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Field Artillery: The Evolution of Indirect Fire Methods and the Acquisition of Targets

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Introduction

This paper is intended to give a brief history of the evolution of indirect fire and the methods of target acquisition developed for field artillery over the last century and a half or so. It deals mainly with gunnery in Commonwealth forces, which, with minor differences, all used the same British Army methods.

Direct fire in the artillery sense is the basic business of shooting at a target you can see from your weapon, a method of infantry and cavalry support and strong-point destruction that precedes the invention of gunpowder.

Indirect fire is the science of hitting a target with a projectile when the target is hidden from the firing position by great distance, weather, or an obstruction such as a terrain feature like a forest, a hill or a town. A simple analogy would be the problem of a golfer needing to reach a green out of sight behind trees: which direction, exactly? what distance, precisely?

For centuries, field artillery could not hit what it could not see. Primitive methods of indirect fire were used by siege and fortress artillery, but they depended on a relatively inflexible line of stakes or other markers between the gun and a point from which the target could be seen.

In the siege of Sevastopol during the Crimean War the Russians used some very good systems of signalling to enable fortress artillery to hit British forces in positions unobserved directly from the guns.

Toward the end of the 19th century there arose several reasons why artillery had to be concealed from the enemy, not least the fact that "if the enemy is in range, so are you". The advent of smokeless powder in the 1880s reduced the guns' self-generated smoke screen after firing, leaving them in full view of enemy riflemen using much improved long distance weapons, and later, machine guns. This forced the artillery to move rearwards from the front line, and generally swung the guns' emphasis from direct to indirect fire.

The range of guns also increased over time, but initially could not be used to the full extent because of target invisibility from the guns' position. This was due to factors ranging from the limitation of human eyesight to terrain obstructions. There needed to be a more complex system to guide artillery fire.

A basic system of implanted markers worked in siege warfare but was quite unsuitable for use in field combat requiring mobility and rapid lateral shifts of fire. What was needed was

a way of swinging the guns in any direction to fire at pre-defined map coordinates or in response to orders from a spotter or forward observation officer (FOO).

The answer was remarkably simple. In the 1890s, European artillery began using primitive dial sights consisting of a circle or part of one in combination with a pointer, an aiming point visible from the gun position, and consequent rotational adjustment of the gun to the correct bearing.

The range, how far the gun would fire, was set from tables giving the necessary barrel elevation and size of propellant charge. All that was then needed were fine corrections passed from a spotter observing the target, at first by flags but by the time of the Russo-Japanese War in 1905, by telephone. From then on, artillery could hit any target within range.

The First World War 1914-1918

The basic firing unit for field artillery on the Western Front was a battery, normally six guns. Artillery observers were forward with the infantry while the guns were sited some distance behind, intended to be out of sight of the enemy. The guns were laid parallel to each other aimed at the enemy on a known useful or practical bearing, called the zero line (ZL), usually accomplished using a device called a director; the position of the guns was then fixed on a map. The gun position was plotted with a tool known as an artillery board dealing with range and bearing.

The forward observer, knowing the location of the gun battery, could then give the target's range and bearing to the guns and then adjust the fire by giving corrections to those parameters relative to the guns-to-target line. The FOO did not need to use a map reference.

For set-piece attacks by large formations such as a division or a corps, it was essential that as many guns as possible fire in harmony with each other. This meant that they all had to be on the same surveyed grid, a system of map coordinates. All guns within range could then fire on the same target area.

Observers eventually found it difficult to detect targets of opportunity in the enemy front line because both sides learned to conceal themselves and avoid attracting attention. One consequence of this was that opportunity targets were generally small and needed no more than the fire of one battery.

The relative lack of visible targets led to an emphasis on harassing fire against known re-supply routes behind the enemy's forward trenches. Defensive shoots to defeat German attacks and raids, particularly at night, also required predicted fire, *i.e.* fire on plotted specific zones or locations not necessarily in view at the time.

From late 1916 the British, ably assisted by a Canadian, Lt.-Col., later General, Andrew McNaughton, led the way in counter battery techniques – the science of detecting and firing back accurately at the enemy's artillery positions. In particular, this involved sound ranging and to a lesser extent (muzzle) flash spotting to locate hostile batteries. In addition, both sides rapidly developed skills in the interpretation of aerial photographs to locate artillery emplacements and other worthwhile targets.

World War I brought major changes in the use of artillery. Indirect fire had become the most common practice, range tables were essential, survey and maps were critical, meteorological data was distributed every few hours, and gun sight calibration was a regular activity.

The First World War had clearly demonstrated the limits of artillery in the absence of mobile communications, although wireless had been used to control fire on various occasions, including by aircraft from early 1915. In the mid-1920's a British artillery officer, Lt.-Col. Alan Brooke (later Field Marshal,) wrote of what could be called the "revolution in artillery affairs" that flowed from the availability of radio on the battlefield.

