along each side. The front (higher) part was the working space for the gun layers, and the rear (lower) part for the loaders. Three-quarters of the platform’s length was within the main gun shield, but the rear extended beyond the shell pit shield. Man holes, cover plates, and inspection panels allowed access to installed machinery. A short ladder on each side near the rear allowed access from the platform to the shell pit shield. Stanchions and hand-rails were fitted around the rear end. The platform was cut away to clear the various pipes, and had openings and holes to mount fittings, such as the cradle lock controls and the rammer on the left side, the pump for the wash-out gear at the rear, the valves for the rammer and wash-out pump on the right side, the cradle lock interlock underneath the platform, and the control levers above the platform.

A steel sliding platform, located behind the breech and operated by the elevating gear, enabled personnel to work at the breech. Completely covering the hole at the loading elevation, it was designed to slide under the fixed platform as the cradle was elevated, opening the hole to provide clearance for the gun on recoil.

Ammunition and Loading





The loading system. Left: the long square box houses the rammer and ramming tube. The tube containing the two ½-charges is partially into the chamber. The "U" shaped tray below the ramming tube is the projectile loading tray - the projectile is already in the breech. The ammunition hoist can be seen in the background above the rectangular housing. Right: in the pit. The ammunition elevator is at the right with a trolley on the circular railway. A projectile has just been placed into the cage. 1936 Handbook.

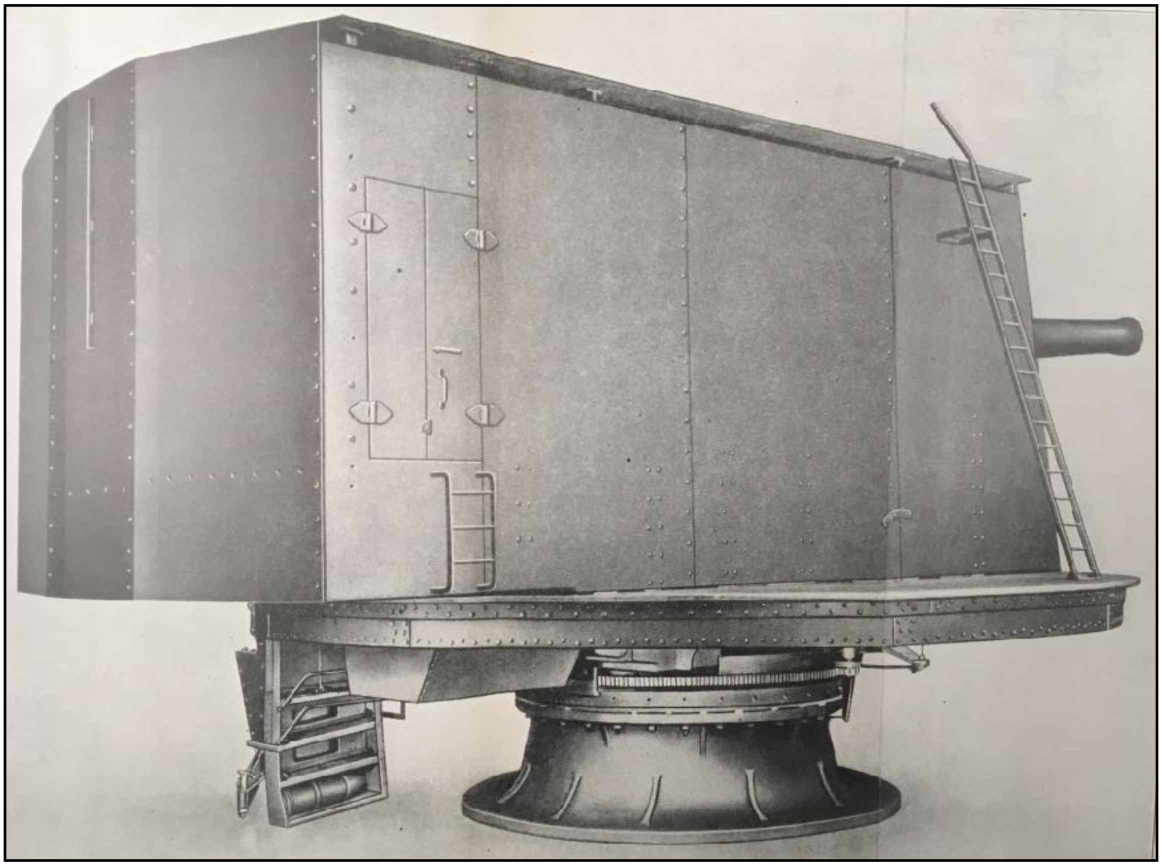
The ammunition handling and loading system was completely changed. The hoists and trolleys under the shell pit shield of the Mk 5 mounting were removed, and a circular railway installed in the floor of the emplacement. An ammunition lift (elevator/hoist) was installed to the left of the breech. A cage with two compartments ran vertically in the lift. Shells were transferred from the magazine opening or shelf in the pit onto two four-wheeled trollies that moved on the rails. Each trolley held two projectiles. When loaded, the trolley was moved around the track to the left side of the lift, where it was held in place by a catch. The trolley then remained attached to the lift while the gun traversed. When needed, one of the projectiles was rolled into the rear compartment of the ammunition cage, and the second projectile moved forward on the trolley. Two ½-charges were placed in the front compartment of the cage by hand. Hydraulic power then raised the cage with the cartridges and projectile from the emplacement floor to the fixed platform

The hydraulically powered rammer rocker, rammer, and loading tray were located at the left rear of the platform. The rammer extended beyond the rear of the platform. To load, the rammer rocker was rotated over until it rested against the lift. When the cage reached the upper platform, the first ½-charge was ejected, rolled into the loading tray, and hand rammed *backward* into the cartridge rammer tube. The second ½-charge was similarly loaded into the tube. The projectile was then rolled into the loading tray, and the rammer and tray were rotated into line with the breech. A carrier in the loading tray moved forward to the breech face to protect the breech screw threads. The rammer tube then forced the projectile off the tray and rammed it into the breech under hydraulic power. This action seated the front of the rammer tube against the rear of the breech. The charges were then hydraulically pushed out of the tube and into the breech, and the rammer tube was withdrawn. The rammer, loading tray, and rammer rocker were a very complex system, supported by a hydraulic motor. The description of the system, less the hydraulics, takes up ten full pages in the handbook. As noted in Chapter 6, due to a British design error, the supercharge cartridge would not fit in the rammer tube. This required the production of a special supercharge for Devils Battery, which prevented the battery from achieving its theoretical maximum range.

If the hydraulics failed, the projectile and charges could be raised to the gun platform by a hand-operated windlass and shell grab. If the hydraulic rammer failed, the loading tray could be disconnected from the rammer rocker and rotated into position using a hand spike. The projectile was then hand rammed into the breech using a rammer staff and four men, and the cartridges loaded by hand as in the Mk 5 mounting.

In summary, the Mk 7 mounting was an extremely complex structure. Combined with the infrastructure problems caused by the low-lying gun emplacements, Devils's Battery was probably the most problematic of all the heavy coast artillery batteries in Canada.

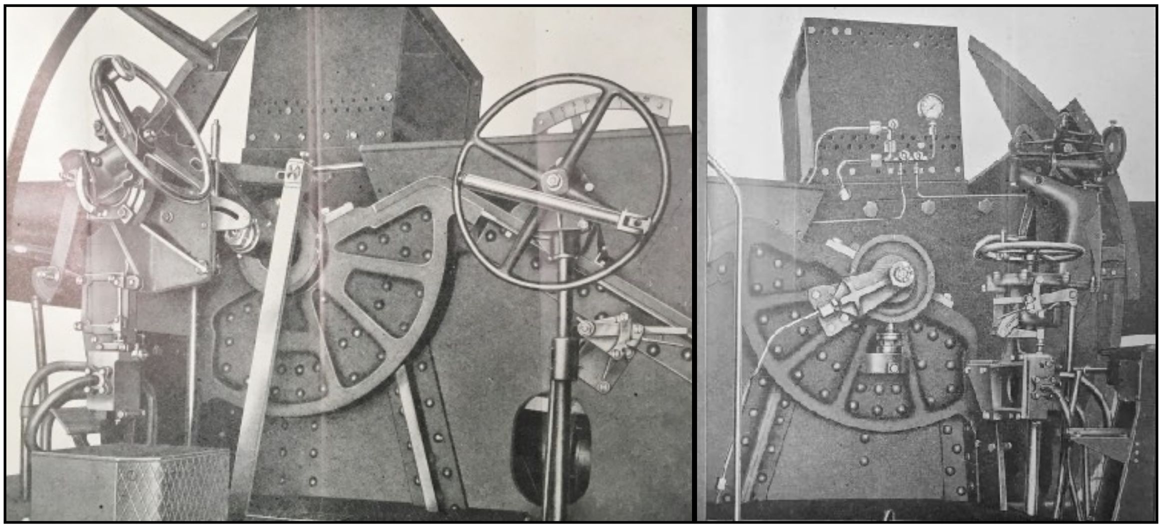
Mounting, B.L., Mark 9 (Oxford Battery, Sydney, NS)[36]



The 9.2-inch Mk 9 mounting as seen from the right rear. The main shield is an enclosed gun house, sitting on a rotating pit shield. Entry is by the door in the side with another on the other side. The pedestal assembly was very similar to the other mountings, but the hydraulics and fittings were significantly simplified from the earlier Mk 7 mounting. The ammunition cage can be seen at the lower left. It held a projectile in the lower compartment, and two ½-charges in the shelves above it. 1944 Handbook.

The Mk 9 mounting was the last of the 9.2-inch coast defence gun mountings. It replaced the cancelled Mk 8 twin turret and was a simplified version of the Mk 7. Approved for production in 1942, it was installed in an emplacement approximately eight feet (~2.43 m) deep. Its fully-enclosed, armoured gun house finally recognized the threat presented by low-flying attack aircraft. The pedestal and main structure of the carriage were very similar to the Mk 7 mounting. The elevating and traversing gears were normally operated by hydraulic power, but could be worked manually if necessary. It was capable of all-round traverse, and the gun could be fired between -5° depression and +35° degrees elevation. The loading angle was 5° elevation. Either the Mk 10 or Mk 15 ordnance could be installed on the mounting. Mark 15 guns were mounted on the Mk 9 mountings at Oxford Battery at Sydney, NS.

As in the Mk 7 system, an air blast system on the mounting purged the gun chamber after firing in order to minimize the possibility of flash back, and clear the bore of gases. The air cylinder in the recoil system could be recharged from the same high pressure source. A wash-out gear, consisting of three nozzles, was fitted to throw jets of water on the mushroom head of the axial vent, the obturator, and into the chamber when the breech was opened after firing.



Left: the elevating layer's station on the Mk 9 mounting with the automatic sight and the range receiver gear removed. The elevation could be set by power or by hand. The normal power hand wheel is to the left and the manual elevation hand wheel is to the right. Right: the traversing layer's station on the Mk 9 mounting with the forward traversing hand wheel, but without the bearing receiver. In the background are the trunnion bearing and air blast fittings. 1944 Handbook.

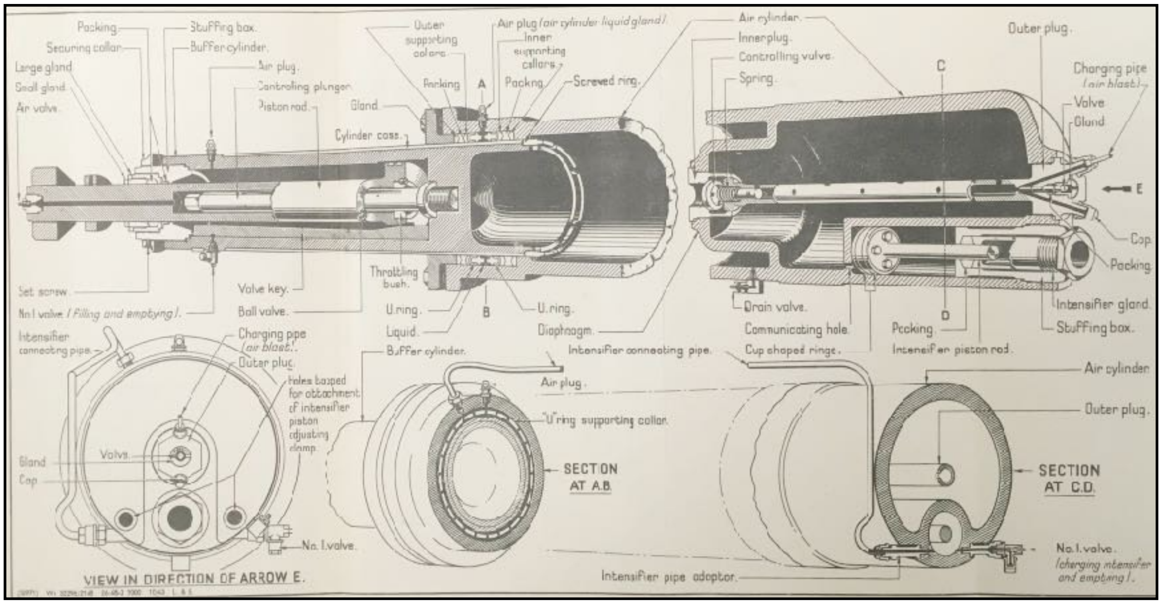
Elevating Gear

As in the Mk 7 mounting, the elevating gear could be operated from two positions on the left side of the mounting above the fixed platform in front and in rear of the trunnion. The forward position had the power elevation controls as well as a hand wheel for manual elevation. Power was provided by a hydraulic motor mounted on the shell pit shield. The layer had a brake pedal to stop elevating. The rear hand wheel provided completely mechanical manual backup using bevel and mitre gears. It could be disconnected from the worm gear by a clutch lever. The controls worked a worm gear connected to two geared arcs attached to the cradle.

Traversing Gear

As in the Mk 7 mounting, the traversing gear could be operated from two positions on the right side of the mounting. The forward position had power and manual controls and the auxiliary position to the rear of the trunnion bearing had a manual control hand wheel. The traversing gear was a toothed rack that encircled and was attached to the pivot plate. A rack pinion meshed with the gear. The auxiliary hand wheel could be de-clutched from the mechanism. Power was supplied by a hydraulic motor mounted on the bolster. A clutch below the horizontal hand wheel selected power or manual operation. Overall, the hydraulic system was considerably simplified.

Recoil Mechanism



A schematic of the recoil system on the Mk 9 mounting. The principles are the same as the Mk 5 mounting, but the general design has been updated. 1944 Handbook.

The hydro-pneumatic recoil mechanism had been fully modernized. The general principles had not changed from the Mk 5, but the construction and materials had evolved. The recoil system consisted of a hydraulic buffer to absorb the recoil, assisted by a compressed air recuperator that also returned the gun into battery. An intensifier increased the pressure in the recuperator. The front of the buffer cylinder was connected to the band holding the gun to the carriage. The piston rod in the buffer was connected to the front transom. A valve in the piston rod regulated the flow of the hydraulic fluid from one end of the buffer to the other. The maximum recoil (metal to metal in the buffer) was 42 inches (1.07 m). The length of the recoil was normally adjusted to 39 inches (0.99 m).

On firing, the gun slid through the cradle to the rear, taking the buffer cylinder with it. The piston did not move, and the movement of the cylinder caused liquid to pass through the port in the piston from front to rear, setting up a fluid resistance that absorbed the recoil. The moving cylinder also acted as a ram for the recuperator, forcing air through a control valve into the rear chamber. When the gun stopped recoiling, the valve closed and the air pressure on the buffer cylinder forced it (and the gun barrel) forward towards the normal "in battery" position. The piston port opened, and the return of the fluid to the front chamber acted as a throttle on the recuperator and prevented a violent return to the in battery position. As the gun approached its forward position, a plunger entered a cavity, and the resistance of forcing the liquid out of the cavity acted as brake and brought the gun to a smooth stop.

Sights

For direct fire, an automatic sight was fitted at the elevation layers position on the left side of the mounting. When the crosshair of the No. 7 (or No. 22) Sighting Telescope was laid on the waterline of a target ship, the sight automatically adjusted the elevation for the range to the target. There were corrections for the state of the tide and the muzzle velocity of the gun. The sight could be moved laterally twelve degrees right and left to bring the line of sight parallel with the direction sight on the right of the mounting.

A No. 1 Direction Sight on the right side of the mounting allowed visual tracking of the target. It was pivoted horizontally from a bracket, and attached to a drift correction cam attached to the cradle. This connection automatically corrected the sight for the average drift caused by the projectile spin at all angles of elevation, and allowed the gun layer to concentrate on tracking the target. Separate corrections for drift that was specific to a type of projectile and for deflection (leading the target) could be manually input into the sight.

Unlike the Mk 5 mounting, there was no third position in the emplacement pit for laying the gun using data transmitted from the battery plotting room. The range, determined by the range finder in the observation post, or from radar, was transmitted by Magslip to a No. 3 Range Receiver mounted in front of the elevation gun layer. This displayed the range to be set on two dials. The left dial was marked in 25 yard (22.86 m) increments, and numbered every 500 to 5,000 yards (457.2 to 4,572 m). The right dial was marked every 5,000 yards to 40,000 yards (4,572 to 36,576 m). Each dial had two pointers. One was set by the electrical signal from the Magslip. The other pointer was connected to the gun through a spindle to the converter in the range receiver gear. The gear detected the elevation set on the gun, and converted it to a range and the spindle moved the pointer on the dial. Corrections for muzzle velocity and charge temperature could be input into the converter. The gun layer then elevated or depressed the gun until the two pointers lined up in both dials. The dials were illuminated for night operations.

