Innovation and Adaptation: How British and Canadian artilleries rose to meet the demands of the First World War

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The First World War is notable not merely because it was a global war, but because of the new emerging nature of war that it reflected. It was not only a war on a global scale but also an industrial scale. The merging of industry and technology allowed this war to conduct battle on a scale not seen before in history while also necessitating a substantial increase in technological innovation to provide combatants with the upper hand. This innovation occurred ubiquitously, yet perhaps among the most notably in one particular field of warfare: the artillery. While the artillery had been previously viewed as simply an accessory to battle, the First World War necessitated changes in warfare which not only proved artillery to play a central role in achieving success, but also brought about significant development in the techniques of gunnery and the technologies used in its deployment.

The immobile nature of trench warfare was a primary catalyst for the development and the increased role of artillery throughout the War. Since the 18th century, horse-drawn guns had to match the cavalry for mobile warfare, but this changed along with the changing face of battle in the First World War: "The First World War rendered movement in forward areas by horse obsolete."[1] High casualties and trench warfare led to re-evaluation of the role of artillery.[2] The ascent of immobile trench warfare was itself the result of the heightened use of firepower as it halted the ability of enemy infantry to mobilise, meanwhile neither side was able to effectively use their artillery to eliminate the other's firepower and restore the possibility of mobility.[3] Wire obstacles also reduced infantry mobility, making terrain impassable unless cut by artillery fire. As a result, the involvement of artillery became a greater necessity than a mere accessory to battle.[4] By late 1915, it had been determined that an infantry assault could not be successful without the allocation of the proper amount of artillery rounds per metre of frontage. Planning became mathematical and methodical. Whereas in 1914, the standard for a British offensive was 100 rounds per gun, this had tripled by 1915 and would increase substantially as the war went on. By 1916 the strategy became to devastate the enemy with artillery, allowing the infantry to mobilise and secure the territory. Artillery planning then became central to the success of the all-arms battle.[5]

The greater focus on artillery came with its own concerns, however. The main issues facing European military leaders at the outset of the war were "ammunition resupply, the use of heavy artillery, the concealment and protection of guns, the organisation of command and control at high levels, and the need to improve communications". As the war progressed, the solution of these issues came to be better fire power, rather than mobility."[6] There were four primary phases of artillery development; first, the recognition of the deficiencies of current artillery doctrine in 1914; second, the development of new methods and materiel in 1915; third, adoption of "mass destruction" artillery tactics in 1916-1917; and fourth, the adoption of "neutralisation" tactics in 1917-18.[7] The increased role of the guns meant that greater resources and development would be dedicated to the artillery. An adverse effect of this was that the increased firepower often made impassable the very terrain it was meant to make clear. Not until 1917 would artillery techniques be adequately perfected to allow greater mobility when the focus on neutralisation rather than destruction allowed the terrain to remain more intact.[8]

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[1] Bailey, Jonathan BA, ed. *Field artillery and fire power*. Vol. 1. Routledge, 2003. P. 11.
[2] Capt Phillips, Jamie, "Andrew McNaughton: His Influence on Artillery and Intelligence during the First World War" Royal Canadian Artillery School. P. 1.
[3] Badsey, Stephen, and Paddy Griffith. "British Fighting Methods in the Great War." (1996). P. 27.
[4] Badsey and Griffith. "British Fighting Methods." P. 27.
[5] Ibid. P. 27-28.
[6] Ibid. P. 25.
[7] Ibid. P. 23.
[8] Ibid. P. 27.

As the role of artillery grew, so did the need for more centralised command and control of the artillery and with this came a greater appreciation of its effectiveness. Restricted ammunition meant that the artillery had to learn to concentrate its fire in order to economise its effect. This came with two major lessons. Firstly, the artillery of the Great War would require hitherto unknown increases in ammunition supplies to win the firefight. Secondly, artillery would need to be better integrated into planning and brought under more centralised command to economise effort and maximise effect.[9] The main concern was just where all these rounds would come from since production could scarcely keep up with demand. As a result, quality was sacrificed for quantity, with many rounds being produced with faults. Such restrictions maintained the need for artillery to remain concentrated, specifically coordinated, and centrally planned.[10] Furthermore, Andrew McNaughton's work in the Counter-Battery Office relied heavily on intelligence, using aerial photographs to develop accurate maps. This work not only allowed effective counter-battery fire, but by collating intelligence at a higher level of command also confirmed in the minds of the senior leadership the importance of artillery's role as "through its control and use of tactical intelligence, the CBO became one of the most powerful tools in the British and Canadian war effort."[11] Therefore, not only did the necessarily increased role of the artillery mean that it would be more centralised in command, but it also meant that commanders would be able to have a better appreciation of its role.