The Second World War 1939-1945

The artillery command and control system developed by the British and adopted by the Commonwealth was the best in the world. An important aspect was the modern wireless, including a portable manpack set, which was used to control artillery fire. It was the key to indirect fire on the mobile battlefield by providing instantaneous communications between forward observers and their guns at the rear. It enabled the large concentrations of mobile fire power that became a characteristic of Commonwealth artillery.

By 1941 a new system for correcting observed fire was introduced using compass points, *e.g.* "Shift your fire 400 yards from north east of where it is targeted now", abbreviated as "Go NE 400 yards". This was applicable to every battery without correction, regardless of the position of the observation post (OP). It had the added advantage that even the infantry could understand and use it if their artillery OP officer was knocked out.

A significant advance in artillery for finding, observing and engaging targets was the introduction of air observation posts early in the war. This involved artillery officers trained as pilots to fly light aircraft and do their job from aloft. Although at somewhat greater risk than ground OPs, they could see considerably more of the enemy terrain and movement. Whether or not directed by an air OP, it became common for field artillery to mark a target with coloured smoke to make it easier for the allied combat air patrols to identify it before attacking.

Apart from the planned setting up of a gun position with the attendant careful survey and orientation of the guns, a "quick action" was sometimes called for. An example would be in the "advance to contact" phase of an offensive. A FOO would be travelling with the vanguard, his troop of guns possibly 2000 metres behind. If the vanguard was held up by enemy action or the FOO spotted a target, by radio he would order the guns into a quick action. The guns would immediately deploy and the gun position officer would indicate a bearing to a troop aiming point for the guns to lay on, and he would quickly map-spot the position. The guns could be in action in two to three minutes, providing rapid firepower support for the troops engaged at the front.

The command and control of Commonwealth artillery made giant strides in the Second World War. The whole was linked together by an intricate network of radio, and proved a wonderfully responsive and flexible weapon.

The Korean War 1950-1953

In 1950 "Target Grid Procedure" was adopted. With this method, for observed fire, the OP merely gave a grid reference and a bearing for the target, *e.g.* "GR123456 OT 240°". Observing the fall of shot, the OP then gave corrections relative to the location, *e.g.* "Go right 100, drop 400".

Although the Korean War took place in the nuclear age, it was fought with conventional weapons, and mainly by the army. The contribution of the artillery was particularly noteworthy in that theatre . "There is no doubt", wrote a British infantry officer, "that in defence the artillery had done more to break up and destroy enemy attacks than anything else".

The artillery's influence on the war was the result of extraordinary quantities of ammunition fired in many of the battles; for example the expenditure by the Divisional Artillery between April 1 and July 27, 1953, was 428,232 rounds of 25-pounder and 87,127 rounds of 4.2-inch mortar ammunition, a daily average exceeding 3,500 and 730 rounds respectively. In his published account of the war, the U.N. Commander in Korea, American General Matthew Ridgway, acknowledged the importance of "our massive firepower" in offsetting the enemy's tremendous superiority in manpower.

Post-Korea to today

The mid-60s saw abandonment of the term "zero line" first employed in WW I, to be replaced by the term "centre of arc". This was a logical consequence of adopting "Target Grid Procedure" 15 years earlier, plus other refinements, which generally made life easier for observers in directing the guns to fire on targets.

Instead of using a zero line the guns were oriented in the centre of arc bearing relative to grid north. Troop centre, a point estimated as the "centre of mass" of a troop's guns, replaced the single pivot gun as the basis for calculation.

Artillery also adopted the use of mils (6400 in a circle) instead of degrees, in keeping with NATO standards.

In the late 1960s Canadian artillery went from an eight gun, two troop battery organization to a six gun battery and a single working CP. Among other things, this simplified battery deployment procedures and consolidated all the command post work.
Deployment was made faster by employing a system of two CPs, one the alternate, that exchanged roles as the battery changed position. One went ahead of the gun group and prepared the new position for occupation, setting up ready to shoot as soon as the guns arrived and were in action. The other, which controlled the guns at the old position, led them to the new one and then organized as the alternate CP, in due course going ahead to prepare the next position.

In the latter years of the 20th Century computers largely replaced the manual computations in the gunners' command post. The ground positioning system (GPS) simplified the fixation and orientation of the guns. FOOs were equipped with laser range finders. Unmanned airborne devices (UAD) or drones came into service for surveillance and identifying and fixing targets. Sound ranging systems and counter-mortar radars were greatly improved.

In Afghanistan, Canadian artillery assets include 155 mm towed guns (helicopter transportable,) 81 mm mortars, fully computerized wireless sound ranging, counter-mortar radars, UADs, and a digital meteorological system supported by the air force. FOOs are equipped with laser tools including those for identifying ground targets to aircraft.

The guns used in Afghanistan have onboard digital computers for fixing their position and can fire a normal round to a range of up to 30 km. They can also fire a "smart shell" called "Excalibur" to a range of 40 km with a lethal accuracy of 10 metres. To achieve this precision a FOO must first fix the target using overhead imagery to a high degree of accuracy. This information is passed to the guns where corrections for weather conditions and propellant temperature are incorporated, and then, with the aid of its own inertial GPS guidance, the Excalibur shell is directed at the target.

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