When the target could not be tracked from the gun, the gun layer’s position on the right was equipped with a No. 3 Bearing Receiver, which received Magslip signals from the battery plotting room. The receiver was similar to the range receiver described above. The right dial was marked in five minute increments and numbered every 30 minutes of arc to ten degrees. The left dial was numbered every ten degrees to 360 degrees.

The bearing receiver geared two drives and a corrector for deflection and convergence. Convergence was necessary when the guns were widely separated and it was desired to concentrate the fire of the battery on a point. One gun was selected as the “pivot gun” and the other two guns would apply a correction that converged the fire of all three guns on a single point. The correction was applied by a cam on the two non-pivot guns that was unique to the surveyed location of each gun.

Loading and Ramming

There were major changes in the Mk 9 loading system. The cartridges and projectile were raised from the emplacement floor to the gun level by a hydraulically-powered ammunition lift (elevator or hoist) located on the left of the mounting near the breech. The lift had a cage that carried a complete round with the projectile in the lower tray and two ½-charges in separate compartments above the shell. The cage moved vertically on rollers inside the lift. A wire rope was attached to the top of the cage and connected to a hydraulic press (ram) that raised the cage to the fixed platform. When the ammunition had been removed, the the hydraulic control valves were opened and the cage returned to the lower level under its own weight. If the hydraulics failed, the cage could be hoisted to the working platform using a hand-operated windlass.

Projectiles were moved to the cage by two trolleys that ran on a circular railway on the emplacement floor. A trolley held two projectiles, and had a catch that engaged in the bottom of the ammunition lift. Once the trolley was connected, the lift pulled it around the railway as the gun traversed. When the trolley was empty, the catch was disengaged and the trolley moved off the rails to make way for the second trolley. Cartridges were carried to the lift by hand.

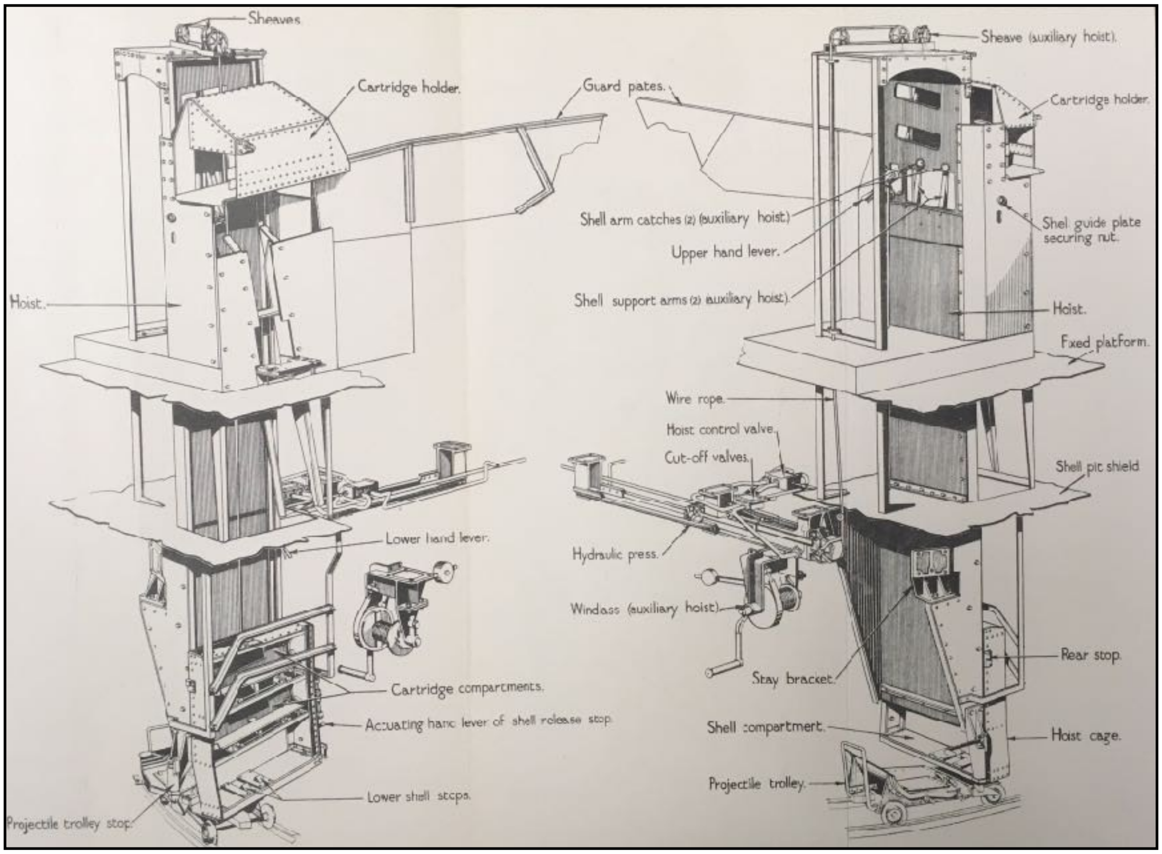
On the gun platform, the projectile was transferred to a loading tray and the cartridges to a cartridge holder. The loading tray arm was mounted on a supporting frame, and rotated from a position beside the ammunition lift to a position behind and in alignment with the breech. Movement was controlled by a handspike fitted to a bearing on the end of the loading tray arm shaft.

A hydraulically-powered chain rammer was mounted on the shell pit shield behind the gun. A movable platform bridged the gap between the loading tray and the chamber of the gun to protect the threads of the breech screw. The normal stroke of the rammer was 12 feet 1.8 inches (3.70 m). The cartridges were loaded by hand. If the chain rammer failed, hand ramming was possible as in the Mk 5 mounting.

The gun had to be lowered to an elevation of 5° for loading, and a loading stop with a spring loaded plunger was mounted on the right side of the carriage body. The speed of elevation or depression was reduced as the cradle approached the loading angle by a cam that operated a hydraulic cut-off valve.

Shields and Protection

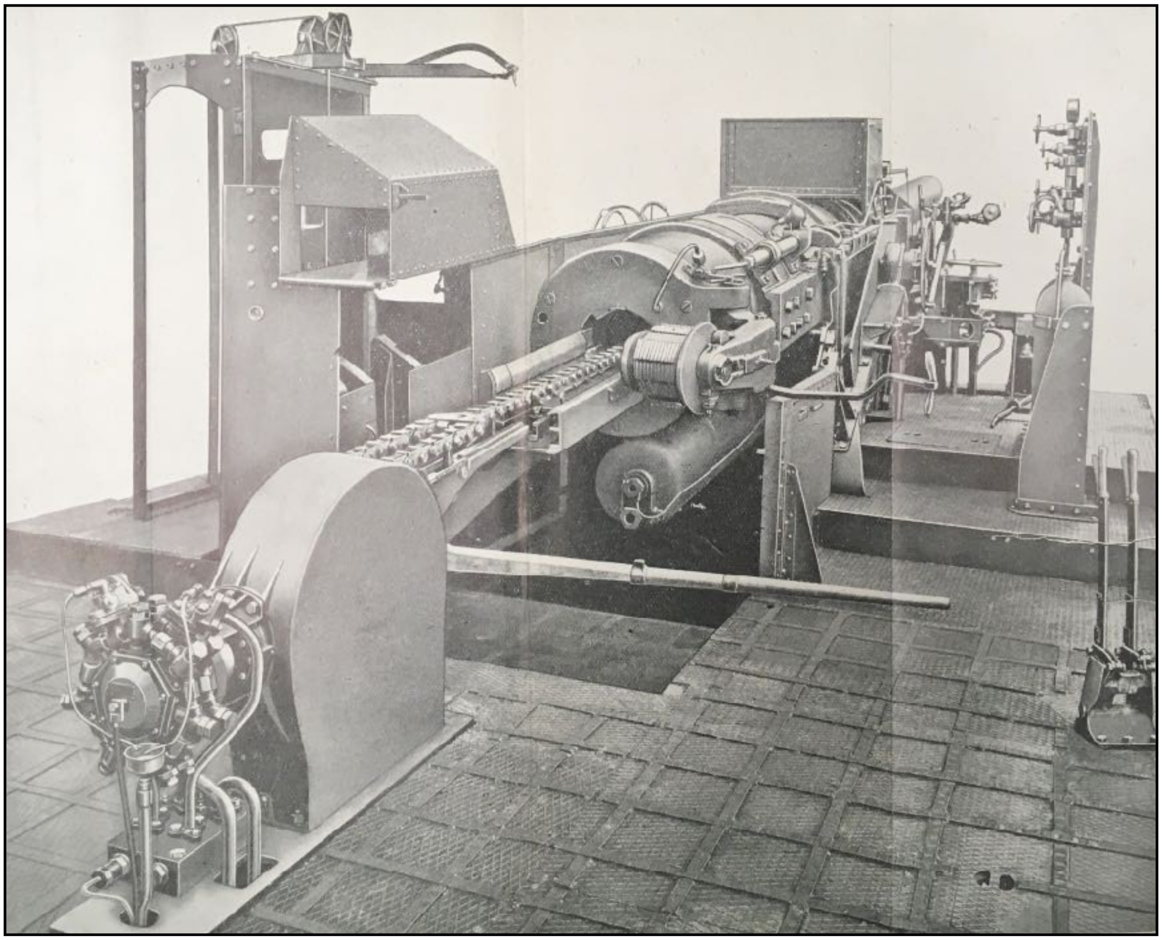
Shell pit and overhead shields were provided to protect the gun numbers and vulnerable parts of the mounting. The shell pit shield was circular with a central longitudinal opening. It covered the emplacement between the body of the mounting and the concrete wall. It was supported by cantilever brackets attached to the body of the mounting. Various fittings were attached to the shield, such as the overhead shelf, fixed platform, the hydraulics for the



A schematic of the ammunition lift. The projectile trolley at the bottom ran in a circular railway around the bottom of the emplacement. 1944 Handbook.

ammunition lift, and other parts of the hydraulic system. It also served as a platform outside the main gun house shield. A rectangular hole fitted with bars to form a grating was on the floor on each side at the front of the shell pit shield. Another rectangular hole towards the left rear provided clearance for the ammunition lift. The hydraulic ram cylinder for the ammunition cage was secured to the underside of the shield towards the left rear, and the elevating gear engine was mounted on the left top of the front cantilever. A short steel ladder, fastened to the shield in front of the body, allowed access to the various fittings from the pit.

The overhead or main shield (gun house) was supported on the shell pit shield and protected the front part of the fixed platform. It consisted of steel plates that were fastened together and supported by girders. Fittings on the roof supported a runway beam with lifting tackle, which was mainly used to lift the 6-pounder sub-calibre gun into position for training. The front of the shield had a port for the gun barrel, with blast protection plates above and below the gun. There were two sight ports with shields. A door on each side at the rear with a short ladder allowed entry into the gun house. A long ladder on the right front accessed the roof. The rear wall had a rectangular plate that could be opened to allow the rammer stave to enter the gun house for hand ramming.



The Mk 9 mounting with the gun house shield removed. The chain rammer is in the foreground. The loading tray is in position behind the breech, and the chain rammer has been extended into the breech. The large handle pointing horizontally in the middle ground is the operating handspike to rotate the loading tray from the ammunition lift (the tower on the left) into alignment with the breech. The layer's position can be seen to the right of the large square box above the barrel. 1944 Handbook

A steel fixed working platform was supported jointly by the body and shell pit shield, and extended along the sides of the body and across at the rear of the carriage. The rear end of the platform had an opening to allow clearance for the gun on recoil. The opening in the floor was covered by a sliding platform that allowed the detachment to work in the breech area. The sliding platform was designed to slide under the fixed platform as the cradle was elevated, in order to provide clearance for the gun on recoil. The platform had two levels with a step half way along each side. The front (higher) part was a working space for the gun layers, and the rear (lower) part for the breech operators and loaders. Rectangular man holes, cover plates, and inspection plates allowed access to installed machinery. A short ladder on each side near the rear allowed access to the shell pit shield. Stanchions and hand-rails were fitted around the rear end. The platform was cut away to clear the various pipes, and had openings and holes to mount fittings, such as the cradle lock controls and the rammer on the left side, the pump of the wash-out at the rear, the valves for the rammer and wash-out pump on the right side, the cradle lock interlock underneath the platform, and the control levers above the platform.

The Mk 9 was the last of the 9.2-inch mountings. Photographs indicate that it was considerably simplified compared to the Mk 7 mounting although, in Canada, it was never completely operational. Certainly, it was the best mounting for the Canadian climate.

Fire Control Equipment

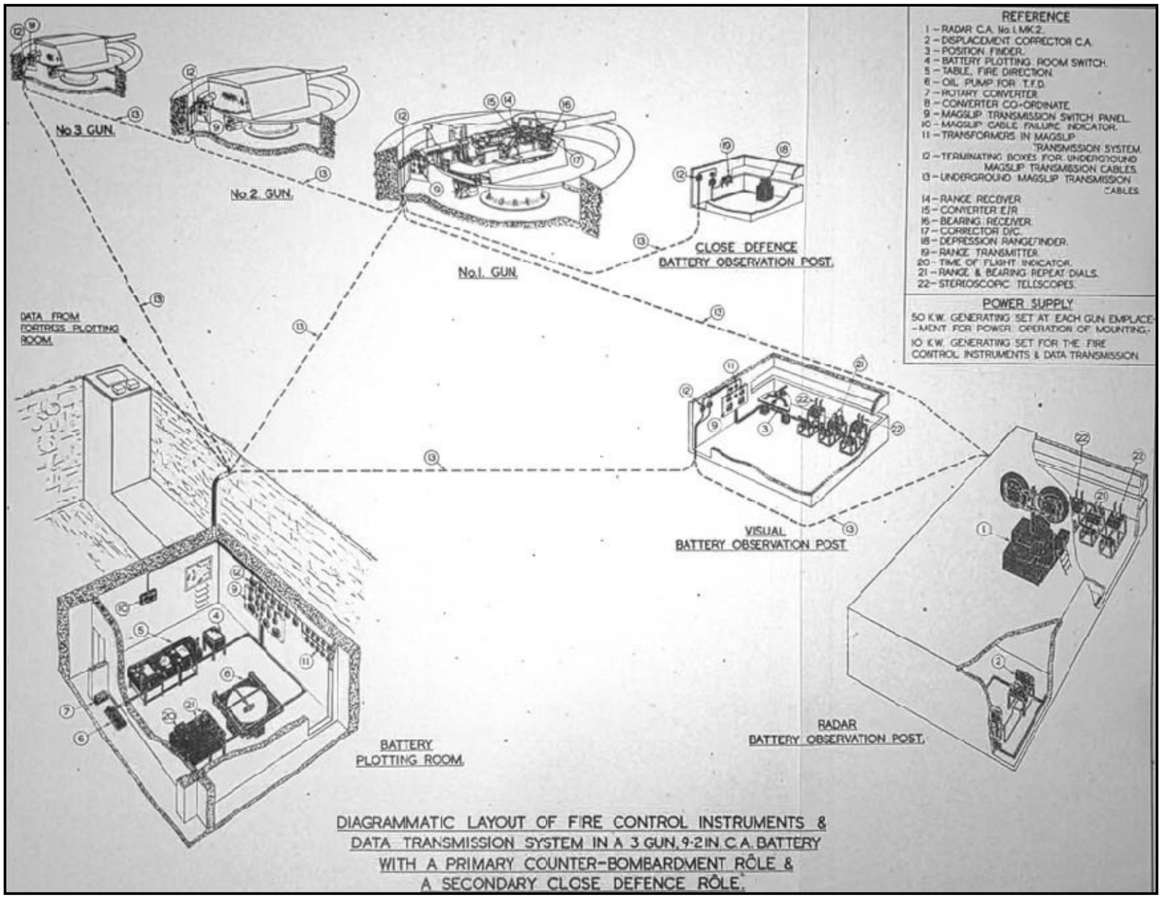


Diagram of a British Second World War 9.2-inch gun battery, listing the equipment held at each location. The layout of the new Canadian batteries was similar, but none of them had a separate close defence observation post, although Albert Head had searchlights and was considered to have a secondary close defence role. The Second World War, 1939-1945, Army: REME, Volume 2, Technical.

The guns themselves were useless without the supporting fire control instruments. At the beginning of the twentieth century, although state of the art for the time, these were quite basic and allowed only daylight operation. When the guns were retired, the system was capable of excellent accuracy, night and day, at long range, and in all weather conditions.

Rangefinding

The trajectory of a projectile is not flat, and establishing the range to a target is essential to obtain a hit. The gun barrel is then raised to an angle (elevated) that will let it achieve the required range. At longer ranges, it is necessary to make a small, but necessary, correction for the curvature of the earth. Also, for a coast defence gun, as for a naval gun, the target is always moving and the range will change continuously. If a target is close and can be seen from the gun, automatic sights can be used, and these have already been described.