Among the most crucial artillery developments was the shift towards indirect fire. British experiences in the Boer War indicated the need for a move towards indirect fire, with open-action fire in range of enemy small arms having caused heavy casualties.[12] However, the shift to indirect fire had not been fully made by the beginning of the War, as demonstrated at the Battle of Le Cateau where Brigadier Headlam, artillery commander of the 5th division, sited his guns forward amid the infantry. On the other hand, the 3rd and 4th Divisions sited most of their guns further in depth, sacrificing firepower for survival (the 3rd Division's only four forward guns were destroyed).[13] This resulted in the Germans expending massive amounts of ammunition on counter-battery fire which, at the time, was largely guesswork. Because of this, most of the 3rd's guns survived and were able to inflict devastating fire on the Germans. The 5th Division, however, lost ⅓ of their guns along with many officers, gunners, and horses.[14] it became quickly clear, then, that a rearward positioning of the guns and a greater focus on indirect fire would be necessary to ensure success.

Improvements on the use of artillery continued in the early war, though much of the technique remained imperfect. The Battle of Loos in 1915, saw the emergence of a crucial new artillery tactic: the "lifting barrage". Like the previous "straight barrage" the lifting barrage advanced at regular intervals, but unlike the straight barrage, it did not advance arbitrarily, but trench by trench. This was succeeded by the "piled up barrage" where the lift would advance at intervals until reaching the enemy line, at which point the barrage would "pile up". Finally, this was succeeded by the "rolling barrage". However, the success of artillery tactics was still restricted by the imperfected technique of map firing. Such inaccuracies meant that artillery had to register their targets in advance, thus sacrificing some element of surprise.[15]

Canadian gunner Andrew McNaughton was a pioneer of overcoming the inaccuracies of artillery of the day. As a McGill University scholar, his academic career was put on hold when his battery was sent overseas at the outbreak of the War. After being wounded at the Second Battle of Ypres, he used his time healing to apply his scientific knowledge to artillery theory, designing "a range card for the eighteen-pounder, containing tables which permitted moving targets of opportunity to be engaged with greater accuracy."[16] Furthermore, McNaughton noted that there was a need to conserve ammunition and was a pioneer of accounting for the "corrections of the day" such as barometric pressure, temperature, and wind to ensure accuracy and conserve ammunition. He was even known to carry a thermometer in order to control for the temperature of the rounds.[17] McNaughton hypothesised that barrel wear would slow muzzle velocity and reduce range, causing rounds to drop

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[9] Ibid. P. 27.
[10] Ibid. P. 28.
[11] Phillips "Andrew McNaughton" P. 12-13.
[12] Strong, Paul, and Sanders Marble. *Artillery in the Great War*. Grub Street Publishers, 2011. Ch.1 P. 15.
[13] Strong and Marble. *Artillery in the Great War*. Prologue.
[14] Ibid. Prologue.
[15] Badsey and Griffith. "British Fighting Methods." P. 29.
[16] Phillips, "Andrew McNaughton. P. 3.
[17] Ibid. P. 4.

short on friendlies. Wear varied by each gun, so McNaughton used a Boulenge electrical chronograph to measure the velocity of rounds from individual guns and apply corrections prior to the assault on Vimy.[18] Whereas pre-war artillery methods had been comparatively a matter of guesswork, the first years of the First World War brought about new scientific methods of firing.

By the mid-war, the central role of artillery in battle had become cemented, and this meant further development in the field. In the preparations for the Battle of the Somme, the emphasis placed on the destruction of the enemy by artillery bombardment required development of new gunnery techniques and the centralisation of command and control via an artillery commander at the corps level . Aerial observation was still scant of experience, so new methods of calculation were devised to improve accuracy.[19] Likewise, counter-battery fire was still a developing skill so the focus remained on the close battle, which was divided into three phases: “preliminary bombardment, the barrage, and the exploitation and consolidation phase.”[20] The Bombardment at the Somme focused on destroying enemy machine guns, obstacles, and communication lines. The German response to the British battle of attrition was to make use of greater depth and German machine guns were deployed behind the line of the attacking barrage. To account for this, Lord Cavan, commander of XIV Corps, made use of both deeper barrages and smokescreen concealment , and initiated the practice of registering some guns in the fire plan on contingency targets in depth.[21] The artillery’s role had been further developed and asserted, yet there were still improvements yet to come by the War’s end.

The second half of the War continued to see major advances in artillery doctrine. After overcoming the shortage of heavy guns and ammunition deficiencies, the period following the offensives of 1915-1916 saw the emergence of formalised artillery doctrine, as can be observed in the planning of the Battle of Arras.[22] The experience of the Somme led to the publishing of two doctrinal documents: “Artillery Notes No. 3: Counter-Battery Work” and “Artillery Notes No. 4: Artillery in Offensive operations”. These marked the transition of the role of artillery from a focus on mobility and rapid fire to organisation, concentration, and accuracy of fire as part of the battle of attrition to debilitate the German defensive structure stretching across the continent.[23] “Artillery Notes No. 4” also centralised the command of the artillery within each corps[24] and clarified how the role of the guns should be allocated, pointing out that the heavy guns such as the 8”, 9.2”, 12”, and 15” howitzers should be reserved for counter-battery fire and harassing the enemy in their depth, while the lighter 18-pdrs and 4.5” howitzers should focus on the barrage and infantry support.[25] After the Germans’ strategic withdrawal, the advance to the Hindenburg Line brought the realisation that heavy and medium artillery could be as mobile as field artillery, which had not been so realised thus far due to the static nature of the war. The advent of the tank also allowed greater mobility with less artillery support, allowing more artillery to be allocated to other tasks.[26]

