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From Bombs, Bullets, and Bayonets: The Transformation of Canadian Infantry Firepower at Vimy Ridge

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> Recent experience has proved that the present organization and training of our Infantry have not succeeded in developing the maximum offensive power bestowed by the weapons with which it is now armed.
>
> One reason for this failure appears to be the want of combination in the employment of these weapons, viz., the rifle, the bayonet, the Lewis gun, the bomb and the rifle grenade.
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> Canadian Corps G.340, 27 December 1916[1]

Canadian infantry on the Somme in 1916 after the completion of artillery program, had little more than bombs, bullets, and bayonets to overcome unsuppressed German strongpoints. The result was too many dead and wounded often accompanied by failure. Like most other British and Dominion formations, Canadian infantry could not generate the firepower required to defeat unsuppressed defences. At Vimy Ridge, in

[1] Canadian Corps, G.340, 27 December 1916, 99/3, RG9 III-C-1 v3842, LAC.

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contrast, they could overpower their opponents even when the guns had not fully neutralized them. This increased capability was not the result of new infantry weapons, but rather the consequence of a better deployment and employment of the existing ones.

A topic of much popular and scholarly attention is the inception, invention, and innovation of new weapons and technology, their development, and eventual production.[2] There is an even more voluminous quantity of work in the business sector on new product development and introduction.[3] There is a broad understanding in this sector that the success in the development and introduction of innovative products or services require the delivery of a 'whole product.' That is not just the item itself but packaging, pricing, distribution, support, training, sales, and marketing necessary for its commercial success.

With new weapons, readers and authors are especially interested in their specifications because they are easily measured and compared—the speeds and feeds. They miss out what is the equivalent of the commercial 'whole product,' understanding that success is dependent on more than specifications. Focusing on these risks overlooking critical factors. For instance in 1940, the French tanks, such as the Somua S35 and Char B1, were equivalent or superior to their German equivalents and were available in comparable numbers.[4] Based purely on an assessment of the material

[2] For instance, see Jeremy Black, *War and Technology,* (Bloomington: Indiana University Press, 2013); Kenneth Macksey, *Technology in War: The Impact of Science on Weapon Development and Modern Battle,* (London: Arms and Armour, 1986); Paul G. Gillespie, *Weapons of Choice: The Development of Precision Guided Munitions,* (Tuscaloosa: University of Alabama Press, 2006); Nicholas D. Evans, *Military Gadgets: How Advanced Technology Is Transforming Today's Battlefield-- and Tomorrow's,* (Upper Saddle River, NJ.: FTPrentice Hall, 2004).

[3] Some examples include, *The Journal of Product Innovation Management,* Nadia Bhuiyan, "A Framework for Successful New Product Development," *Journal of Industrial Engineering and Management* 4, no. 4 (2011); Arie Karniel, *Managing the Dynamics of New Product Development Processes: A New Product Lifecycle Management Paradigm,* (London: Springer, 2011); Kenneth B. Kahn and Product Development & Management Association., *The PDMA Handbook of New Product Development*, 3rd ed. (Hoboken, N.J.: Wiley, 2013); Marc A. Annacchino, *New Product Development: From Initial Idea to Product Management,* (Boston, MA: Butterworth-Heinemann, 2003); Marc A. Annacchino, *The Pursuit of New Product Development: The Business Development Process,* (Boston: Butterworth-Heinemann, 2007); Antti Sääksvuori and Anselmi Immonen, *Product Lifecycle Management*, 3rd ed. (Berlin: Springer, 2008).

[4] Kenneth Macksey, *Tank Force: Allied Armor in World War II*, Ballantine's Illustrated History of World War II Weapons Book No 15 (New York,: Ballantine Books, 1970).

factors, the German six-week victory was inexplicable. The difference lay not in better machines but how the Germans deployed and employed them. During the Battle of Britain, while German radar was equivalent or better to British models, the superior British command and control resulted in a more successful defensive system.[5]

The specifications are only one factor that defines how effective was a weapon. They are inert without trained and capable personnel to operate them, officers who employ them to take best advantage of their capabilities, commanders and staff who effectively integrates them into the larger combat system, and administration to manage replacements, maintenance, supply, and training. Further, they are rarely standalone but comprise a system consisting of the device, spare parts, tools, transport, and possibly munitions expended by it. Even the grenade, a relatively simple object, required ancillary components, such as pin-pullers, boxes for transportation of the grenades and detonators, and buckets and vests to carry them in battle. Multiple tools, spares, and other pieces accompanied more complex weapons, such as the Lewis Gun with its 6.8-kilogram bag of spare parts.[6]