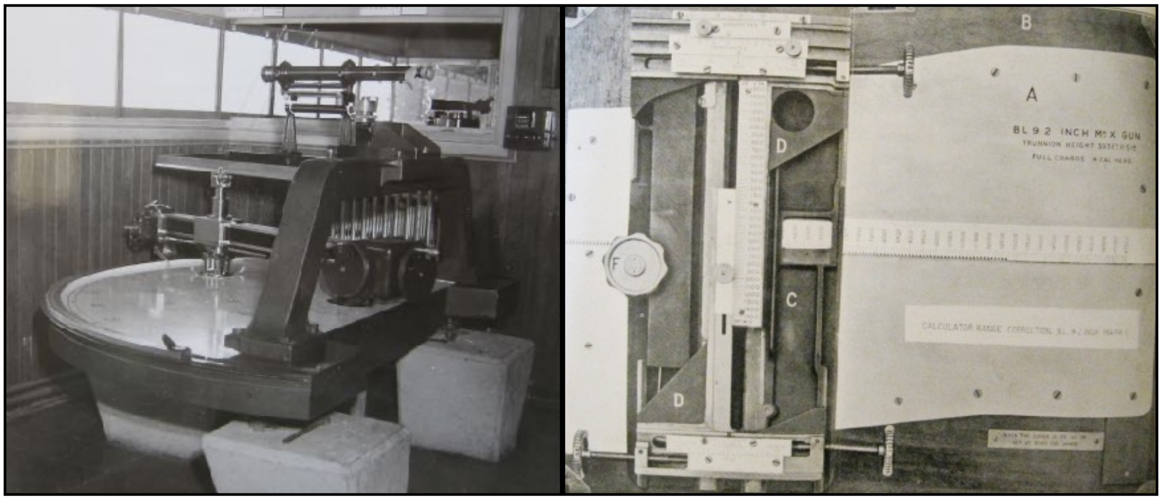
An optical rangefinder (the long rod on the roof) being installed for the 6-inch guns at Lingan Battery at Sydney, NS. The crate is still on the roof of the observation post. The 9.2-inch guns used a similar rangefinder in their battery observation posts. Lingan Fort Record Book.

Otherwise, some other instrument is necessary to establish the range.

In the 20th century, until the development of radar, range was determined using either an optical rangefinder, or a depression position finder (DPF). These instruments were mounted in the fortress or battery observation posts, and normally transmitted their data to the fortress or battery plotting room. The instruments were improved and upgraded over time. The effectiveness of a DPF depended on its height above sea level. A telescope was mounted on a solid base. The vertical angle to the water was determined by extremely fine vertical adjustments on the instrument, which together with the accurately surveyed height, allowed calculation of the horizontal distance to the target. The telescope mounting sat on a chart table that allowed the determination of the bearing of the target. With adjustments for the displacement of the guns from the observation post, as well as corrections for ballistic and meteorological factors, the range and bearing data could then be passed to the guns.

In the early years, the battery observation post at Sandwich Battery had a Depression Position Finder, Type “E” Mk 2. It was located 176 feet above sea level and had an effective range from 1,400 yards to 14,000 yards. In contrast. the battery observation post at Albert Head in the 1940s used a Depression Position Finder, Type “T” Mk 2. This determined the range and bearing to the target, corrected for displacement from the pivot gun, and electrically transmitted the data to the battery plotting room. It could also give the coordinate position of the target and its course and speed. It was accurate to 1% up to 37,550 yards. The other new batteries had similar instruments.

At Albert Head, the Fortress Observation Post had a Depression Position Finder, Type “Z” Mk 2. This transmitted the data to the Fire Command Post or Fortress Plotting Room and was accurate to 1% up to 29,675 yards. When a battery was part of a fortress rangefinding system, a coordinate converter at the battery



Left: depression position finder in the battery observation post at Albert Head. Albert Head Fort Record Book. Right: The Calculator, Range Correction, B.L. 9.2-inch Gun, Mark 1. The various scales on the instrument allow corrections for barometric pressure, temperature, and wind (including tide, and target movement). The corrected range is displayed on the main scale. The corrector was unique for a given battery. 1923 Handbook.

plotting room received target location data from the fire command post and converted it into bearing and range to the target based on the pivot gun.

The range corrector allowed the battery commander to improve accuracy by applying corrections for variable ballistic factors. Depending on the instrument, corrections could be applied for variation in muzzle velocity of the gun, temperature of the propellant charge, air temperature and density, wind direction, non-standard weight of the projectile, and rotation of the earth at long ranges. While this may seem a bit fussy, the cumulative effect of these factors could change the impact point by several hundred yards.

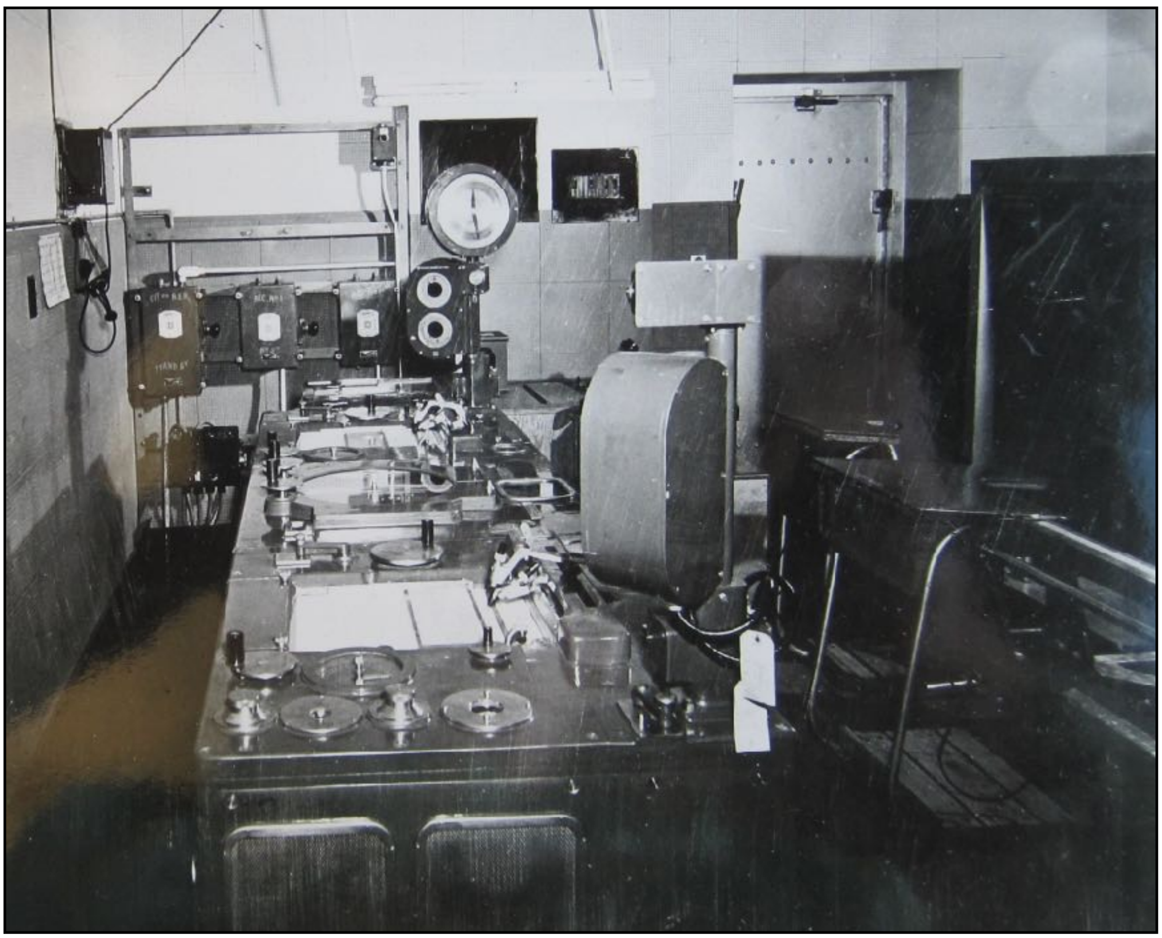
Data Transmission

The earliest data transmission system was electro-mechanical with a transmitter in the command post sending an electrical signal to a dial with a pointer in the gun pit. The gunners had to manually traverse or elevate the gun to match the transmitted data. There was no automation, and the system was less accurate than the Magslip system that followed

Magslip was a synchronization system, developed about 1938 that, in its simplest form, had an electric transmitter in the battery plotting room and a receiver at the gun. Data would be calculated in the BPR, entered into the transmitter, and then passed to the guns over multi-core electric cables. The pointer on the receiver then pointed to the same value as the transmitter, and the bearing or range could be set manually on the gun (see the description of the receivers in the section on the relevant mounting). In more advanced versions, a converter in the BPR would calculate the required bearing and elevation of the gun (with corrections as necessary), and all the gun layers had to do was elevate and traverse the gun until the two pointers matched. This eliminated errors introduced by verbally transmitting the fire orders.

However, the accuracy of a receiver dial was limited to 1/360 part of a circle and this was not accurate enough for coast artillery. For example, for a bearing of 121° 30', the 121 could be transmitted, but the 30 would have to be estimated. Therefore the system used two dials, each with its own pointer. One dial would give the degrees and the second dial the minutes, with the appropriate increments in each dial.

Data transmission required that cables be laid between the battery observation post, battery plotting room, and the guns. As the guns became separated, this required tunnels for cabling, that were made large enough for personnel traffic. The battery plotting room had a switch that allowed the incoming and outgoing data from the battery plotting room to be transmitted to the guns by several alternative routes, in order to compensate for battle damage.



Battery plotting room at Albert Head with the Table, Fire Direction, Mk 3B in the foreground. The plotting assistant's tables are to the right. Fort Record Book.

Battery Plotting Room

At the beginning of the twentieth century, the battery observation post (BOP) and the battery plotting room (BPR) were close together, often on different floors in the same building. The battery commander worked at the BOP and passed his orders directly to the guns. In the new batteries, with the increased range requiring more complex instrumentation, the BPR became a separate underground structure. The BPR had a fire direction table that was manned by a plotting officer and a team of operators. During the Second World War, the battery commander's position in action moved from the BOP to the BPR, mainly because of the introduction of radar. Information from all sources - fortress and battery - was sent to the BPR and entered into the fire direction table to plot the track of the enemy ships. With radar, this was independent of visibility and the BOP became just a daylight observation post.

Radar[37]

The invention of radar significantly improved the prediction of the range to the target. The story of radar development in Canada is well described in W.E. Knowles Middleton's *Radar Development in Canada*, but a brief summary is included here. Canadian work on the CD type radar began in September 1939. It operated on a frequency of 200 MHz, and used a massive antenna on the top of a tall tower. After development at the National Research Council in Ottawa, a 70-foot (~21 m) high tower was constructed at Duncan Cove near Halifax in the spring of 1941. Comparison tests with other equipment were carried out in the fall. These were reasonably successful, but that also indicated that a radar operating in the 3,000 MHz band would be more efficient. Nevertheless, the test radar was capable of measuring a bearing to a target within plus or minus 4.5 minutes of arc, and range to within 29 yards (~26 m) in most weather.

In January 1942, the Canadian Army requested NRC to develop a coast defence radar operating in the 3,000 MHz band. The army had such confidence in the NRC that 41 units were ordered from Research Enterprises Limited (REL) in April, only two weeks after the preliminary design conference. The radar had to include a "displacement corrector". This received the range and bearing from the CDX radar set, converted it to the range and bearing to the target based on the pivot gun, and transmitted it to the battery plotting room. An experimental model was tested at Duncan Cove in October 1942, and the improvement over the CD radar was readily apparent. Not only were the range and accuracy better, the whole antenna was based on two 4-foot (~1.2-m) diameter circular dishes and was only slightly more than eight feet (2.4 m) high. The prototype was tested in February 1943 and production began in the summer. Fourteen sets were manufactured at Research Enterprises, Ltd., with an additional five sets being made for the USSR. In 1946, the set was modified to include the radar return from the shell splashes, becoming the CDX No. 2 Radar. This allowed the battery commander to correct the fire onto the target.

By 1946, ten CDX radars were deployed, three at Halifax (Devils, McNab, and Chebucto Batteries), three at Sydney (Lingan, Oxford, and Petrie Batteries), one on Partridge Island at Saint John, NB, two at Victoria (Mary Hill and Albert Head Batteries), and one at Barrett Battery at Prince Rupert. Halifax, Sydney, Victoria, and Prince Rupert also had an older CD radar for the use of the fire commander.

Left: a comparison of the CD Radar and the CDX radar. The CD is the massive structure on the tower. The CDX is the twin 4-foot (~1.2-m) circular dishes at the base of the tower in the foreground. The building under the tower houses the electronics and the operators, generators, etc.

Above: the CDX No. 2 Radar at Albert Head. The dishes can just be seen on top of the observation post. Fort Record Book.

The CDX No. 2 Mk 1 Radar was designed as rangefinding and splash-spotting fire control instrument. It included a displacement converter to correct for the distance of the radar from the centre of the battery it supported. It had a maximum effective range of 37,000 yards (~33,800 m), and could determine the bearing to a target accurate to within ten minutes of arc at that range. Accuracy was less if there were two targets within 200 yards (~180 m) on the same bearing. The shell splashes on hitting the water could be detected as long as the splash was within 2.5 degrees of the bearing and 1,000 yards (~915 m) from the target. This allowed the fire to be corrected onto the target. Data was passed to the gun using a Magslip indicator or by telephone. The radar was manned by a detachment of one sergeant and five operators. If continuous operation was needed, several detachments would be required.

The CDX radar consisted of a tower assembly with transmitting and receiving antennae, a transmission system to the equipment racks, and a turntable and motors to rotate the antennae. In the operations room, there were three large equipment racks: one held the measuring system, displacement converter, and DC power supply, the second held the main receiver and display units, and the third contained the bearing control and measurement systems and transmitter. Commercial power was normally used, but electricity could be supplied from a 7.5 KVA generator if necessary.

Camouflaged searchlight position at Albert Head. Fort Record Book.

Searchlights

Given the ranges involved in the counter-bombardment role, searchlights were not effective, and the 9.2-inch guns rarely had searchlight support. Sandwich battery did have searchlights to support the two 6-inch guns at the battery, but the 9.2-inch section was considered a daylight battery only. Neither Devils nor Oxford Batteries had direct searchlight support, although Devils could conceivably have used the other Halifax searchlights. Albert Head was the exception. Two American pattern 60-inch concentrated beam searchlights (manufactured by Canadian General Electric) were installed in the battery area, which allowed the battery to have a secondary close defence role. The searchlights were powered by diesel generators.

Comparative Data Summary

Ordnance Mark 10

Construction type: Steel (wire wound).

Calibre: 9.2 inches (234 mm).

Barrel length: 442.35 inches (11.2 m).

Rifling: (Mk 1) 37 grooves, polygroove, modified plain section, straight until 303.6 inches (~7.71 m) from the muzzle then increasing twist from zero to 1 turn in 30 calibres; (Mk 2) 46 grooves, polygroove, plain section, uniform twist, 1 turn in 30 calibres for 353.8 inches (~9 m).

Breech mechanism: single-motion Welin screw.

Ignition: 0.4-inch electric or percussion vent tube primer.

Weight of gun and breech: 62,720 pounds (28,450 kg).

Ordnance Mark 15

Construction type: Steel (built up).

Calibre: 9.2 inches (234 mm).

Barrel length: 442.35 inches (11.2 m).

Rifling: 48 grooves, polygroove, plain section, uniform twist, 1 turn in 30 calibres for 353.8 inches (~9 m).

Breech mechanism: Asbury single motion breech with Welin screw.

Ignition: 0.5-inch electric or percussion vent tube primer.

Weight of gun and breech: 62,496 pounds (28,348 kg).

Mounting Mk 5

Type: open top barbette.

Recoil mechanism: hydro-pneumatic with 42-inch (1.07-m) normal recoil.

Elevation: -10° to +15°.

Traverse: 265º

Sights: autosight, rocking bar sight, range and bearing dials.

Weight (without ordnance): 212,800 pounds (~95,524 kg).

Mounting C Mk 6A

Type: enclosed gun house.

Recoil mechanism: hydro-pneumatic with 40-inch (1.02-m) normal recoil.

Elevation: -10° to +30°.

Traverse: 360°.

Sights: autosight, direction sight, range and bearing receivers.

Weight (without ordnance): No list of weights for the C Mk 6A mounting has been found. It would have been heavier than the Mk 5 mounting.

Mounting Mk 7

Type: Gun house (open rear).

Recoil mechanism: hydro-pneumatic with 40-inch (1.02-m) normal recoil.

Elevation: -5° to +35°.

Traverse: 360°.

Sights: autosight, direction sight, range and bearing receivers.

Weight (without ordnance): 147,640 pounds (~66,968 kg). Note: This weight may not include all the parts in the mounting.

Mounting Mk 9

Type: Enclosed gun house.

Recoil mechanism: hydro-pneumatic with 39-inch (1.0-m) normal recoil.

Elevation: -5° to +35°.

Traverse: 360°.

Sights: autosight, direction sight, range and bearing receivers.

Weight (without ordnance): 283,556 pounds (~128,618 kg).

Range

The nominal maximum range (without correction for non-standard ballistic conditions) depended on the maximum elevation, propellant charge, and c.r.h of the projectile. As has been noted before, there are many different values for range quoted in the files. The ranges below are from the relevant handbook.

On a 15° Mk 5 mounting with normal full charge and a 2 c.r.h shell, the maximum range was 15,000 yards (13,700 m).

On a 30° C Mk 6A mounting with a normal full charge and a 4 c.r.h shell, the maximum range was 27,900 yards (~25,500 m). This could be increased slightly with supercharge.

On a 35° Mk 7 mounting with a normal full charge and a 4 c.r.h shell, the maximum range was 29,600 yards (~27,050 m). The guns at Devils Battery were not able to fire the full supercharge (see Chapter 6).

On a 35° Mk 9 mounting with a supercharge and a 5/10 c.r.h shell, the maximum range was 31,300 yards (~28,620 m).