The success of the new methods was proven in the battle of Arras in 1917, where the greater involvement of artillery in planning and the greater centralisation of command and control allowed a comprehensive, unified role for the artillery. In the battle of Vimy ridge, as part of the Battle of Arras, the artillery was planned in four phases: the first was a 14-day bombardment with only ½ of guns to avoid revealing their locations. For the second phase, 7 days preceding the attack, all guns and machine guns were to release a barrage. The third phase, as part of the overall assault, utilised a rolling barrage and counter-battery neutralisation. And in the fourth and final phase, the batteries advanced, and fired on targets of opportunity.[27] According to Jackson Hughes, the success of the new approaches was observed when,

> “By the end of the day the Third Army had followed its creeping barrage some three and a half miles into the German defences; the Canadians of the First Army had not advanced so far, but most of the heavily defended Vimy Ridge was in their possession.”[28]

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[18] Ibid. P. 10.

[19] Badsey and Griffith. "British Fighting Methods.". P. 32.

[20] Ibid. P. 32.

[21] Ibid. P. 33.

[22] Hughes, Jackson. "The monstrous anger of the guns: the development of British artillery tactics, 1914-1918." PhD diss., 1992. P. 129.

[23] Hughes. "The monstrous anger of the guns" P. 136.

[24] Ibid. P. 136.

[25] Ibid. P. 137.

[26] Badsey and Griffith. "British Fighting Methods." P. 37.

[27] Phillips, “Andrew McNaughton”. P. 12.

[28] Hughes. "The monstrous anger of the guns." P. 145.

The test of battle had then proven the efficacy of the new artillery doctrines and the necessity of centralised command and control in battle planning.

The Battle of Cambrai was a trial for new ideas and equipment in the late-war period. Artillery used fire planning on a massive scale with improved accuracy to neutralise the enemy while tanks further reduced the need for artillery to destroy enemy obstacles. Artillery's new role, then, was to neutralise enemy artillery and infantry firepower, allowing greater focus on firing on the enemy depth and facilitating greater breakthroughs. [29] By this time, major scientific bounds had been made in predicted fire and counter-battery fire, which reduced the need to register targets via previous firing, and thus increased the aptitude for surprise. Better indirect fire had also improved the ability for camouflage and concealment of the guns, while the generation of gas and smoke rounds allowed the ability to neutralize, rather than destroy, the enemy. Likewise, better maps, and appreciation for meteorological factors, ammunition variation, and muzzle velocity allowed more accurate calculations.[30] Finally, the new role of artillery in the all-arms battle was fully realised at the Battle of Amiens in August 1918 where there was no initial bombardment to clear obstacles, as tanks had taken over that role. This, however, allowed a more devastating, intense barrage during the assault.[31] Cambrai clearly demonstrated the transformation of the application of artillery from direct fire and destruction to indirect concealed fire and neutralisation.

Not only were changes made to the doctrine and application of the guns themselves, but the ascent of indirect fire necessitated new methods for observations and attaining information. McNaughton was considered an innovator in the technique of sound ranging to locate enemy guns. [32] Moreover, McNaughton made improvements to counter-battery observation post methods, siting the OPs himself and instructing them to relay up the bearing at which they had seen the flash from enemy guns. Once two OPs had reported sighting enemy guns in the same position he would find the intersection of the bearings to locate the position of the enemy in order to engage them with his own guns.[33] He also advocated the use of survey sections with theodolites. This method was similar to that employed using OPs. once one section had spotted a flash, it would report it bearing to the HQ. This would then be passed on to the other sections. Once all sections had reported the same flash, this allowed them to pinpoint the enemy gun's location.[34] McNaughton asserted that this method could locate an enemy gun 10,000 yards away.[35] McNaughton was also a strong advocate for the employment of sound ranging in the Canadian Corps to locate enemy guns. This new technology was initially viewed with suspicion by leaders. "The military thought scientists were far too visionary and gadgety to be of any help in the field." However, McNaughton's personal scientific experience allowed him to bring in the British sound-ranging expert team with ease.[36]

The First World War saw the ascent of the artillery as a combat arm absolutely central to military success through innovations in the techniques, employment, and technologies of gunnery. The immobility of trench warfare ensured that superiority of artillery firepower was essential and achieving this superiority required development and re-evaluation of the role of the guns in battle. Innovations in the centralising of command and control, the science of gunnery, and its doctrines allowed this success to be achieved. The artillery was made central to success in the First World War by adapting to the new demands which the war imposed on it.

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[29] Badsey and Griffith. "British Fighting Methods". P. 37-38.
[30] Ibid. P. 37-38.
[31] Ibid. P. 41.
[32] Phillips, "Andrew McNaughton" P.1.
[33] Phillips, "Andrew McNaughton". P. 4.
[34] Ibid. P. 7.
[35] Ibid. P. 7.
[36] Ibid. P. 9-10.

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