Introducing a new weapon necessitates critical decisions on how to deploy and employ it. In some cases, a significantly increased availability of an existing device can trigger the need for a reconsideration of earlier choices. The US Army refers to this as doctrine, training, leader development, organization, materiel, and soldier, which the paper simplifies to deployment and employment.[7] Deployment refers to the decisions on its organization, staffing, control, training, transport, maintenance, and logistics. Employment refers to how units use them in battle. The extent to which the new weapon reaches its potential is wholly dependent on these decisions. Get one wrong and it can significantly diminish its effectiveness. This topic, outside of tactics, however, receives little scholarly attention.[8]

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[5] Matthew Cooper, *The German Air Force 1933-1945: An Anatomy of Failure,* (London: Jane's, 1981), p. 182.
[6] *The Tactical Employment of Lewis Guns, S.S. 197,* (General Staff, 1918), p. 22.
[7] Williamson Murray, ed., *Army Transformation: A View from the U.S. Army War College* (Carlisle, PA: U.S. Army War College, 2001), p. 100.
[8] Notable exceptions include David J. Childs, "British Tanks 1915-18, Manufacture & Employment," (PhD, Glasgow University, 1996); Anthony James Saunders, "A Muse of Fire: British Trench Warfare Munitions, Their Invention, Manufacture and Tactical Employment on the Western Front, 1914-18," (PhD, University of Exeter, 2008); Bill Rawling, *Surviving Trench Warfare: Technology and the Canadian Corps, 1914-1918,* (Toronto: University of Toronto Press, 1992).

The paper examines these critical choices in the context of the introduction and use of new infantry weapons in the Canadian Corps in 1916. It explores three case studies focused on the period of the Somme Campaign and at Vimy. Each one looks at aspects of deployment and employment for Lewis Guns, and grenades/rifle-grenade and Stokes trench mortars. Each case study highlights how incorrect decisions limited their utility and how these challenges were successfully or unsuccessfully addressed after the Somme.

The paper starts by justifying why infantry weapons were important in a war so dominated by artillery. It then introduces the decisions that accompany their introduction and the trade-offs they entail to set the context. The heart of the essay is the three case studies. Each follows the same structure. A brief review of the weapon and its specifications, the critical deployment and employment choices that affected its effectiveness on the Somme, and what changes occurred after to address the problems.

There are four key sources for the argument. The first is the compilation of the responses to a Canadian Corps post-Somme questionnaire. On 3 November 1916, the Canadian Corps asked all units down to the battalion level multiple questions on the lessons from the Somme. This included queries on the weapons highlighted in the case studies. Of the 64 possible responses from 48 battalions, 12 brigades, and 4 divisions, 52 were found.[9] These answers are an invaluable source of information on how units actually used the different weapons and what the commanders thought of them. The second is a detailed analysis of 57 contested Canadian battalion attacks on the Somme defined as a minimum of two companies crossing no man's land.[10] The third is records related to the three case studies scattered throughout the documents of the Canadian Expeditionary Force (CEF). They highlight how the Canadian Corps addressed the challenges identified on the Somme over the winter of 1916/1917 and into 1918. Finally, a review of war diaries for Vimy Ridge reveals how the infantry fought differently than on the Somme and its consequences.

[9] Canadian Corps, G.428, 3 November 1916, 14/4, RG9 III-C-3 v 4227, LAC.

[10] This excludes actions where only a single company took part, where a unit was to assault but did not do so, or where the Germans did not contest the attack. William F. Stewart, *The Canadians on the Somme, 1916: Canada's Neglected Campaign*, Wolverhampton Military Studies (Solihull, West Midlands, England: Helion, 2017), p. 294.

Why Infantry Weapons Matter in the First World War

Artillery was the dominant arm on the Somme and through the war. It inflicted the majority of casualties and while it could not guarantee victory, the guns dramatically improved the odds.[11] For the period of 15 April to 15 May 1917, 76.1% of German wounded were caused by artillery.[12] In the contested battalion attacks on the Somme, effective shelling resulted in a full success in two-thirds of the engagements and at least a partial one in almost all the attacks (94%). An ineffective artillery program produced only a partial success in one in six actions with the remaining attacks outright failures.[13]

Given the critical importance of artillery why then did infantry firepower matter? The guns dominated, but not everywhere, not always, and not in all circumstances. On the Somme, the artillery's effectiveness declined over the course of the Canadian Corps' operations, due to the excessive tempo of attacks, poor conditions, and inexperience.[14] As a result, artillery bombardments and barrages based on contemporary reports were partially effective or a failure in just over 40% of the contested battalion engagements.[15] In these cases, the troops had to overcome the German resistance with at best minimal artillery assistance, which resulted in failure in most of the operations.