Ammunition

Introduction

A round of 9.2-inch ammunition consisted of a projectile, a propellant charge, a fuze (that depended on the type of shell), and a vent tube primer (that ignited the propellant). In the battery location, each gun had at least one adjacent underground magazine for ammunition storage. In the magazine, the shells and charges were stored in separate rooms. Depending on the battery layout, a hoist lifted the ammunition to the floor of the emplacement. From there it was moved to the gun working level (see the description in the section on the relevant mounting). The projectile was loaded first. It was raised from the gun pit and aligned with the breech. The fuse was inserted (and set if necessary) before the projectile was rammed. It was then rammed into position at the front of the chamber. Ramming could be completely manual - men pushing on a rammer staff - or could have various degrees of power assist. The charge was then pushed into the chamber. The full charge was in two parts - in half- or quarter-sized charges. The vent tube primer was inserted in the firing lock before the breech was closed.

An indication of scale - the projectile room in the magazine, probably at Sandwich Battery early in the Second World War. The hoist to take the shells up to the emplacement floor is in the background. Each shell weighs 380 pounds (178.4 kg). Moving them was not a trivial task. The shells are not fuzed. LAC 399183.

The required stock of operational ammunition (according to the British standard) varied over the years. However, until the end of the Second World War, Canada rarely purchased the recommended level of ammunition. Before the First World

War, the authorized scale of ammunition was 400 rounds of armour-piercing and 200 rounds of common luddite (explosive) shells per gun. In 1934, there should have been 275 rounds per gun (rpg) at Halifax (mostly armour-piercing, capped (APC)), and 250 rpg at Esquimalt. During the Second World War, each gun was supposed to have at least 250 rounds of APC and 31 rounds of high explosive (HE) ammunition available either in its magazine or in its supporting ammunition depot. At the end of the war, the reports in the Fort Record Books generally indicate this quantity was present, although some of the ammunition was an older version.

As an example, the magazine of B/1 gun at Albert Head on 10 August 1944 contained 412 projectiles:

- 21 APC Mk 4 projectiles filled in September 1912;
- 79 APC Mk 5A projectiles filled in August 1924;
- 250 APC Mk 12B (4 c.r.h. head) projectiles filled in January 1943;
- 50 HE Mk 13A projectiles filled in 1917;
- 4 Shrapnel Mk 10A (practice - plugged) projectiles; and
- 8 Practice Mk 8B projectiles.

For propellant, there were 657 half or quarter charges:

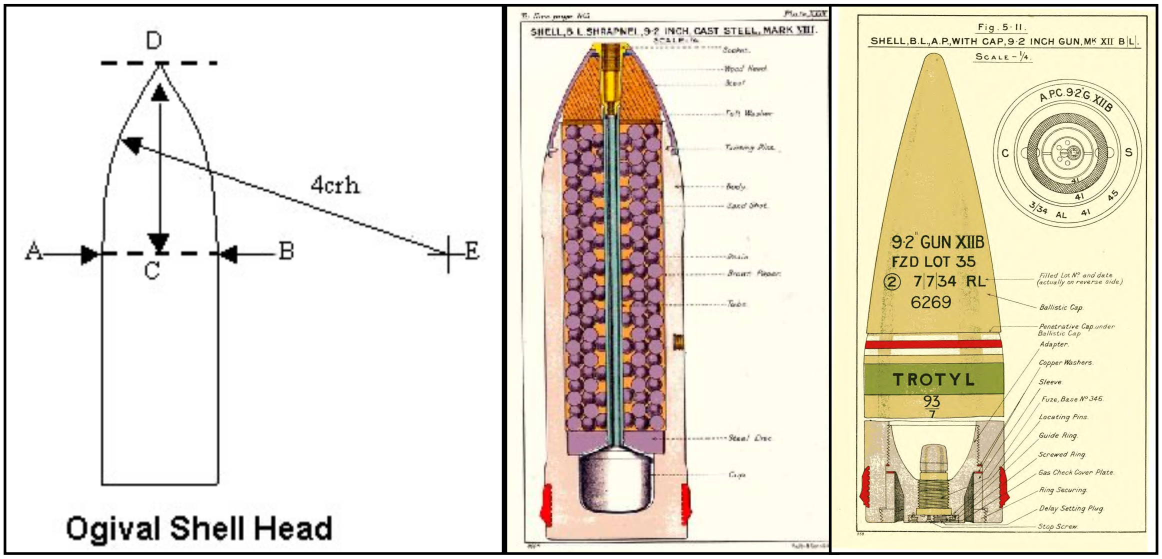
- 7 ½-cartridges of 60-lb cordite MD 37 Mk 2 filled in March 1913;
- 12 ¼-cartridges of 27¼-lb cordite W173 Mk 1 filled in February 1939;
- 132 ½-cartridges of 54½-lb cordite W173 Mk 1 filled in February 1929;
- 34 ½-cartridges of 53½-lb cordite MD 26 Mk 1 filled in May 1930; and
- 472 ½-cartridges of supercharge 62 lb 9.5 ounce cordite WM 245 Mk 1 manufactured in February-March 1943.

Ammunition was not cheap. Order-in-Council 1918-1686 dated 5 July 1918 authorized the purchase of $12,000 worth of 9.2-inch ammunition. OiC 1924-0983 requested another $15,000 of ammunition on 12 June 1924, but that was not approved. In 1936, the cost of an APC Mk 12B shell was quoted at £48, and a cartridge slightly more than £13 (the exchange rate was about £1 = $5 Canadian). The cost to have the approved 250 rounds in the magazine would have been more than $76,250 per gun, not counting transportation and storage costs. As a comparison, during the Second World War, an army private (gunner) was paid about $1.30 per day (not counting allowances).

Calibre Radius Head

Calibre Radius Head (c.r.h.) was (and is) a measure of the aerodynamic streamlining of a projectile. It has a highly mathematical definition, but for the layman, it described the radius of the arc that shaped the nose of a projectile in terms of the calibre of the projectile (a-b in the diagram (Navweaps)). For the 9.2-inch gun, the nose of a 2 c.r.h. projectile described an arc with a radius of 18.4 inches - a rather blunt nose. The nose of a 4 c.r.h. projectile was an arc with a radius of 36.8 inches, which was more streamlined, had reduced aerodynamic drag, and a greater range. The final version had a 6 c.r.h. head with a radius of

27.6 inches. Increasing the c.r.h. of a projectile reduced drag, and increased range.



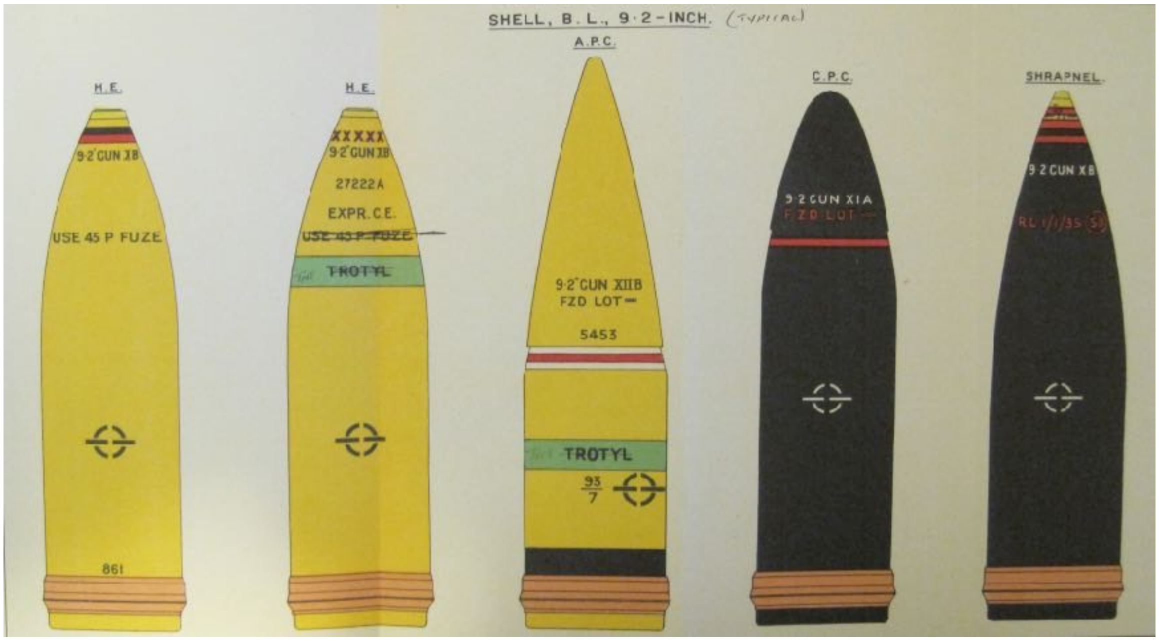
Left: a diagram of calibre radius head. The calibre of the shell is A-B. The radius of the nose of the shell centres at point E, and A-E is four times the A-B dimension. (Navweaps). Centre: a shrapnel shell with a 2 c.r.h. nose. Right: an armour-piercing (capped) with a nominal 6 c.r.h. nose - much more streamlined. Treatise of Ammunition.

Projectile Types

The ammunition for the 9.2-inch gun was continually modified and improved over the fifty years of its Canadian service. The 1923 handbook indicates the existence of thirteen marks (versions) of high explosive shells, and nine marks of armour-piercing projectiles. In some cases, the differences were minor, but others were a complete re-design. At least six different fuzes were in use. Obsolete projectiles sometimes had their explosive removed and were used for practicing loading drills.

The 1906 handbook lists the following types of projectiles for use with the 9.2-inch guns: common lyddite, armour-piercing, armour-piercing (capped), shrapnel, solid practice shot, and a paper shot. Except for the paper shot, they all weighed 380 pounds (178.4 kg). Surprisingly, the 1944 Handbook for the Mk 15 barrel includes the same types of ammunition, some of which were almost certainly obsolete. This probably indicates that, because full-calibre live firing was relatively rare, most locations had older ammunition in stock.

The 1906 common lyddite shells were made of steel and filled with 40 pounds (~18 kg) of lyddite - the predecessor to TNT. The explosive was later changed to TNT, but the old ammunition remained in service until it was used up. In 1944, Devils Battery still had stock of Mk 13A Lyddite ammunition that had been manufactured in 1928, and it was still authorized for use by the handbook. Depending on the version of the shell, the No. 45, 45P, 119, 230, or 230P fuze could be used.



A selection of shells. From the left: high explosive, high explosive, armour-piercing capped, common pointed capped, shrapnel. Treatise of Ammunition, 1915.

In 1906, the armour-piercing projectile was forged or cast steel, and contained an 18-pound (8.2-kg) explosive charge that was ignited by a fuze in the base of the shell (hopefully after the projectile had penetrated into the enemy armour). The armour-piercing (capped) (APC) projectile was similar to the AP projectile with the addition of a specially-shaped mild steel cap that protected the nose of the projectile on impact, and improved the penetration into armour plate. The mild steel cap was then covered with a lightweight ballistic cap to improve the aerodynamics. In 1944, all the batteries had Mk 12B APC ammunition in stock. Depending on the version of the shell, the No. 15, 15D, 16, 16B, or 346 base fuze could be used.

The 1906 shrapnel shell contained about 628 2-ounce (57 gram) lead balls with a small bursting charge and a nose fuze. By 1944, the Mk 10B shrapnel shell had a 6 c.r.h. nose and contained about 2,790 balls (0.6 ounce - 17 grams each) in a resin matrix. Depending on the version, the No. 15, 15D, or 88 time fuze could be used.

The 428-pound paper shot had four sections, each filled with wood pulp and sawdust that broke up on firing. It was used to test recoil systems in peacetime, when the use of normal ammunition was impractical. For the Mk 2 paper shot, only 400 yards (~365 m) of range clearance was needed. There was no reference to a paper shot in 1944.

The official practice shot was a solid cast iron or steel slug. It contained no live fuze or explosives. All batteries had practice shot on hand in 1944. In some cases, obsolete projectiles had their explosive removed and were used as practice shot.

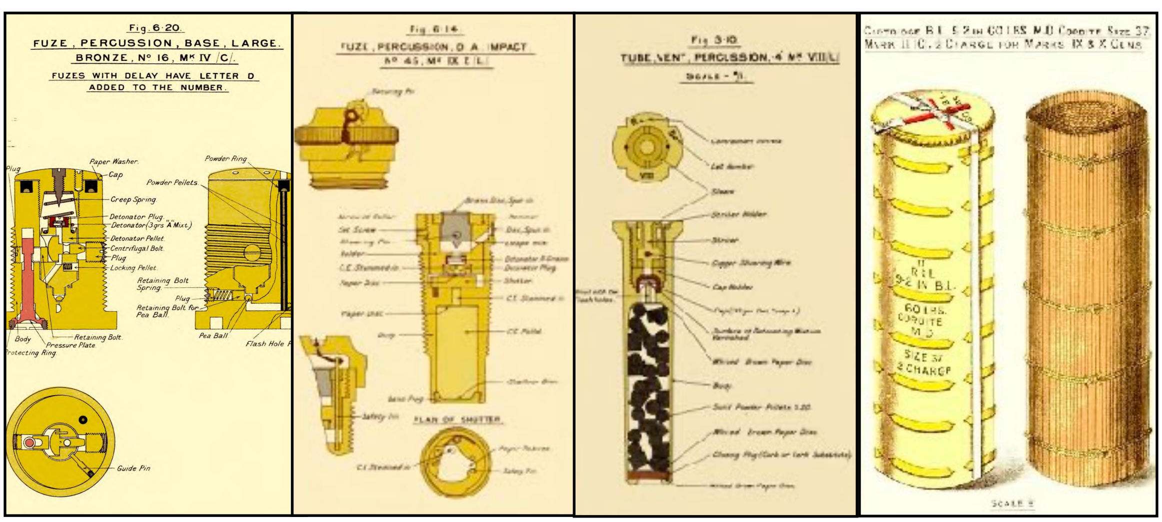
The 1944 handbook also listed a common pointed (capped) shell that was filled with gunpowder (the predecessor to lyddite, which had been replaced by TNT). However, it noted that no more ammunition of this type was being produced.

Originally, there was also a drill shot to allow ramming practice. It was shaped so that it could not completely enter the chamber, and had an eye in the base to allow extraction back through the breech. Even in 1906, no more drill rounds were being made.

Propellant Charge Types

Cordite was a propellant developed about 1889 to replace gunpowder. It consisted of 58% nitroglycerine, 37% nitrocellulose and 5% petroleum jelly. The mixture was extruded into spaghetti-like rods that were quickly nicknamed “cordite". Because it caused high erosion in the gun barrels, the original compound was soon changed to 65% nitrocellulose, 30% nitroglycerine and 5% petroleum jelly, which was known as Cordite MD (modified). Cordite MD cartridges weighed approximately 15% more than the Mk 1 cordite cartridges they replaced, due to the less powerful nature of Cordite MD.

The 9.2-inch charge was loaded in two ½-charges because of the weight. Each ½-charge contained 60 pounds of MD 37 cordite in a silk bag. An igniter compound was stitched on one end. A ¼-charge containing 30 pounds of MD 37 cordite allowed training with reduced charges. Later, a 53½-pound charge that used MD 26 cordite replaced the 60-pound ½-charge. The “26” and “37” indicated the thickness (in 0.01 inches (.254 mm)) of the die used to extrude the cordite rods. There was also a 26-pound 12-ounce (~12.1-kg) ¼-charge of MD 26 cordite. The supercharge was a similar design, but contained more propellant. The supercharge saga is recounted in Chapter 6.



Left to right: base fuze, nose fuze, percussion vent tube primer, ½-charge cartridge. Treatise on Ammunition.

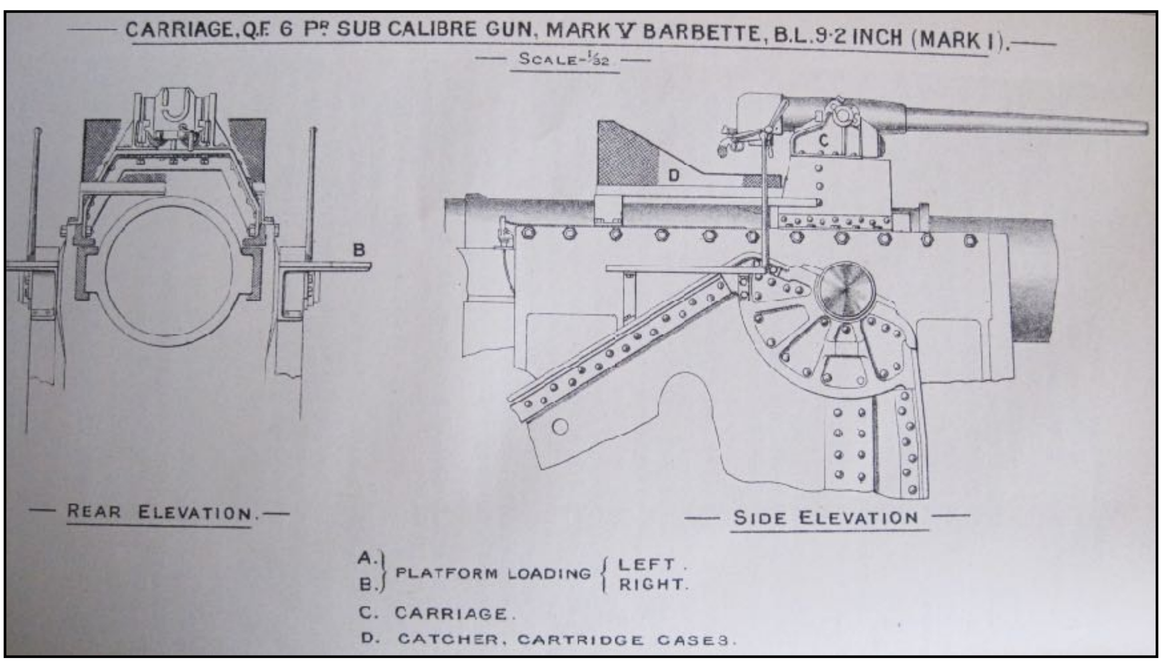
Fuse Types

The projectiles used several types of fuzes, depending on the role and version of the shell. High explosive shells used a nose fuse, which triggered the shell on impact. The armour piercing shells used a fuze in the base of the shell, since the nose was shaped and hardened to penetrate armour plate. In this case, the fuze was triggered by the rapid deceleration of the shell on impact. The shrapnel shell was supposed to burst in the air over troops in the open, and used a time fuze that had to be set before firing.