For two or more hours after the barrage had moved on, neither side's artillery could intervene effectively in a contested zone, because they did not know where their friends and foes were. A signals blackout accompanied most attacks where communications were incomplete, tardy, and dreadfully unreliable.[16] In these circumstances, the guns had only a limited role in firing standing barrages off stage to hitting their own troops. The Canadians would fire a protective barrage beyond the final objective and the Germans on no man's land. Further, in the wasteland conditions, troop inexperience, and lack of distinctive landmarks, it was exceedingly difficult for

[11] Paul Strong and Sanders Marble, *Artillery in the Great War*, Kindle ed. (Barnsley: Pen & Sword Military, 2011), E-book, loc. p. 55.
[12] Alexander Watson, *Enduring the Great War: Combat, Morale and Collapse in the German and British Armies, 1914-1918,* (Cambridge: Cambridge University Press, 2008), p. 15.
[13] A partial success was where part of the final objective was captured and held. Stewart, *Neglected Campaign*, p. 296.
[14] Ibid.
[15] 58% of the bombardments and barrages were fully effective, 9% partially effective and 33% failures.
[16] Stewart, *Neglected Campaign,* pp. 133-5.

units to provide accurate positioning information. In one instance, a battalion's reported position was off by a thousand metres.[17] In another, on 28 September the 26th Battalion claimed it was close to taking Regina Trench. This caused the brigade commander to cancel a bombardment to support two other battalions also attacking it. Unfortunately, the 26th was far from where they claimed and the other battalions' attack failed.[18]

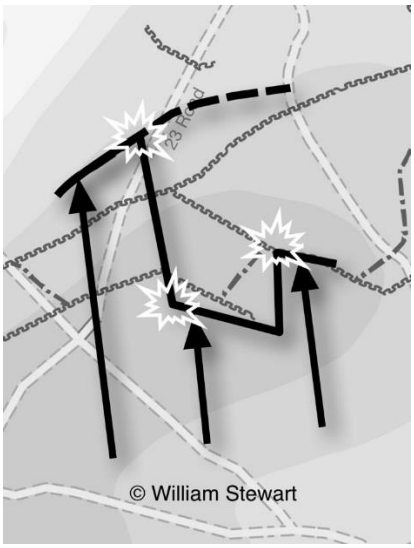
The other situation where the guns could not intervene was where the infantry positions were too close to the enemy for the artillery to safely fire without hitting them. There were constant complaints by the Canadian infantry on the Somme of their own gunners shelling them.[19] Owing to multiple sources of inaccuracy and inconsistency in the guns, the rounds, and the gunners' practices, shells fired from the same piece with the same settings landed not on the aiming point but in a zone around it. The result was if the enemy were within 200 metres of Canadian troops; they were effectively immune from shelling by the standard 18-pounder field piece. Given the uncertainty of locations of both the enemy and friendly forces it would take time to gain confidence that the artillery would not shell their own troops. The other option was to pull back to allow the heavy artillery to fire, but the 6" howitzers needed a 400-metre zone and 8" howitzers 500 metres.[20] Commanders were naturally loath to surrender ground gained at so costly a price. For instance, the Canadian Corps commander, Lieutenant-General Sir Julian Byng, cancelled a proposed counterattack at Mouquet Farm in early September 1916 because it would require pulling troops back to fire the heavy artillery.[21] At Vimy, the 4th Division could not provide the usual artillery support for an afternoon attack on 9 April as its forces held trenches on either side of the target sector.[22]

Many attacks on the Somme resulted in patchy situations where the Germans held part of the objective or were too close to the infantry to be shelled. It was at these crux points where infantry firepower became decisive. In the questionnaire responses, the dominant answer was that another attack with fresh forces and a new barrage with

[17] 11th Brigade Lessons from the Somme, 20 December 1916, 44/1, RG9 III-C-3 v3843, LAC.
[18] 5th Brigade War Diary, 28 September 1916, RG9 III-D-3 v4884, LAC.
[19] Stewart, *Neglected Campaign*, pp. 185, 284.
[20] Cyril Bentham Falls, *Military Operations: France and Belgium, 1917*, vol. 1 (London: Macmillan, 1940), p. 442.
[21] Stewart, *Neglected Campaign,* p. 79.
[22] 4th Division War Diary, 9 April 1917, RG9 III-D-3 v4859, LAC.

its attendant delays of hours to days was necessary. Consequently, the offensive would stall and the Germans given the opportunity to bolster their defences. In most cases, the attack broke down—especially given the concerns with advancing with exposed flanks.[23] On the Somme, the Canadian infantry was effectively limited to fighting with bombs, bullets, and bayonets, which did not generate enough firepower to consistently achieve victory. It meant brave men had to try to overcome German strongpoints and machine gun nests without direct and indirect fire weapons to suppress the target to allow them to close. The outcome of these attacks was often the loss of the gallant attackers long before they could reach the enemy.

Illustration 1: Artillery Limitations



Example Somme attack with white explosions marking the crux points where artillery had limited effect, and it was up to the infantry to advance based on their own firepower.

Deployment Decisions

All the deployment and employment decisions were a series of trade-offs such that the correct choice depended on multiple contingent factors. What might work well in one set of circumstances might fail in a different set. What is more, a change in one decision could have repercussions on other decisions and might render them invalid. For instance, the increase in number of Lewis Guns in infantry battalions and their

[23] Stewart, *Neglected Campaign,* p. 286.

addition to artillery batteries and other formations affected maintenance, transportation, and ammunition supply considerations.[24]

The first aspect is organization—how were the weapons organized? Did the basic unit comprise one, two, three, four, or more weapons? This was important as fewer weapons per unit made them easier to control and more flexible. This approach, however, made it more difficult to mass for effect and less resilient to losses. It also required more experienced officers and NCOs to command the greater number of units. For instance, one reason the Canadian Corps moved to a six-gun battery for field artillery in 1917 was to make better use of the limited supply of trained battery commanders.[25]

The second decision was staffing, which was how were the officers and men found for the weapon. There were essentially three options adopted by the British Army and CEF—secondment, use an existing arm or branch, or create a separate corps. With secondment for officers and detachment for other ranks, the authorities reassigned the personnel to another formation, but they remained on the books of the original unit. This approach had the advantage of finding staff for weapons that did not fit with the existing structure without the considerable overhead of a separate corps and used extant policies, procedures, and structures. It, also, carried several significant disadvantages that will be discussed with trench mortars. Adding to an already formed arm or branch worked best when it was not dramatically different from existing weapons nor required specialist expertise and training beyond the unit's capabilities. Integrating into an extant structure required the least overhead.

Finally, there was a separate corps responsible for selection, training, promotions, assignments, and other administrative matters. At Byng's insistence, Canadian authorities formed the Canadian Machine Gun Corps (CMGC) in April 1917 to improve the administration, promotion prospects, and efficiency of the machine gun arm.[26] It also meant those who recovered from wounds, illness, or injury returned to their units,

[24] 2nd Divisional Ammunition Column A.C.6-19, 27 March 1918, 1/6, RG9 III-C-3 v4082, LAC; First Army 8003/81 (Q.C/1), 23 July 1918, 6/5, RG9 III-C-3 v4303, LAC.
[25] Alun Miles Thomas, "British 8th Infantry Division on the Western Front, 1914-18," (PhD, University of Birmingham, 2010), p. 242.
[26] Byng to Turner, 26 February 1917, MG30 E46 v10, Turner Fonds; LAC; Byng to Turner, 18 January 1917, 99/10, RG9 III-C-1 v3864, LAC.

unlike previously where they might be posted to the infantry. Forming a separate corps ensured protection of the arm's interests but carried a considerable overhead in administrators. It also risked contention over objectives, tactics, and ideals. A training document that accompanied the formation of machine gun battalions in 1918 reinforced this by stating: "The Machine Gun Service must therefore be regarded as a distinctive Arm with tactics of its own."[27]

Tensions between the enthusiasts who want independence and control for their weapon and the traditionalists who insist on integration were a constant. This is evident in the establishment of the Machine Gun Corps, Tank Corps, and the RAF during the First World War where the enthusiasts gained autonomy. The introduction of a new weapon/technology caused a moment of plasticity where all the basic decisions were open to discussion. Whether it became the basis of a new arm depended on its ubiquity, capabilities, difficulty of operation and employment, supply, technical challenges, and effectiveness of its advocates, such as Raymond Brutinel of the CMGC. There were always trade-offs between providing the lowest command levels access to greater firepower with pooling it at higher echelons to better manage its concentration.

Counter examples of failed independence were trench mortars and gas. GHQ made the explicit decision to integrate trench mortars into the existing infantry and artillery structures. It stated: “Anything in the nature of a Trench Mortar Corps involving a special organization and a special Base Depot to supply reinforcements has therefore been avoided.”[28] The British and Germans adopted the same policy of making the offensive use of gas a responsibility of their engineers, although the artillery fired gas shells.[29] The Americans went a different direction and formed a separate Gas Service in September 1917 in the American Expeditionary Force.[30] This tension between enthusiasts and integrationists lasted long beyond the formation of a new arm or