Primers

The 9.2-inch gun used a vent tube primer to ignite the charge. The firing lock fitted into a channel in the breech screw (the vent). The lock was designed to hold an electric or a percussion primer, which looked like a large rifle cartridge without the bullet. The electric primer was ignited by an electric current from a battery, and the percussion primer was ignited by being struck by a firing pin. The Mk 10 barrel used a 0.4-inch (~10 mm) diameter primer, and the Mk 15 barrel used a larger 0.5-inch (12.7 mm) primer. The operation of both sizes was similar. This was the major operational difference between the Mk 10 and Mk 15 barrels, since they were ballistically identical. The difference caused no problems as long as all the barrels in one location were the same type.

Sub-calibre Training Guns

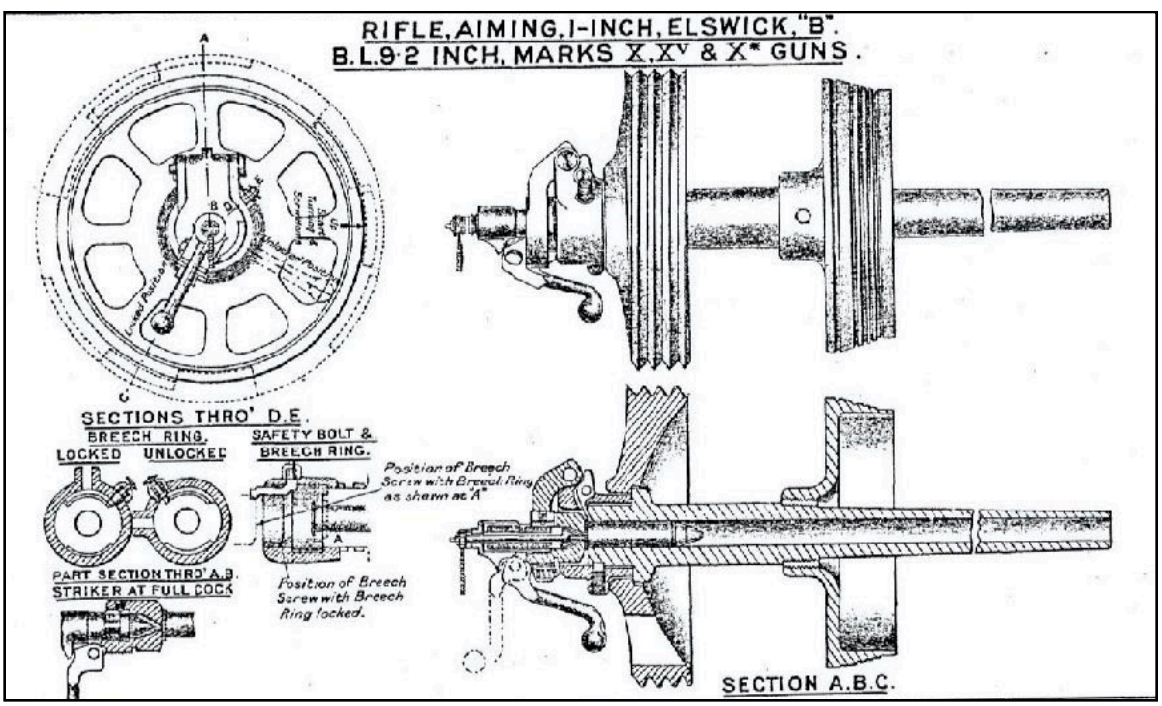


To save cost, the 9.2-inch coast defence guns were equipped with two types of training guns: the 6-pounder Hotchkiss sub calibre gun and the Elswick 1-inch aiming rifle. The 6-pounder allowed the detachment to practise their normal loading drills, while engaging a target at a reduced range. The aiming rifle essentially trained the gun layers by shooting at a paper target.

6-pounder Hotchkiss

The 6-pounder Hotchkiss sub-calibre training gun was mounted on a saddle attached to the main carriage above the trunnions. The 6-pounder had its own cradle on the saddle. Levelling screws in the saddle allowed the sub-calibre gun to be aligned with the main gun. A loading platform was mounted on each side of the main gun for the gunners working the Hotchkiss. A “cartridge catcher” behind the 6-pounder controlled the ejected cartridge case, preventing it from hitting the gunners. When using the 6-pounder, the various range and elevation scales on the sights of the main gun were replaced with special versions that allowed the Hotchkiss to be laid using the standard sighting drills for the larger gun. The 6-pounder could be dismounted and stored in the gun stores room when not in use. Because of the weight, it took twelve men, essentially slinging the 6-pounder barrel from two handspikes and moving it rearwards off the main carriage. In the C Mk 6A gun house, there was a small rolling overhead crane to do the work. The gun was fired from a lanyard that passed down to the layer’s position. Each 9.2-inch gun in Canada had its own 6-pounder sub-calibre gun.

Elswick 1-inch Aiming Rifle



To permit gun-laying practice over a short range, the 9.2-inch gun could have a 1-inch rifle inserted into the gun barrel. The aiming rifle was independent of the main gun and had its own breech mechanism. It was held in the barrel by two circular frames in the chamber, the rear one of which screwed into the breech screw. When using the aiming rifle, the main breech was never closed. Set screws allowed the frames to be adjusted onto the axis of the bore of the main gun. The rifle was loaded like a normal rifle, but it used electrically fired ammunition. In theory, the aiming rifle could be used with the automatic sights by substituting a special cam to replace the standard autosight cam. However, there is no indication that the Canadian guns had such a cam, and this may not have been used in Canada. There were three aiming rifles in the inventory at Albert Head, but it was noted during construction that the terrain at the fort prevented their use on two of the three guns.

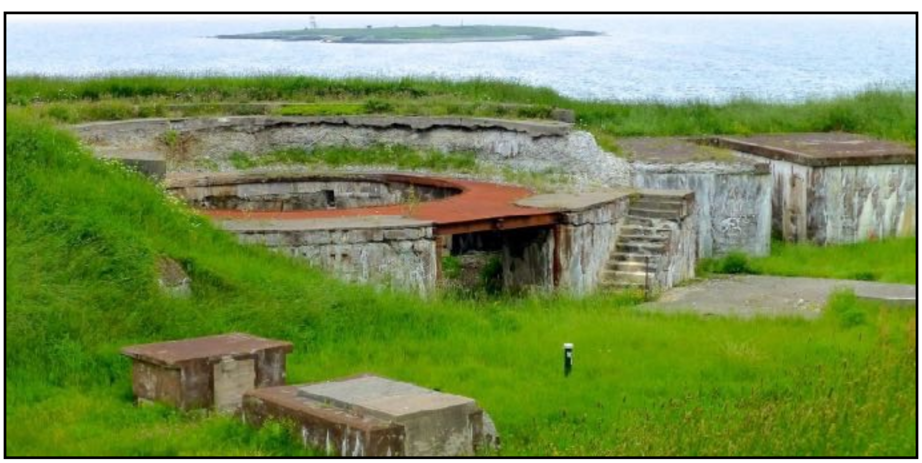
Chapter 13 - The Gun Positions Today

The 9.2-inch guns were the heavyweight coast defences of Canada for more than 40 years, including two world wars. Today, although most of the gun positions still exist, they are in poor condition. None of the guns, mountings, or support equipment are still in place.

Fort McNab, Halifax, NS

Today, Fort McNab is a national historic site managed by Parks Canada. The 9.2-inch gun emplacement is on the right. A radar station was built on the emplacement after the gun was removed during the Second World War.

Devils Battery, Halifax, NS



Today, Devils Battery is on private property belonging to the Hartlen Point Forces Golf Club. All three gun emplacements are exposed, but the access points to the tunnels and buildings are sealed. The island can be seen in the background. Photo: fortwiki.com.

Sandwich Battery, Halifax, NS

Today, Sandwich Battery is still on DND property and is part of Canadian Forces Base Halifax. The old gun positions still exist in very poor repair. Apparently some of the damage is a result of the emplacements being used for demolition practice. The two 9.2-inch gun emplacements are on the right, and the two 6-inch emplacements can be seen in the lower left. Photo: Moneywagon via Wikipedia Commons.

Oxford Battery, Sydney, NS

Today, Oxford Battery is located mostly on Crown Land. The site contains the remains of the gun emplacements and over 1,200 feet of concrete trenches. The remains of the observation post are nearby on private property. All the concrete structures are damaged and covered with graffiti. Photo: Cape Breton Post.

Signal Hill Battery, Esquimalt, BC

Today, Signal Hill Battery is still on DND property. The gun positions still exist, but are in very poor condition. Photo: Google Earth.

Albert Head Battery, Esquimalt, BC

Today, Albert Head Battery is on DND land in the Albert Head Point Training Area. The gun emplacements still exist. Photo: Google Maps.

Conclusion

For most of the last fifty years of its existence, the Canadian coast artillery followed British doctrine. Until about 1945, this was official government policy, as agreed at the Imperial conferences. Britain decreed that a defended port would have guns capable of defeating heavy armoured warships, and apart from some temporary batteries during the Second World War, this role was filled by the 9.2-inch coast defence gun.

In reality, the threat to a Canadian port from the battleships of any potential enemy was low. Apart from the United States, who were at least nominally friendly, any enemy warship attacking either coast would be far from home, and pursued by the heavy ships of the Royal Navy or other allies. The potential reward from attacking a protected port would not be worth the risk of damage to the ship, especially when it was far from a source of repair.

Nevertheless, Halifax was the major British base in the Northern Atlantic Ocean, and Victoria/Esquimalt served the same role in the North Pacific. From 1867 to 1905, Britain armed and manned the defences at Halifax, and to a lesser extent at Esquimalt. When Canada took over responsibility for the defence of the bases in 1905, three 9.2-inch guns were operational at Halifax and two emplacements were under construction at Esquimalt. Almost fifty years later, Halifax, Esquimalt, and Sydney, NS, each had a three-gun battery of heavy guns, with two other equipments in general reserve.

In the two world wars, an attack on any harbour by a battleship or cruiser was a rare event. However, a threat cannot be ignored, and the 380-pound shell of the 9.2-inch gun was a significant deterrent to any warship wishing to raid a harbour. Indeed, during a discussion as to whether a [cheaper] 6-inch gun would be an adequate deterrent to a cruiser armed with 8-inch guns, a handwritten note in the margin of the file stated that the 9.2-inch guns could completely destroy the cruiser, making deterrence unnecessary.

All of this is hindsight. An enemy threat should be evaluated based on capabilities. During the first half of the twentieth century, was (for example) Halifax a legitimate target for an enemy battleship? Yes. Could, in the extreme case, a major enemy warship reach and attack the port? Certainly. If the port was undefended, could the military and civilian establishments in the port be damaged or destroyed? Definitely. The potential threat to the port(s) could not be ignored, and suitable defences had to be in place. Any other action could only be considered gross negligence.

In the twentieth century, no Canadian base was ever attacked by a heavy warship. Whether considered a deterrent or protector, the 9.2-inch coast defence guns stood on guard, and had a long, honourable career in Canadian Service.

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Annex A - The Other Heavyweights

This section has been extracted from Guns of the Regiment, Service Publications, 2016, by permission of the author. It has been slightly edited.

Halifax, Sydney, and Esquimalt were not the only defended ports in Canada. Both Québec and Saint John, New Brunswick, were considered important before the First World War, and other locations became prominent during the Second World War. Defences followed the usual pattern: heavy counter-bombardment guns, medium close defence guns, and light fast-firing anti-torpedo-boat guns. However, although some were planned, the other ports never received 9.2-inch guns.

7.5-inch, B.L., Mk “C” Gun on Mk “A” Barbette Carriage (Québec)

7.5-inch B.L. Mk “C” Guns at Québec. Courtesy Roger Sarty.

Although Québec City was a major fortress during the smoothbore era, it had declined in importance after the introduction of the railways. The city could not be approached by water after the river froze. For the rest of the year, the threat, in reality, was low. Enemy surface ships could not easily penetrate far up the river, and risked being cut off by naval warships if they did. When Major Treatt reviewed the coast defences in the 1930s, he did not even visit Québec City, and on several occasions, official documents noted that the defences at Québec were a political necessity, not a strategic one. That said, Québec was equipped with 7.5-inch counter-bombardment guns early in the 20th century, and they were never removed from the port until after the Second World War.

Two breech-loading 7.5-inch 50-calibre Mk “C” guns on a garrison mounting were ordered from Vickers Sons & Maxim in December 1903. The guns were a commercial version of the naval 7.5-inch Mk 5 guns that were mounted in the *Warrior*, *Minotaur*, and *Achilles* classes of British armoured cruisers. The main difference was a modification to the rifling. Originally, the guns were intended to be mounted at Red Head Battery to defend the port of Saint John, NB. However, the commanding general of the Militia changed between the time of the order and the arrival of the guns, and the new commander did not believe in defending a commercial port. At the time, with Britain responsible for the naval defence of Canada, and also maintaining the fortresses at Halifax and Victoria, Québec was the major Canadian-operated fortress, and the guns were redirected there.

The guns were delivered in 1905, and were issued for mounting on garrison barbette carriages on 2 November 1906. Construction progress was slow, but by June 1912, they were in position in the upper battery at Fort Martinière near Québec City, although they were still deficient in sights and other accessories.

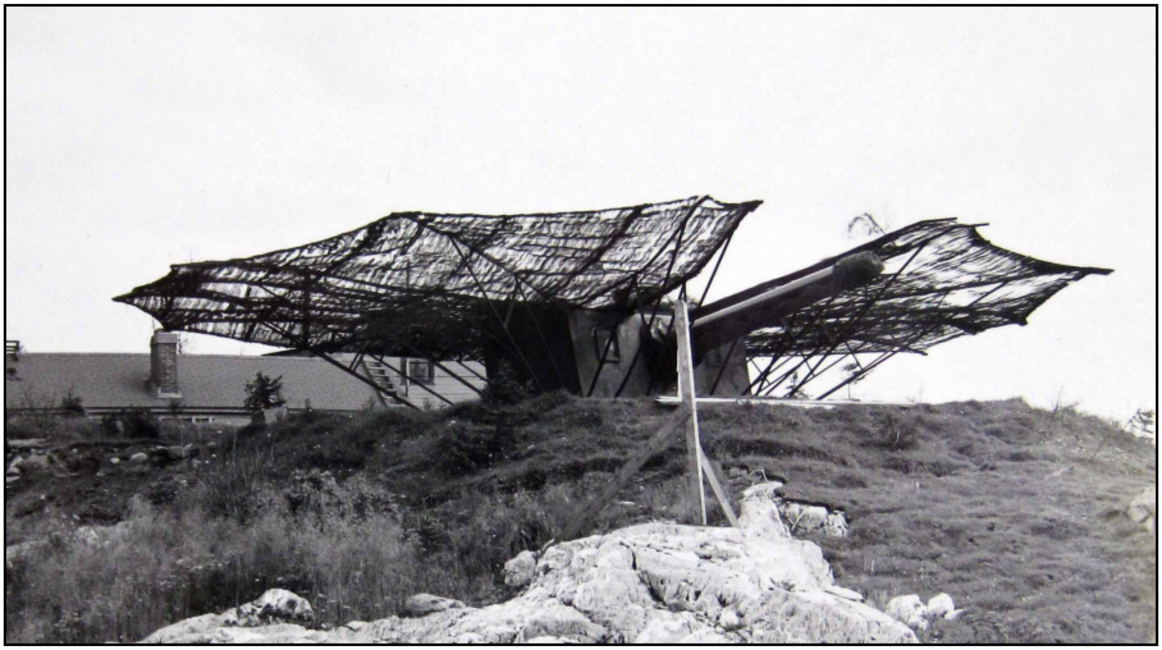
A company of the 6th (Québec and Lévis) Regiment, Canadian Garrison Artillery (Non-Permanent Active Militia), manned the guns during the First World War. Between the wars, the guns were preserved and maintained by the Royal Canadian Ordnance Corps. Québec was not part in the coast defence evaluation in the late 1930s because the threat was considered negligible. However, when the war started, political considerations required some form of defence. During the Second World War, the 59th Heavy (later Coast) Battery, RCA, manned the guns and also provided a detachment to support the Port Examination Service at Saint Jean. The guns were reported ready for action on 27 August 1939, and four training rounds were fired on 17 April 1941. The guns were not operational during the winters. Fort Martinière ceased operation on 1 October 1943, and the guns were placed in preservation for the rest of the war. Not really needed or wanted, and seldom used, the 7.5-inch Mk "C" guns were the final chapter in the heavy defensive armament that had been a characteristic of Québec City for almost 340 years.