[27] First Army Policy Regarding Employment of Machine Guns, 10 May 1918, 16/9, RG9 III-C-1 v3832, LAC.
[28] Second Army OLB/166, 22 May 1916, 6/4, RG9 III-C-3 v4119, LAC.
[29] Charles Messenger, *Call to Arms: The British Army 1914-18,* (London: Weidenfeld & Nicolson, 2005), pp. 188-189; Hermann Cron, *Imperial German Army 1914-18: Organisation, Structure, Orders-of-Battle*, 2006 ed. (Solihull, UK: Helion and Company, 1937), pp. 166-7.
[30] Leo P. Brophy and George J. B. Fisher, *The Chemical Warfare Service; Organizing for War*, United States Army in World War II: The Technical Services (Washington,: Office of the Chief of Military History, Dept. of the Army, 1959), p. 11.

branch. There were considerable complaints in 1918 about division machine gun battalions and the infantry's loss of control over them.[31] Haig, during the 100 Days, demanded that: "Tanks must join the Army" meaning to integrate them into the existing structures.[32]

A third decision was how and where were the weapons' operators and their commanders to be trained. A separate corps, such as the CMGC, instructed new personnel and the units' commanders trained the units. There was a fault line between the ideal of unit commanders having absolute responsibility for instruction and the realities of the Western Front, but they lacked the time and experience to properly prepare the instructors. Further, as all the weapons in the case studies were wartime introductions there was no pre-war expertise to draw upon. To address this, an extensive education system supplemented unit training. GHQ established a series of schools to train instructors and provide specialist training at GHQ, army, and corps level and at times division schools.[33] In some cases, instruction required separate training facilities, as with trench mortars with their greater range. For example, the 42nd Battalion in preparing for Vimy sent their Lewis gunners to train at a nearby machine gun range and the bombers and rifle-grenadiers in a bomb-pit dug behind the transport lines.[34]

The fourth decision was where in the command hierarchy the weapons' basic unit resided. This differed with the soldier for grenades, company for Lewis Guns on the Somme, and brigade for Stokes mortars and Vickers machine guns. As a result of the learning process, GHQ centralized some weapons and decentralized others. Examples of this include the Lewis Gun moving over the winter of 1916-1917 to the platoon, while in 1918 the Vickers machine gun formed a separate battalion under division control. There were always trade-offs as deploying them at the lower echelons provided these formations with greater firepower and ensured they brought them into action in an

[31] See for instance, 9th Brigade War Diary, Narrative of Operations from 25th to 30th August 1918, 15 September 1918, RG9 III-D-3 v4900, LAC; 6th Brigade G.3/206, 31 October 1918, 2/16, RG9 III-C-3 v4137, LAC; 11th Brigade War Diary, Narrative of Operations Carried out between September 2nd and Sept. 5th, 1918, RG9 III-D-3 v4905, LAC.

[32] Christopher Byrnley Hammond, "The Theory and Practice of Tank Cooperation with Other Arms on the Western Front in the First World War," (PhD, University of Birmingham, 2005), p. 267.

[33] *Instructions for the Training of the British Armies in France (Provisional)*, (General Staff, 1917).

[34] 42nd Battalion War Diary, 1 March 1917, RG9 III-D-3 v4938, LAC.

environment of severely restricted communications. While pooling at higher level allowed greater massing of firepower, better control, and more efficient utilization of technical specialists when in short supply. Concentrating the weapons made it also easier to develop tactics and promote efficiency. One challenge of the trench mortars with the infantry was that its senior officer was a captain who would have little sway in dealing with lieutenant-colonels and brigadier-generals.

The fifth decision was how the weapons and their paraphernalia were moved, both tactically and administratively. Tactical decisions refers to weapon transportation on the battlefield. A major limitation of both the heavy machine gun and Stokes was their crew's inability to rapidly advance their weapons in combat. Both were heavy and awkward loads that attracted enemy fire. This resulted in their inability to keep up with the advancing infantry. Administrative decisions determined how the weapon was transported when away from the battlefield. Horse drawn transport was a common solution using existing wagons that were in production and well understood. For instance, a horse-drawn limber moved Vickers machine guns when not in combat, while the Lewis gunners had to make do with a backbreaking handcart initially. In 1917, the Lewis Gun also received a horse-drawn limber. While suitable for movement behind the lines, they were vulnerable to enemy fire. Further, as the war progressed, difficulties in obtaining animals increased. As a result, even in the face of the clear inadequacies of transport for the Stokes mortars, the only option was to take away from the existing allotment of animals.[35] The plethora of additional weapons, tools, and munitions meant battalion commanders were loath to give up any of their horses.

How were the weapons supplied? All weapons discussed in this paper had a high-rate of fire that demanded stockpiling munitions prior to an attack and an efficient means of resupply during battle. Otherwise, shortages would drastically curtail their effectiveness. A divisional ammunition column supplied trench munitions, including rifle, machine gun, and trench mortar rounds, grenades, flares, and rockets. As the Vickers machine gun was a pre-war weapon, the planners provided for it in the ammunition supply considerations. But, what they could not account for was the advent of new weapons and the amount of ammunition consumed by them. They required improvisation in the existing supply channels. Based on a 1918 analysis, one

[35] See for instance, Canadian Corps, G.692/1-17, 21 June 1918, 18/4, RG9 III-C-3 v4193, LAC.

Vickers machine gun with a crew of ten would fire only somewhat fewer rounds per day (20,000 versus 25,000) than an entire 1,000-man infantry battalion in a 'show.'[36] At its maximum rate of fire, the Lewis Gun could consume the same number of rounds as 36 men trained to the pre-war standard of 15 rounds a minute. There was no pre-war provision for trench mortar shells, grenades, signal rockets, or flares.

The supply system worked satisfactorily up to the delivery of the trench munitions to the forward dumps. The problem was there was no good solution other than manually moving supplies from there to the weapons. Troops carried grenades and work parties often supplemented Vickers machine gun crews shifting their ammunition forward. Lewis Gun crews at full strength could carry considerable ammunition on their own and carrying parties often supplemented their efforts. The minimal crews assigned to a Stokes mortars limited how many rounds they brought into battle.

Weapons wear, break, and the harsh conditions on the battlefield damage them, all which necessitates maintenance and repair. The more resources devoted to these activities, the greater the weapon's availability and shorter the period it is out of action after damage. The challenge with a new weapon is that its wear characteristics and how often it is damaged is unknown. For instance, when the British army introduced the 18-pounder field piece in 1904, it did not test it with prolonged shelling at a high rate of fire. Consequently, a design flaw with the springs in the buffer that brought the gun barrel back into position caused them to wear out much sooner than expected. With not enough springs available to keep up with the intense shelling on the Somme, up to 30% of these pieces were out of action.[37] A large complex weapon system was inoperable because of a single component that cost less than 1% of the weapon.

The fundamental questions regarding maintenance and repair was what the unit could do what and what specialist formations in the rear did. Again, there were trade-offs as the more the unit did the shorter the period the weapon was unavailable. It, however, meant over loading units with specialists they needed only rarely and was inefficient. An example is the evolution of maintenance management of tanks. Initially,

[36] Estimated Daily Requirements During Show, 23 March 1918, 1/6, RG9 III-C-3 v4082, LAC.
[37] Martin Farndale, *History of the Royal Regiment of Artillery: Western Front 1914-18,* (Royal Artillery Instn, 1986), 152; Comments BOH, Southam, 1 July 1929, CAB 45/137, TNA.

every tank battalion had a workshop attached to repair and maintain their vehicles. The expansion of the tank service meant there were insufficient trained technical personnel for each battalion, and they moved to the brigade level. Eventually, the authorities centralized the workshops to get the most out of the scant supply of technicians and artificers. [38] The centralization of the workshops was more efficient than the decentralized approach, but it was less effective. For instance, the 14th Tank Battalion when assigned to the Canadian Corps in the Battle of Second Arras in 1918 had to admit that it was uncertain where all its tanks were. It had just fought at Amiens in the Fourth Army and in the Second Battle of the Somme in the Third Army. All these movements meant it lost track of the tanks that were sent for repair.[39]

Employment Decisions

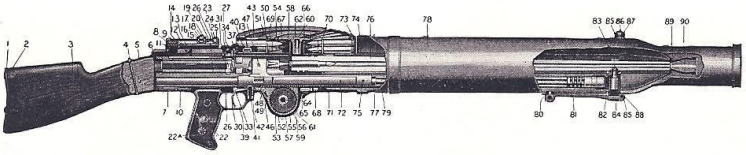
Employment deals with how the army uses the weapon in battle from the individual device up to its integration into the operations at the highest level. This topic gets much more academic coverage than deployment issues. It includes how to operate the individual weapon, the tactics of the basic unit, how this unit works in combination with the other components of the next level formation, and how it fits in with the overall operational approach. Another way to view this is to use the Lewis Gun as an example of how the British Army provided manuals and instructions for each level by 1917. The basic operations document was *Method of Instruction in the Lewis Gun*, with SS 106 *Notes on the Tactical Employment of Machine Guns and Lewis Guns* on how to employ it in battle. SS 143, *Instructions for the Training of Platoons for Offensive Action* provided training for the new platoon organization including the Lewis Gun section. The manual for the new battalion structure was SS 600 *Organisation of the Infantry Battalion and Normal Formation for the Attack* and for preparing the division in the new tactics in SS 135 *Instructions for the Training of Divisions for Offensive Action*. GHQ regularly revised these documents over the course of the war. This was in reaction to the learning process, changes in German tactics, and the introduction of new weapons and munitions like the 106 fuze, and improved tank models.