The 7.5-inch (190.5-mm) barrel had a length of 387 inches (9.8 m), and weighed 15 tons. The polygroove, plain section rifling had 45 grooves with a uniform twist of one turn in 30 calibres. The breech was an interrupted screw with a single motion opening mechanism. It used De Bange obturation, and electric or percussion ignition.

The mounting was a barbette carriage on a roller bearing race that weighed 36.75 UK tons (37.3 tonnes). It had a hydro-spring recoil mechanism, with a nominal recoil of 18-inches (46-cm). The mounting could elevation from -5° to +20°, traverse 300º, and had automatic and rocking bar sights.

The guns at Martinière Battery had a maximum range of 14,000 yards (12,800 m). They fired 200-pound (90.7-kg) common pointed, common pointed (capped), and high explosive projectiles using a 62.75 pound (28.5 kg) cordite charge. The CPC shell could penetrate 4.5 inches (11.4 cm) of Krupp Cemented Armour at 3,000 yd (2,740 m).

7.5-inch, B.L., Mk VI Naval Gun on Mk V CP Mounting (Saint John, NB)



7.5-inch B.L. 45-calibre Mk 6 Naval Gun on Mk 5 CP Mounting at Mispec Point at Saint John, New Brunswick. The wing-like structures are camouflage nets. Mispec Fort Record Book.

Saint John, New Brunswick, was the Atlantic end of the Great Communications Route that stretched from Québec City to Rivière de Loup, then up over the Temisquata Portage and down the Madawaska and Saint John rivers to the port. Before the railways, this was the winter route to the sea, but with the expansion of the railways, it was rarely used. Saint John was a commercial port, and several Chiefs of the General Staff refused to defend the port. However, the construction of a large dry dock in the 1920s meant that the port needed some protection. Under the Ultimate Plan, Saint John was to be equipped with 9.2-inch guns. For the Interim Plan, when Britain offered three 7.5-inch guns that had been removed from a *Hawkins* class cruiser, the offer was accepted. The guns and mountings arrived from Britain in April 1940 and were emplaced in June. After firing proof rounds, the battery became operational on 5 August.

Although Mispec Battery was intended as an interim structure, it was heavily built, and the concrete works still exist today. The design of the emplacements was similar to the circular coast defence barbettes that had been standard since the 1890s. The foundation ring of the mounting was bolted to the bottom of a large circular pit, approximately two metres deep, whose sides were constructed of steel-reinforced concrete. Steel plates, arranged around the upper part of the pit and attached to the top of the barbette, protected the equipment below, and served as a working platform for the gun detachment. A box-like steel shield enclosed the top of the mounting and the breech of the gun.

Because of the need for speed and economy of construction, the magazines at Mispec Battery were on the surface behind the gun positions. These were heavy reinforced-concrete structures, and the crew moved ammunition from the magazines to the guns on wheeled trolleys. The concrete battery observation post, which still stands on top of an 80-metre-high hill behind Mispec Point, was completed in November 1940. In December 1942, NDHQ decided that the 7.5-inch guns at Mispec would not be replaced by 9.2-inch guns. The battery ceased operations on 10 August 1944, but the guns remained in place in preservation. They were removed in July 1946 and placed in storage. Their disposal was authorized on 22 December 1953, and the guns were sent to Turkey as part of NATO mutual aid in 1954.

The 7.5-inch breech-loading 45-calibre Mk VI naval gun was designed in 1915 for use on the British *Hawkins* class cruisers. Because of its weight, extremely basic mounting, and manual operation, the gun was not overly successful, and seventeen were transferred to the coast artillery.

The 45-calibre steel barrel was of built-up construction with inner "A" and "A" tubes, and a full-length wire winding covered by a full-length jacket. It was 349.2 inches (8.87 m) long and, with the breech mechanism, weighed 13.79 UK tons (~14.01 tonnes). The rifling was 44 grooves, polygroove, with a twist of one turn in 30 calibres. The breech mechanism used a Welin breechblock with single-motion Asbury opening mechanism. It used De Bange obturation, and either electric or percussion ignition.

The Mk V mounting was a revolving turret on rollers, rotating around a central pivot, weighing 31.5 UK tons (~32 tonnes). The structure carried the cradle that supported the barrel and hydro-spring recoil mechanism. A high tensile steel gun shield, attached to the platform, protected the detachment. The traverse and elevation operations were manual or hydraulic, with power provided to the pump by an electric motor. Elevation was from 0º to +30°, with 360º traverse. The gun could be loaded at up to 10º elevation. The mounting had a telescopic sight on the right and an elevation hand wheel on the left.

It fired 200-pound (90.7-kg) high explosive and common pointed (capped) shells, using a 61 pound (27.7 kg) cordite charge. The maximum range was 21,110 yd (19,300 m) at 30º elevation.

American 8-inch M1888 Gun on M1918 Barbette Mounting on M1918 Railway Carriage

American 8-inch railway mount M1918, showing the firing platform formed by cross ties laid on H-beams. This type of mounting was was installed at Prince Rupert. At Christopher Head, the gun and mounting was removed from the rail car and placed on a concrete pad. Fort Record Book.

On 21-22 October 1940, a Joint Conference of American and Canadian Commanders was held at Victoria, BC, to discuss joint defence of the west coast. They concluded that the Strait of Juan de Fuca and the entrance to the Strait of Georgia must be closed to hostile ships. To assist with this, in January 1941, the Americans loaned four 8-inch railway guns to Canada.

The 8-inch railway gun was developed by the American Army during the First World War for use by their forces in Europe. They built 37 systems from their existing stock of M1888 8-inch guns. The mountings were relatively simple, being a rotating barbette on drop-bed flatcars supported by two four-wheel, 70-ton rail trucks. Its weight in action was 78 US tons (~70.76 tonnes). By the Second World War, many had been removed from active service, but some were available for loan.

Two of the guns were installed at Christopher Point, near Victoria. With their maximum elevation of +42°, they had an extreme range of 23,400 yards (21,400 m), and effectively reached across the Juan de Fuca Strait to Port Angeles on the American side. With American guns mounted on the south side of the strait, any enemy ship could be effectively engaged. Although originally on a railway carriage, at Christopher Point, the guns were removed from the rail cars and mounted on a fixed pad. The installation was completed three days before the Japanese attack on Pearl Harbour. The battery used an American system of range finding, and had its own plotting room at Church Hill and Beechey Head. The first full charge practice shoot took place on 24 February 1943. The guns were removed and returned to the US in October 1943.

In January 1942, the United States War Department made available another two 8-inch railway guns for a counter-bombardment battery at Prince Rupert. A position was selected at Fairview Point, where the guns could cover an arc of fire extending approximately 25,000 yards (22,800 m) from the city area. The guns were moved onto sidings from the main CNR line, and solidly braced in positions under which a large quantity of rock had been sunk into the muskeg. No. 9 Heavy Battery, RCA, fired proof rounds on 2 July 1942, and the guns were ready for action. The Americans provided 100 service rounds of ammunition and 25 practice rounds. All the equipment was removed from service and returned to the US in December 1944.

The M1918 Mk I railway car was a drop-frame type with a structural steel frame on standard 70-ton four-wheel railway trucks. The car had air and hand brakes and standard couplers and buffers. Outriggers and floats took up the shock of firing. In the firing position, a platform was constructed of four 8-inch thick “H”-beams that lay on the track ties with six oak cross ties laid on the upper flanges. The car was jacked up, the platform assembled below it, and car lowered onto the platform. The gun was supported by an ammunition car that contained racks for the projectiles and charges, and an “I-beam” trolley hoist for moving the ammunition to the gun car.

The barrel was 278.5 inches (7.07 m) long and weighed 32,218 pounds (14,614 kg) with the breech mechanism. Originally it had 48 rifling grooves with increasing twist from 1/50 to 1/25 calibres, but the guns had been relined with 72 grooves. The breech mechanism was a Welin screw, and used electric or friction ignition.

The gun fired 200-pound (90.7-kg) high explosive shells and 260-pound (118-kg) armour-piercing-capped shells using a 70.75 pound (32.1 kg) cordite charge.

American 10-inch M1888 Gun on Barbette or Disappearing Carriage

A 10-inch coast defence gun on McNutts Island at Shelburne, NS, today. The gun was abandoned after the Second World War. Charles H. Bogart.

The United States introduced the 10-inch seacoast gun into service about 1892. It was essentially a larger version of their 8-inch gun, and was mounted either on a barbette or a disappearing carriage. It continued in American service through the early part of the twentieth century, but was considered obsolete by 1939.

During the Second World War, under the Lend-Lease agreement, the United States provided eight M1888 guns for use in Canada. Two guns were installed at each of McNutt's Island at Shelburne, NS, Fort Prevel at Gaspé, Québec, Fort Cape Spear at St. Johns, Nfld, and Wiseman Cove at Botwood, Nfld. All were manned by Canadian gunners. Two others, manned by Americans, were mounted on Signal Hill near St. Johns, Nfld, and were later moved to Redcliff Hill in 1942. All the guns were sited to provide long range counter-bombardment protection to their ports. None of the guns were fired in anger.

Although Shelburne was not initially a defended port, it quickly became an adjunct to Halifax for assembling convoys, and was therefore given protection. The 104th Coast Battery, RCA, mounted the guns on barbette carriages in July 1941, both guns being transferred to Canada from Quarles Battery, Fort Worden, Washington, in the US. The guns were proof fired and the fort became operational on 19 March 1942. It ceased operation in October 1943. The guns and the mountings were declared for disposal in 1948, but are still there today.

The construction work at Fort Prevel at Gaspé started on 24 May 1941 and the guns were mounted on 5 August; one on a barbette carriage and one on a disappearing carriage. After an uneventful career, the fort was declared non-operational and closed on 2 October 1943. The guns and the mountings were declared surplus and scrapped in 1948.

Fort Cape Spear protected the approaches to St. Johns, Nfld. The guns were installed on disappearing carriages in October/November 1941, both having been transferred to Canada from Fort Mott, New Jersey. They were proof fired and became operational on 26 April 1942. In 1946, the mountings were removed, but the gun barrels remain there today.

Wiseman's Cove Battery protected the approaches to Botwood, Nfld. Two guns were installed there in 1941. As with the others, they had an uneventful career, and were removed at the end of the war.

On the barbette carriage, the recoil was absorbed by a hydraulic buffer and by the carriage sliding up an inclined ramp, resulting in a nominal recoil of 50 inches (1.27 m). The ramp provided a gravity-based return into battery. The mounting itself was a conventional design, allowing -7° to +15° elevation and 160° traverse. Essentially all operations were manual. The weight in action was about 64.6 UK tons (~65,6 tonnes).

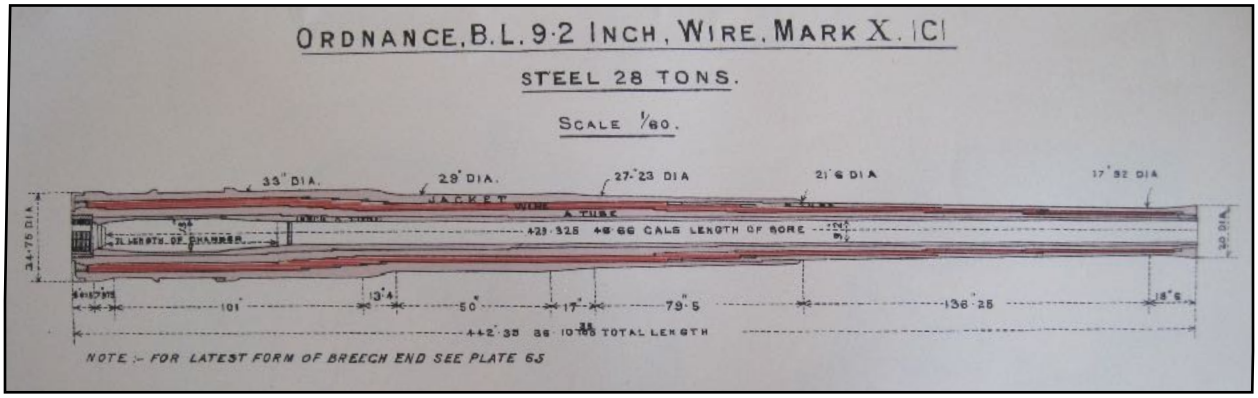
The disappearing carriage was an unusual design with a counterweight suspended underneath the front pivot point, and with an auxiliary base section supporting the rear end of the mounting. Traverse was limited to 70° either side of centre, and elevation was from -5° to +12°. The design was complicated and only a few were built. The weight in action was about 120.5 UK tons (~122.4 tonnes).

The barrel was 367.25 inches (9.33 m) long and weighed 67,183 pounds (30,474 kg) with the breech mechanism. It had 48 rifling grooves with increasing twist from 1/50 to 1/25 calibres. The breech mechanism was a Welin screw, and used electric or friction ignition.

The maximum range depended on the mounting. At Fort Prevel, the barbette carriage had a maximum range of 16,400 yd (15,000 m), while the disappearing carriage was limited to 14,200 yd (13,000 m).

The 617-pound (280-kg) semi-armour-piercing ballistic-capped shells could penetrate 14.7 inches (37.3 cm) of Krupp armour at 1,000 yd (915 m). Its 155 pound (70.3 kg) cordite charge was split into two ½-charges for handling. During the war, the Dominion Arsenal manufactured charges for the guns.

Annex B - Manufacturing the 9.2-inch Gun



A schematic of the Mk 10 wire wound barrel. 1906 Handbook.

The *Treatise on Ordnance* in 1908 described the manufacturing process for heavy British guns, and used the 9.2-inch Mk 10 gun as an example. It noted that British artillery guns of all sizes were constructed using the same methods. There had been improvements in the factories, and the introduction of improved motor-driven machinery, as well as the use of high speed tool steel, had reduced the time for some of the operations by 75 per cent. That was significant considering that, under the most favourable conditions, a heavy gun took about nine months to manufacture.

The description of the manufacturing process in the *Treatise* is extremely detailed, and this is a very simplified summary. To avoid endless repetition in the text, keep in mind that, at every step in the process and often at intermediate stages in each step, the gun would be measured, gauged, tested, and analyzed to ensure that the process was proceeding correctly. If faults were found, the work would be repeated or corrected as necessary.

The process began when the War Office, or the Admiralty, stated the performance requirements for the gun, such as range, projectile power, and weight. These requirements were considered by the Ordnance Board, who eliminated any impossible conditions and then requested designs from the gun founders. Proposals were generally submitted by the government's Royal Gun Factory (RGF), and by commercial firms such as the Elswick Ordnance Company, Vickers, Sons, and Maxim, or the Coventry Ordnance Company. The most suitable design was accepted or, if necessary, modified to meet the requirements. If new technology was involved, a test gun would be made.

Having received an order, the selected manufacturer then prepared drawings and specifications, and ordered the various forgings - the raw, un-machined, roughly-shaped metal parts produced by the steel makers. Although most armament firms could produce the heavy forgings in-house, for large guns they were normally received from the steel makers in the roughly-shaped state.

The 9.2-inch Mark 10 barrel had four main forgings: an “A” tube, an inner “A” tube, a “B” tube, and a jacket. The “A” tube formed the basic gun barrel and provided both longitudinal and radial strength. To extend the life of the gun, a second tube was inserted into the “A” tube. This “inner “A” tube” contained the rifling and absorbed the wear and erosion caused by the firing and, when worn out, could be replaced without sacrificing the whole barrel. Steel wire was then wrapped around the barrel to add strength, and the front half of the wire was covered by the “B” tube and the rear half by the jacket.

The Forgings

The steel makers would prepare steel ingots with the required composition of iron and other metals. The ingots would then be heated and hammered (forged) into the right shape and length. Given that the 9.2-inch gun was more than 36 feet (~11 m) long, the size of the oven and hammer was considerable.

After forging, metal discs were removed from each end and tested. If the tests were satisfactory, and the forging met the dimensional specification, then manufacture continued. The forging was tested for alignment and, if bent, was heated to about 1,000°F and straightened under a hydraulic press. It was then placed on a lathe or boring machine and all surplus metal was removed, inside and out, leaving about a 1-inch margin compared to the finished dimensions. It then moved to the heat treatment process.

The forging was placed in a vertical furnace and its temperature was gradually raised to between 1,450° (~780) and 1,750°F (950 °C), depending on the previous test results. The temperature was not always the same for both ends of the forging, being governed by the thickness of the metal and other factors. For a large forging, this process took from seven to nine hours.

When the required temperature was reached, a crane (which in the Royal Gun Factory was capable of lifting 200 tons) lifted the forging from the furnace and moved until it was hanging over an oil tank. It was then rapidly lowered until the top of the forging was well below the surface of the oil, where it remained for four to six hours. The oil tanks were 60 feet (~18 m) deep, and contained about 200,000 gallons (~750,000 litres) of oil. This oil-hardening increased elasticity (the ability of a material to resist deformation), but reduced ductility (the ability of a material to deform without breaking). The forging also tended to warp.

The forging was again placed in a furnace, and slowly and evenly reheated. It was then allowed to cool slowly in the furnace for about 24 hours, to reduce internal stress. Discs were again cut off the ends of the forging and tested. If it failed any of the tests, the forging could be further treated and retested.

After being tested for alignment, and straightened if necessary, the forging was roughly turned and bored to bring the dimensions within the range of the finishing tools. During these operations, the barrel was carefully examined for any flaws from the heat treatment. If the forging was clean and free from flaws, it was passed on for the next operation. The foregoing process was common to all four main forgings.

The "A" Tube

After forging, the "A" tube was then "finish-bored". The bore had a taper of 1-in-500 from the breech to the muzzle in order to allow insertion of the inner "A" tube. This operation took about three weeks , with the machine running day and night. After testing, it was ready to receive the inner "A" tube.

The Inner "A" Tube

The finish boring of the inner "A" tube was carried out simultaneously with the "A" tube. This was a shorter operation than taper boring, although it was essential to have a perfectly round and straight bore. The boring head used five cutters and burnishers that passed through the tube three times, doing finer work on each pass until the tube was about 0.01-inch (~2.54 mm) from its finished size. The outside of the tube was then turned with a taper of 1-in-500 to correspond to the interior of the "A" tube, with shoulders being formed at the required places. The finished dimensions were slightly larger than the "A" tube, so that when the inner "A" tube was driven home to the shoulders, it squeezed the bore of the inner "A" tube, placing the tube under compression. See "Firing Stresses" below.

The inner "A" tube was inserted into the "A" tube and was forced onto its seating to within about six inches of the shoulders, while the tubes were horizontal. The tubes were then moved to a deep pit, placed vertically with the muzzle down, and the inner "A" tube was driven home using a five ton weight dropping eight to twelve feet onto the breech end. When this operation was completed, the joined tubes were considered to be a gun, which was given a registered number that applied to it for the rest of its life.

The exterior of the gun was then turned to its finished dimensions, and the propellant chamber at the breech end of the bore was roughly machined. The inside of the rear of the "A" tube was screw-threaded to take the breech bush, which was then fitted. A collar was then shrunk on over the rear of the "A" tube, to reinforce the tube over the breech bush and also to form a support for the end of the wire coils.

Wire Wrapping

The flat ribbon-like wire that was used in gun manufacture was generally 0.25 inches (6.35 mm) wide and 0.06 inches (1.524 mm) thick. In a heavy gun, a collar to support the ends of the wire was first shrunk on, then intermediate wire fasteners were shrunk on at their respective positions. When the wire tension had to change during the winding, the wire was secured to one of these fasteners and the winding restarted. The wire fasteners were also used to form shoulders, against which corresponding shoulders in the jacket and “B” tube rested, and through which the longitudinal thrust was absorbed.

Winding was always started from the muzzle end. Whenever the wire came against a shoulder, a ring of wire was slipped over the gun and fitted accurately into the edge of the shoulder so as to give an even termination to the layer of wire.

A special apparatus regulated the tension of the wire during the winding. The winding tension varied from 35 to 56 tons per square inch at the start to 20 to 40 tons per square inch at the finish. The gun was then prepared to receive its outer covering (the “B” tube and jacket).

The “B” Tube and Jacket

While the wire was being wound, the jacket and “B” tube were finish-bored and gauged. The wire-wound gun was taken to the shrinking pit, and placed vertically with the breech of the gun at the bottom. The “B” tube was placed in an adjacent pit, breech end down, and was heated to a temperature of about 800° F. A travelling crane raised it, and water was sprayed down the the interior to remove any scale from the heating process. The crane aligned the tube exactly over the gun and lowered it down on to its seating. Its own weight was sufficient to seat it, provided that the alignment was good. Water rings were then placed around the exterior of the tube, the breech end being cooled first so as to ensure the lowest shoulder remained in contact with the corresponding shoulder on the gun. The water rings were gradually raised until the whole of the “B” tube was cooled and each shoulder in its correct position.

The gun was then removed from the shrinking pit, re-gauged and measured before shrinking on the jacket, which was done in a similar manner to the “B” tube. The rear of the jacket had been prepared with screw threads to take a screwed collar or breech ring, depending on the type of construction. The rear of the jacket was heated to allow the collar to be easily screwed on, the final turn being tightened with great force to ensure a good seating.

Firing Stresses

Firing stresses were (and are) caused by radial and longitudinal gas pressure. The radial pressure tends to split the inner “A” tube along its length. To prevent this, the “inner A” tube was placed in compression when it was forced into the “A” tube. The internal gas pressure had to first overcome the compression force, before any destructive force could be applied to the inner “A” tube. As the initial compressive force was overcome, the firing pressure was transmitted to the inner “A” tube. However, that tube was supported by the “A” tube, which itself was in compression from the wire winding. The firing force then had to overcome the compressive force on the “A” tube before it could apply pressure to the “A” tube itself. Similarly, the “B” tube and the jacket supported and compressed the wire. The design ensured that that each layer carried approximately an equal amount of the overall firing stress.

The longitudinal gas pressure tended to force the breech screw and the parts supporting it to the rear and, at the same time, force the inner “A” tube to the front because of the friction between it and the driving band of the projectile. The pressure on the breech screw was transferred to the breech bush and then to the “A” tube. Through the shrunk collar, the “A” tube transmitted this to the jacket nut and jacket. The jacket pulled on the “B” tube, which was prevented from moving by a shoulder at the muzzle connecting it to the “A” tube. Meanwhile, the tendency of the inner “A” tube to move forward was checked by the shoulders between it and the “A” tube.

Therefore, each component of the gun barrel was locked together and, on firing, contributed to the strength of the gun.

Finishing

The gun was then placed in a lathe and finish-turned inside and out. The bore received its final broaching, leaving the gun within about 0.002 inches (0.0508 mm) of the final size. The propellant chamber was machined to the required shape and dimensions by a special expanding tool.

Before starting to machine the thread for the breech screw, the gun was tested for droop. Any long metal cylinder will tend to droop at the ends, and all heavy guns have a natural droop. The gun was supported in the same way that it would be when it was mounted, and the bore was then sighted on each quadrant with a special instrument. If any deviation was observed from the straight line of the bore, the maximum difference was noted. Then, the top of the gun was selected so that the weight would counteract the natural droop of the muzzle as much as possible. There were three points at which it was possible to start the screw thread for the breech bush, and therefore three possible positions for the top of the gun. These were fine measurements. As a guideline, the natural droop of a 12-inch gun was about 0.1 inch (2.54 mm).

The top of the gun having been determined, the exterior was carefully marked for the exterior machining. The breech bush was then screw-threaded to receive the breech screw. Great accuracy was necessary, so that the thread would start from the same point in every gun of the same design. As the thread had to be cut in varying diameters because of the stepped form of the breech screw, a copying arrangement was used. The major diameter of the cavity was cut first and the the tool was moved back successively to cut the smaller diameters. The cutting tool remained still, with the gun revolving round the tool. The operation required skilled attention to ensure the accuracy necessary for the interchangeability of breech screws. In these days of computer numerically controlled machine tools, it is easy to forget the skill that was required from machinists in the past.

The breech end of the gun was then prepared to take the frame for the breech mechanism, with the necessary clearances being machined and holes bored for the fixing screws. The gun was then ready to be lapped and rifled.

Lapping and Rifling

Before the barrel was rifled, both the bore and chamber were "lapped," which removed any machining marks and polished the metal surface.
"Lapping" [grinding] is a surface finishing operation where abrasive material is used as a grinding material at low speeds. It was carried out by an electric-motor-driven machine connected to a long hollow bar. An expanding screw passed through the bar with a two-part lapping head. The head was covered with lead and coated with an oil and emery powder. The bar could be inserted in the gun to any required distance and, as it revolved, the oil and emery gave a very fine surface to the bore of the barrel. The gun barrel was then transferred to the rifling machine.

Rifling is the term for spiral grooves that are cut in the bore to rotate the projectile. Each projectile is circled with a copper "driving" band. When the gun is fired, the band engages in the grooves of the rifling. As the shell moves up the barrel, the band forces the projectile to spin, which stabilizes it in flight. The raised surfaces of the bore between the grooves are called "lands".

"Twist" defines the spiral path of the grooves cut in the bore of the gun. Twist is stated in terms of one complete rotation of the projectile in a distance measured in calibres of the bore. For example, for a 5-inch gun, one turn in 30 calibres means one turn in 30 calibres x 5 inches = 150 inches. The ideal twist for each type of projectile fired by the gun could be different, so the final rifling design was usually a compromise. However, increasing the twist put additional stress on the gun and driving band, and increased the drift (the tendency of a rotating projectile in the air to drift sideways in the direction of the rotation). In the British service, rifling always had a right-hand (clockwise) twist, designed to give a rotation of one turn in 30 calibres at the muzzle.

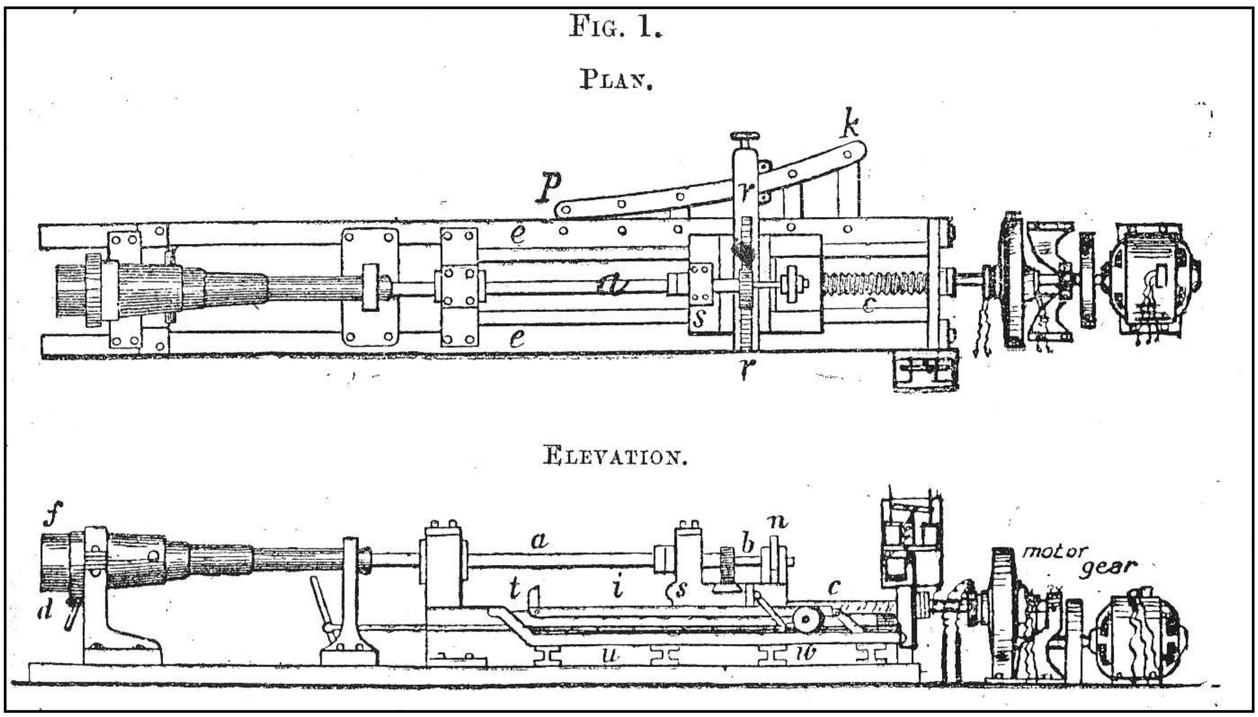
There are two main types of twist: "increasing twist" or "uniform twist". With increasing twist, the aim is to keep the rotational force on the projectile constant throughout the bore. The rifling initially rotates the projectile slowly, and then gradually increases the rate of spin as the projectile moves up the barrel. This causes less initial strain on both gun and projectile, the rotation force is kept fairly even along the bore, and the effects of erosion are less than with uniform twist. However, the average force is higher than with uniform twist, and the driving band on the projectile is continually being re-engraved, which increases drag and slightly reduces the muzzle energy. This was the standard method used by the British in the late 19th century, including the early 9.2-inch Mk 10 gun.

With uniform twist, the projectile has to start its rotation as soon as it begins to travel along the bore. The shell gets a sudden shock, and the rotational force rapidly increases to a maximum level. However, with uniform twist, the average rotation force as the projectile travels up the bore is less than with increasing twist, and the projectile has two percent greater muzzle energy, which increases the accuracy and stability in flight. Also, the forward pressure is less, which puts less strain on the muzzle end, and reduces the liability to choke the bore (the tendency of the projectile to deposit material in the bore and slightly reduce the diameter). Uniform twist became the standard British practice in the twentieth century.

In the original 9.2-inch barrel, the rifling was initially straight, and for the last 303.585 inches (~7.71 m) of the bore steadily increased from zero to one turn in 30 calibres at the muzzle.

As rifling became more common in the mid 1800s, there was a lot of experimentation to determine the best shape of the grooves. The early 9.2-inch gun used the Polygroove Plain Section (Modified) groove - there were many other patterns. Initially, the barrel had 37 grooves, but this was increased to 46 and 48 grooves in later versions.

In the rifling machine (see Figure 1 below), the gun remained stationary, while the rifling bar (a) carrying the cutting head worked horizontally in and out of the bore. Great care was taken in mounting the gun, so that the bar was perfectly aligned with the axis.



The machine that cut the rifling. Textbook on Ordnance.

To give a twist to the groove, the rifling bar (u) had to rotate on its axis at the same time that it moved in and out of the gun. The rate of turn on the axis determined the spiral in the bore. To do this, a rack (r) was placed in the saddle (s), which was geared into a toothed pinion on the rifling bar. The rack worked between guides, which forced it to travel at right angles to the direction of the bar. It was pushed or pulled across the saddle by means of two friction rollers, which had to follow the edges of the copying bar (pk), turning the rifling bar on its axis. The horizontal motion of the bar was derived from an endless screw in the bed of the machine by means of a saddle (s), which travelled on two fixed slides (ee). An automatic reversing mechanism regulated the length of the stroke.

The copying bar (pk) determined the rate of increase of the twist. For uniform twist, a straight copying bar was attached to the machine. For varying twist, the copying bar was curved and this curve would be reproduced in the groove. By changing the copying bar, one machine could be used for any type of rifling, and also for different guns.

The shape of the cutting head determined the form of the groove, and the inclination of the copying bar determined the twist. The cutters were made of very hard steel, set firmly in the middle of the rifling head in a carrier or slide, which could move in a slot at right angles to the axis of the rifling bar. The slide was moved using a square-headed spindle, the head of which worked in an inclined slot at the end of the solid bar, which passed down the whole length of the hollow bar (a). This allowed the depth of the cut to be regulated and the cutter withdrawn on the reverse stroke.

The number of cutters fitted in the rifling head varied according to the size of the gun, with as many as six grooves being cut at the same time. The position of each set of grooves was marked on a band attached to the outside of the breech end on the gun. After one set of grooves had been completed, the barrel was rotated into position for the next using a worm gear with a toothed band attached to the gun. The operation was very precise and the above is only a general description.

Breech Fittings

After rifling was complete, the breech mechanism was installed. All British breech-loading guns used an interrupted screw system, with the type used by the 9.2-inch gun known as the Welin pattern.

The obturation system (the means of sealing the propellant gases from escaping through the breech) was, and is, known as the “De Bange” system, after the name of the French inventor. The system was adopted by the British in 1882, and remains in use with most breech-loading guns today. Of course, the materials used in the modern pad are completely different.

The obturator pad used in the early 9.2-inch guns consisted essentially of a quantity of finely divided asbestos, combined with mutton suet or oil to the required consistency, and enclosed in a strong ring-shaped canvas cover. The pad had two protective metal discs, one in front and one in rear. The pad and discs were mounted on a mushroom-headed spindle, which passed through and was attached to the breech-screw, but could freely move in the axial direction.

When the breech screw was pushed into the gun, the mushroom head and obturator entered the chamber. On rotating the breech screw, the pad was brought into contact with its coned seating in the gun, being pressed home by the pitch of the screw. The bore was then sealed by a buffer that was in contact all round the circumference while, in front of it, the mushroom head formed a loose end to receive the force of the gas on firing. On firing the gun, the gas pressure pushed on the steel mushroom head, which then squeezed the pad against the breech screw. This caused the pad to expand radially, pressing the mixture against the side of the breech and tightly sealing the breech. When the pressure was removed, the pad contracted and pushed the mushroom head to the front again. The obturator was unseated by the travel of the breech-screw to the rear, as the latter was turned to the unlocked position.

Proof Firing

With the breech mechanism in place, the gun was then handed over to the Inspection Branch for proof firing. The bore was very accurately gauged to thousandths of an inch at regular intervals, both horizontally and vertically, and complete sets of gutta-percha (wax) impressions were taken. It was then placed on a proof mounting and about five rounds were fired with solid flat-headed cylinders that were the same weight as the service projectile. Some of the charges were proof charges, which generated about 25 per cent higher pressure than the service charge, and some were ordinary service charges. After firing, the gun was again carefully examined. If no new defects had developed, nor any slight mark perceptibly increased, the gun passed its firing proof, and was marked with a “P” surmounted by a crown.

The impressions of any defect (which would usually be a slight tool mark) were preserved for reference, and a note of any original defect was recorded on the first page of the “Memorandum of Examination” (as the gun history book was known).

Any necessary adjustments were then made to the breech fittings. A clinometer plane was cut and the usual lines and marks engraved.

The gun was then issued for service.

Annex C - The Guns by Serial Number

This annex records the history of the individual guns and mountings. None of the gun history books have survived, so the information has been gathered primarily from the Fort Record Books, and the occasional other document that included the serial number. Where there is doubt, that has been indicated.