[38] J. F. C. Fuller, "Tanks in the Great War, 1914-1918. [with Illustrations and Maps.]," (London: John Murray, 1920), pp. 125-126.
[39] 14th Tank Battalion, N.780, 16 September 1918, WO 95/103/4, TNA.

Case Study: Lewis Gun

Nicknamed the Belgian Rattlesnake by the Germans, the Lewis Guns was arguably the most effective light machine gun in large-scale production in the First World War.[40] It was reasonably reliable, durable, and mobile, albeit weighing about 13 kilograms versus 44 for the Vickers heavy machine gun.[41] It was so respected that the Germans formed their own units with captured guns—a clear recognition of its efficacy.[42] Its theoretical maximum rate of fire was 550 rounds per minute using a cylindrical 47-round magazine with an effective range of 800 metres. Manned by a crew of five but only two needed to operate it. The other three acted as scouts and ammunition carriers. A full Lewis Gun crew could bring a good supply of ammunition into battle as its gunner seldom fired it at its maximum rate.

Illustration 2: Lewis Gun Parts List



LEWIS AUTOMATIC LIGHT MAGAZINE GUN

1, Butt plate; 2, butt plate screws; 3, butt; 4, butt tang screw; 5, butt tang; 6, feed cover latch; 7, butt latch, securing butt to receiver; 8, back sight bed spring; 9, back sight bed spring screw; 10, butt latch spring; 11, back sight bed; 12, feed cover latch pin; 13, feed cover; 14, back sight leaf; 15, back sight thumb piece; 16, back sight slide catch; 17, back sight fine adj. worm; 18, back sight fine adj. worm axis pin; 19, back sight slide catch spring; 20, back sight slide; 22, Firing hand grip; 22A, guard side rivets; 23, back sight axis pin washer; 24, back sight axis pin; 25, back sight axis washer fixing pin; 26, receiver; 27, magazine pawls spring; 30, trigger; 31, feed operating stud; 33, trigger pin; 34, feed operating arm; 37, bolt that closes breech and takes shock of discharge; 39, guard; 40, cartridge guide spring; 41, sear spring; 42, sear; 43, magazine pan; 46, gear stop; 47, striker fixing pin; 48, gear stop pin; 49, gear stop spring; 50, striker; 51, cartridge spacer; 52, gear operated by main spring; 53, main spring casing; 54 magazine top plate rivets; 55, main spring which closes breech and returns parts to firing position; 56, collet pin; 57, main spring collet; 58, magazine centre; 59, main spring rivets; 60, magazine latch spring; 61, gear casing; 62, magazine latch; 64, gear casing side piece; 65, gear case hinge pin; 66, feed operating arm latch; 67, magazine top plate; 68, receiver lock pin; 69, cartridge spacer rivets; 70, interior cartridge separators; 71, radiator casing rear, locking piece; 72, rack, actuated by piston and main spring; 73, Radiator casing rear, platform; 74, radiator casing rear; 75, piston connecting pin; 76, barrel; 77, gas cylinder; 78, radiator for cooling barrel; 79, piston operated by gases of exploding cartridge that ejects empty shell and resets firing pin; 80, regulator key stud; 81, gas regulator key; 82, gas chamber; 83, gas port; 84, gas regulator; 85, clamp ring; 86, fore sight; 87, clamp ring positioning screw; 88, clamp ring screw; 89, barrel mouth piece; 90, radiator casing front.

New International Encyclopedia

[40] Although designed by an American, it was rejected by the US Army, and its designer opened a factory in Belgium to manufacture it.

[41] Various sources have it weighing 26 to 28 pounds. Army Great Britain, *Handbook, Provisional, for The .303-In. Lewis Machine Gun, Magazine Rifle Chamber,* (London, 1915); Neil Grant, *The Lewis Gun*, Kindle ed. (Oxford: Osprey Publishing, 2014), loc. 356.

[42] Grant, *The Lewis Gun*: loc. 1106-20.

On the Somme, initially there was one and then two per company, with the corps planning to increase them to 12 in a battalion.[43] The Germans recognized its effectiveness and targeted its crews, resulting in heavy losses to the teams. For instance, the 22nd Battalion lost all except one of its Lewis Guns in its attack at Courcelette on 15 September.[44] This type of loss rate meant the corps could not raise the number beyond an average of eight per battalion.