Ordnance, B.L., 9.2-inch, Mk 10

#L/178

- 1901 - Manufactured by Elswick Ordnance Company in Britain.
- 1901 - First issue (British).
- 1912 - Second issue (British).
- 1916 - Relined with new inner "A" tube.
- 1921 (October) - Arrived in Canada as replacement gun. Mounted on #A2488 in X/1 emplacement at Fort McNab, Halifax, replacing #L/264.
- 1941 - Dismounted and moved to Mk 7 mounting #35 in X/2 emplacement at Devils Battery, Halifax.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#L/220

- 1901 - Manufactured in Britain (manufacturer unknown).
- 1903 - First issue at Esquimalt.
- 1915 - Mounted on #A2302 or #A2303 at Signal Hill, Esquimalt (emplacement unknown).
- 1938 - Dismounted and sent to Britain for replacement of the inner "A" tube.
- 1941 (April) - Returned to Halifax with new inner "A" tube.
- 1941 - Mounted on Mk 7 mounting #[unknown] in X/1 emplacement at Devils Battery, Halifax.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#L/224

- 1904 - Manufactured by the Royal Gun Factory in Britain. (Records conflict, but confirmed from photo of the breech markings).
- 1906 - Mounted on #A2300 in A/1 emplacement at Sandwich Battery, Halifax.
- 1921 - Condemned for wear & replaced by #L/334. Placed in storage at Sandwich Battery.

- 1936 (August) - Sent to Britain for replacement of the inner “A” tube.
- 1938 (September) - Returned to Esquimalt on SS *Lochmonar*.
- 1939 - Mounted on #A2302 in B/2 emplacement at Albert Head Battery, Esquimalt.
- 1944 - Transferred to C Mk 6A mounting #A2300 in B/2 emplacement at Albert Head Battery, Esquimalt.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#L/242

- 1901 - Manufactured by Elswick Ordnance Company in Britain.
- 1903 - First issue.
- 1915 - Mounted on #A2302 or #A2303 at Signal Hill, Esquimalt (emplacement unknown).
- 1938 - Dismounted and sent from Esquimalt to Britain for replacement of the inner “A” tube.
- 1941 (April) - Returned to Halifax with new inner “A” tube.
- 1941 - Mounted on Mk 7 mounting #31 in X-3 emplacement at Devils Battery, Halifax.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#L/264

- 1904 - Manufactured by Elswick Ordnance Company in Britain.
- 1904 - Mounted on #A2488 in X/1 emplacement at Fort McNab, Halifax.
- 1921 - Condemned for wear and replaced by #L/178. Placed in storage at Fort McNab.
- 1936 (August) - Sent to Britain for replacement of the inner “A” tube.
- 1938 (September) - Returned to Esquimalt on SS *Lochmonar*. Stored at Albert Head Battery, Esquimalt, pending arrival of mounting.
- 1943 - Mounted on C Mk 6A mounting #A2488 in B/1 emplacement at Albert Head Battery, Esquimalt.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#L/286

- 1904 (approximately) - Manufactured in Britain by the Royal Gun Factory or Vickers, Sons, & Maxim Company (records conflict).
- 1906 - Mounted on #A2301 in A/2 emplacement at Sandwich Battery, Halifax.
- 1921 - Condemned for wear and replaced by #L/322. Placed in storage at Sandwich Battery.

- 1936 (August) - Sent to Britain for replacement of the inner "A" tube.
- 1938 (September) - Returned to Esquimalt on SS *Lochmonar*.
- 1939 - Mounted on #A2303 in B/3 emplacement at Albert Head Battery, Esquimalt.
- 1944 - Transferred to C Mk 6A mounting #A2301 in B/3 emplacement at Albert Head Battery, Esquimalt.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#L/322

- 1904 - Manufactured by Vickers, Sons, & Maxim Company in Britain (or possibly by Elswick Ordnance Company - records conflict).
- 1921 - Mounted on #A2301 in A/2 emplacement at Sandwich Battery, Halifax replacing #L/286.
- 1943 (April) - Dismounted and removed to storage in the Ordnance Depot in Halifax when Sandwich Battery became non-operational.
- 1946 - #L322 was assigned to mounting #A2302 after its conversion to the C Mk 6A version. After the mounting was tested at Dominion Bridge, both were sent to No. 17 Regional Ordnance Depot in Vancouver, BC. The gun and mounting were never reassembled or proof fired in Canada.
- 1954 - Shipped to Turkey as NATO mutual aid.

#L/334

- 1904 - Manufactured by Vickers, Sons, & Maxim Company in Britain.
- 1921 - Mounted on #A2300 in A/1 emplacement at Sandwich Battery, Halifax, replacing #L/224.
- 1943 (April) - Dismounted and removed to storage in the Ordnance Depot in Halifax when Sandwich Battery became non-operational.
- 1946 - #L334 was assigned to mounting #A2303 after its conversion to the C Mk 6A version. After the mounting was tested at Dominion Bridge, both were sent to No. 15 Regional Ordnance Depot in Halifax. The gun and mounting were never reassembled or proof fired in Canada.
- 1954 - Shipped to Turkey as NATO mutual aid.

Ordnance, B.L., 9.2-inch, Mk 15

#L/538

- 1944 (Approximately) - Manufactured in Britain.
- 1944-46 - Mounted on Mk 9 Mounting #83 in No. 1 emplacement at Oxford Battery, Sydney.
- 1946 (March) - Proof fired at Oxford Battery, Sydney.
- 1954 - Dismounted and shipped to Spain (Azores) as NATO mutual aid.

#L/543

- 1944 (Approximately) - Manufactured in Britain.
- 1944-46 - Mounted on Mk 9 Mounting #53 in No. 2 emplacement at Oxford Battery, Sydney.
- 1946 (March) - Proof fired at Oxford Battery, Sydney.
- 1954 - Dismounted and shipped to Spain (Azores) as NATO mutual aid.

#L/547

- 1944 (Approximately) - Manufactured at the Royal Gun Factory in Britain.
- 1944-48 - Mounted on Mk 9 Mounting #57 in No. 3 emplacement at Oxford Battery, Sydney.
- 1948 (May) - Proof fired at Oxford Battery, Sydney.
- 1954 - Dismounted and shipped to Spain (Azores) as NATO mutual aid.

#L/530

A spare Mk 15 barrel #L/530 was located at Oxford Battery. According to the report on the dismounting of the guns at the battery, it was shipped to Spain (Azores) with the three complete equipments from the battery.

#Unknown

In addition to #L/530, in 1953, four spare Mk 15 gun barrels were reported in storage at No. 15 (later No. 12) Regional Ordnance Depot at Halifax as general reserve barrels. They could be used with any mounting in Canada. Their date of arrival in Canada is unknown, but was probably shortly after the war. The files are unclear as to whether these Mk 15 spare barrels were shipped to Spain with the guns from Oxford Battery, or later shipped to Turkey as NATO mutual aid at the same time as the guns from Devils Battery.

Carriage, Garrison, Barbette, B.L., 9.2-inch, Mk 5 (later C Mk 6A)

#A2300

- 1904 (Approximately) - Manufactured in Britain at Vickers, Sons, & Maxim Company.
- 1905-06 - Mounted in A/1 emplacement with #L/224 at Sandwich Battery, Halifax.
- 1921 - #L/224 replaced with #L/334.
- 1943 - Dismounted at Sandwich Battery and moved to storage in Halifax.
- 1943 - Sent to Dominion Bridge Company for conversion to C Mk 6A mounting.
- 1944 - Converted to C Mk 6A mounting.
- 1944 - Mounted in B/2 emplacement at Albert Head Battery, Esquimalt, replacing #A2302.
- 1944 (22 March) - Proof fired at Albert Head Battery, Esquimalt.
- 1944 (2 April) - In action at Albert Head Battery, Esquimalt.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#A2301

- 1904 (Approximately) - Manufactured in Britain at Vickers, Sons, & Maxim Company.
- 1905/6 - Mounted in A/2 emplacement with #L/286 at Sandwich Battery, Halifax.
- 1921 - #L/286 replaced with #L/322.
- 1943 - Dismounted at Sandwich Battery and moved to storage in Halifax.
- 1943 - Sent to Dominion Bridge Company for conversion to C Mk 6A Mounting
- 1944 - Converted to C Mk 6A mounting.
- 1944 - Mounted in B/3 emplacement with #L/286 at Albert Head Battery, Esquimalt, replacing #A2303.
- 1944 (7 September) - Proof fired at Albert Head Battery, Esquimalt.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#A2302

- 1912 - Mounted at Signal Hill Battery at Esquimalt (emplacement unknown).
- 1915 - Proof fired at Signal Hill Battery, Esquimalt.

- 1939 - Dismounted and moved to B/2 emplacement at Albert Head Battery, Esquimalt.
- 1943 (December) - dismounted and sent to Dominion Bridge Company for conversion to C Mk 6A Mounting
- 1944-46 - Converted to C Mk 6 Mounting.
- 1946 - After conversion to the C Mk 6A Mounting, #A2302 was completely assembled and tested at the Dominion Bridge Company, and then disassembled and sent to No. 17 Regional Ordnance Depot in Vancouver, BC, with barrel #L/322. The barrel was never mounted nor was the mounting proof fired.
- 1954 - Shipped to Turkey as NATO mutual aid.

#A2303

- 1912 - Mounted at Signal Hill Battery at Esquimalt (emplacement unknown).
- 1915 - Proof fired at Signal Hill Battery, Esquimalt.
- 1939 - Dismounted and moved to B/2 emplacement at Albert Head Battery, Esquimalt.
- 1944 - Dismounted and sent to Dominion Bridge Company for conversion to C Mk 6A Mounting
- 1944-46 - Converted to C Mk 6 Mounting.
- 1946 - After conversion to the C Mk 6A Mounting, #A2303 was completely assembled and tested at the Dominion Bridge Company and then disassembled and sent to No. 15 Regional Ordnance Depot in Halifax with barrel #L/334. The barrel was never mounted nor was the mounting proof fired.
- 1954 - Shipped to Turkey as NATO mutual aid.

#A2488

- 1903 - Manufactured by the Cammell Laird Company in Britain.
- 1904 - Mounted in X/1 emplacement with #L/264 at Fort McNab, Halifax.
- 1921 - #L/264 replaced with #L/178.
- 1942 - Dismounted and sent to Dominion Bridge Company for conversion to C Mk 6A Mounting
- 1942 - Converted to C Mk 6A mounting. This was the prototype converted mounting.
- 1942 - Mounted in B/1 emplacement with #L/264 at Albert Head Battery.
- 1943 (June) - Proof fired at Albert Head Battery, Esquimalt.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

Mounting, B.L., 9.2-inch, Mk 7

#31

- 1907 - First issue in Britain as Mk 5 Mounting.
- 1941 (May) - Converted to Mk 7 Mounting in Britain. Re-issued as #31.
- 1941 - Shipped to Canada.
- 1941 - Mounted in X/3 emplacement with #L/242 at Devils Battery, Halifax.
- 1942 (January) - First test (manual).
- 1942 (February) - First test (hydraulic).
- 1942 (July) - Calibrated at Devils Battery, Halifax.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#35

- 1903 - First issue in Britain as Mk 5 Mounting.
- 1941 - Converted to Mk 7 Mounting in Britain. Re-issued as #35.
- 1941 (November) - Shipped to Canada.
- 1942 - Mounted in X-2 emplacement with #L/178 at Devils Battery, Halifax.
- 1942 (July) - Calibrated at Devils Battery, Halifax.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

#Unknown

- 1904 - First issue in Britain as Mk 5 Mounting.
- 1941 - Converted to Mk 7 Mounting in Britain.
- 1941 - Shipped to Canada.
- 1941 (August) - Mounted in X-1 emplacement with #L/220 at Devils Battery, Halifax.
- 1942 (January) - First test (manual).
- 1942 (February) - First test (hydraulic).
- 1942 (July) - Calibrated at Devils Battery, Halifax.
- 1954 - Dismounted and shipped to Turkey as NATO mutual aid.

Mounting, B.L., 9.2-inch, Mk 9

#57

- 1944 - Manufactured at the Royal Carriage Department in Britain.
- 1944-48 - Mounted in No. 3 emplacement with #L/547 at Oxford Battery, Sydney.
- 1948 (May) - Proof fired at Oxford Battery, Sydney.
- 1954 - Dismounted and shipped to Spain (Azores) as NATO mutual aid.

#53

- 1944 - Manufactured in Britain.
- 1944-46 - Mounted in No. 2 emplacement with #L/543 at Oxford Battery, Sydney.
- 1946 (March) - Proof fired at Oxford Battery, Sydney.
- 1954 - Dismounted and shipped to Spain (Azores) as NATO mutual aid.

#83

- 1944 - Manufactured in Britain.
- 1944-46 - Mounted in No. 1 emplacement with #L/538 at Oxford Battery, Sydney.
- 1946 (March) - Proof fired at Oxford Battery, Sydney.
- 1954 - Dismounted and shipped to Spain (Azores) as NATO mutual aid.

Endnotes

[1] A.J.B. Johnston. Defending Halifax: Ordnance, 1825-1906. National Historic Parks and Sites Branch, Parks Canada, Environment Canada, 1981.

[2] Maurice-Jones, Kenneth Wyn. The history of coast artillery in the British Army. London : Royal Artillery Institution, 1959

[3] Guns of the Regiment.

[4] This is a correction of what I wrote in the Guns of the Regiment. I had misinterpreted a report that implied the two Signal Hill guns were turned over unmounted at Halifax. Contemporary newspaper reports provided by Jack Bates indicate that the guns were at Esquimalt and construction of the emplacements had started before the British left in 1906.

[5] Excerpted from *The Guns of the Regiment* by permission of the author.

[6] Sarty, Roger. A Brief History of the 1st Halifax-Dartmouth Field Regiment, RCA, (1st Halifax Coast Regiment, RCA), from 1869 to 1945.

[7] Report on Condition of B.L. 9.2 inch guns. 1913-1919. LAC Reference: RG24-C-1, file number 46-37-10. Microfilm reel C-5047.

[8] The sources for this section are largely drawn from contemporary newspaper accounts reproduced in Jack Bates' website on the History of Work Point Barracks: http://workpoint.opcmh.ca.

[9] This chapter is generally sourced from the LAC file Armaments, General. 1920-1947. Reference: RG24-C-1-a, volume/box number 2578-2582 inclusive, file number HQS-3338 volumes 1-15.

10 Order in Council 1921-0172 dated 31 January 1921.

[11] LAC RG25 Vo1432 File A32.

[12] LAC Mispec Point Fort Record Book.

[13] Great Britain, War Office. The Second World War, 1939-1945, Army: Royal Electrical and Mechanical Engineers, Volume 2, Technical. The War Office, 1951, pp 157-163.

[14] The saga takes up most of volume 11 of RG24-C-1-a, volume/box number 2578-2582 inclusive, file number HQS-3338.

[15] DHH 355.009 (D12).

[16] DHH 420.013 (D2)

[17] NATO Archives file SGM-0301-54_ENG_PDP dated 6 April 1954.

[18] Fort Record Book Devil's Battery, Halifax, Nova Scotia. [1930-1950]. Reference: RG24-C-20, volume/box number 13131.

[19] LAC B.L. 9.2-inch Mountings, Generally. RG24-C-1-a, Volume/box number: 5902-5903, File number: HQ-46-37-18.

[20] Fort Record Book Devil's Battery, Halifax, Nova Scotia. [1930-1950]. Reference: RG24-C-20, volume/box number 13131.

[21] Fort Record Book Devil's Battery, Halifax, Nova Scotia. [1930-1950]. Reference: RG24-C-20, volume/box number 13131.

[22] LAC, Fort Record Book, Oxford Fort, Sydney, Nova Scotia. [1930-1950]. Reference: RG24-C-20, volume/box number 13150.

[23] DHH 322.001 (D416). Proceedings of a Coast Artillery conference held at NDHQ 13/15 September 1945.

[24] Fort Record Book Albert Head Battery, Esquimalt, British Columbia. 1930-1950. Reference: RG24-C-20, volume/box number 13160.

[25] P.C.S. 508-1-1-1/ P.C.S. 503-1-2-1 ARTY., dated 25 August 1944.

[26] Gun Drill for the 9.2-inch B.L. Marks X, X^{V}, and X* on Mark V Mounting, (Land Service) 1922.

27 Navweaps web site.

[28] Handbook of the 9.2-inch B.L. Guns, Mark IX, "C" Mark IX, and Marks X, Xv, and X* on Carriages, Garrison, Barbette, 9.2-inch, Marks IV, V, Va, VI, and VIa, Land Service, War Office, 1923.

[29] This weight is from the Electrical and Mechanical Engineering Instruction L 352 CA dated 28 January 1944. Handbooks from other dates have slightly different weights.

[30] Handbook for the Ordnance, B.L. 9.2-inch Mk XV, X, Xv, and X* on Mounting 9.2-inch, Mk IX, Land Service, War Office, 1944.

[31] Handbook of the B.L. 9.2-inch Guns Mark IX, Mark "C" Mk IX, and Marks X, Xv, and X* on Carriages, Garrison, Barbette, 9.2-inch, Marks IV, V, Va, VI, and VIa, Land Service, 1923.

[32] 1923 Handbook

[33] Notes contained in the Albert Head Fort Record Book.

[34] Handbook for the Ordnance, B.L., 9.2-inch, Mk X, Xv, and X* on Mountings 9.2-inch, Marks V, VI, VIa and VII, Land Service, 1936.

[35] There are several different ranges quoted for this equipment. This range has been taken from the data summary from the maintenance instructions for the equipment produced by the Royal Canadian Electrical and Mechanical Engineers in 1944. The 1941 firing tables indicated 29,800 yards for a 4 c.r.h. projectile.

[36] Handbook for the Ordnance, B.L., 9.2-inch, Mk XV, X, Xv, and X* on Mounting 9.2-inch, Mk IX, Land Service, 1944.

[37] Knight, Doug. Guns of the Regiment. Ottawa, Service Publications, 2016.