After the Somme, the questionnaire responses were universal in their praise of it and its usefulness in a defensive role. The only issue was how far forward it should be in an assault without exposing the team to too much hostile fire. There was no sense that battalions employed it to provide covering fire for the advance—it was strictly a defensive weapon used to repel German counterattacks. On the Somme, only one battalion (29th) used it once offensively, and it was successful.[45]

There were three factors why the Canadians did not use it in the attack—organization, control, and tactics. On the Somme, the basic manoeuvre unit was the company that commanded the Lewis Guns. It was difficult for the company commander to employ them offensively because they had too many sub-units to control. They commanded six to ten elements—far too many. The commander had four platoons but also possibly two Lewis Gun sections, two sections of bombers, and one or more Colt machine gun sections.[46] Additionally, they had to lead them on a front of 200 to 400 metres and depth of 100, so it was difficult to exert any personal control. Even with today's communications and command technologies, the effective span of command in modern armies for professional officers is a maximum of four to five subordinate units.[47] Somme company commanders had too many responsibilities. As the campaign continued with its 74% loss rate among battalion officers in an attack, the experience level of company commanders plummeted, thereby further increasing the

[43] 2nd Brigade War Diary, 17 August 1916, RG9 III-D-3 v4871, LAC; 2nd Canadian Division G.930, 25 August 1916, 46/1, RG9 III-C-3 v4114, LAC.
[44] Stewart, *Neglected Campaign*, p. 126.
[45] 29th Battalion Report on Operations, 26 September 1916, 56/18, RG9 III-D-1 v4694, LAC.
[46] On the Somme, each Canadian battalion in the 1st to 3rd Divisions still retained four to eight of these machine guns. Canadian Corps, AA&QMG War Diary, 2 July, 24 October 1916, RG9 III-D-3 v4819, LAC.
[47] Richard Bryson, "The Once and Future Army," in Brian Bond, (ed.), *Look to Your Front: Studies in the First World War* (Staplehurst: Spellmount, 1999), p. 52.

difficulty of control.[48] In the Canadian Corps, majors were to command companies but, by the end of the campaign, lieutenants led most of them owing to the crippling casualty rate. For instance, the 49th Battalion attacked on 8 October with lieutenants leading all four companies, as all its majors were *hors de combat* or left out of battle in the rear.[49] The result was companies did not fight as coordinated formations but isolated elements whose battles happened to coincide in time and place.

Tactically, Canadians attacked using linear wave formations with no opportunity for fire and movement approaches. Pre-war British tactics emphasized, 'Concealment, cover, extension, and the respect of firepower'—'fire and movement' tactics.[50] Experience in the war with the under-trained forces in the BEF in 1915 caused the high command to simplify infantry manoeuvres. Some senior British commanders, especially in the Reserve Army in which the Canadians served on the Somme, thought that these tactics were beyond the capabilities of their new divisions. They mandated linear approaches.[51] Units would advance in successive waves approximately 50 metres apart with ideally one man every two metres. According to the War Office's Notes for Infantry Officers of March 1916, 'The pace will be moderate, and on no account must a wild rush be allowed'.[52] The Canadian Corps' tactics were strictly linear and only later in the campaign were suppler tactics attempted.[53]

In 1917, this changed dramatically as the Canadian Corps and British army made the platoon the basic manoeuvre unit comprising a Lewis gun, bomber, rifle grenadier, and rifle section.[54] Byng, when issuing the new platoon organization, believed the new tactical principles of fire and movement embodied in the platoon organization were

[48] Stewart, *Neglected Campaign*, p. 297.
[49] 49th Battalion Report on 8 October 1916, 60/8, RG9 III-D-1 v4696, LAC.
[50] Spencer Jones, *From Boer War to World War: Tactical Reform of the British Army, 1902-1914,* (Norman: University of Oklahoma Press, 2012), p. 81.
[51] John A. English, "Perspectives on Infantry," (Masters, Royal Military College of Canada, 1981), p. 37; Handwritten Notes on Lessons from the Somme, Undated, MG30 E46 v2, Turner Fonds; LAC; M. A. Ramsay, *Command and Cohesion: The Citizen Soldier and Minor Tactics in the British Army, 1870-1918,* (Westport, Conn.: Praeger, 2002), p. 64.
[52] General Staff, War Office, *Notes for Infantry Offices on Trench Warfare*, (London: His Majesty's Stationery Office, 1916), p. 59.
[53] Paddy Griffith, *Battle Tactics of the Western Front: The British Army's Art of Attack, 1916-18,* (New Haven: Yale University Press, 1994), pp. 54-7.
[54] Canadian Corps, G.340, 27 December 1916, LAC.

critical to determining the success or failure of the next operation. Byng emphasized the importance of training with this new organization through personal contact and orders such as:

> During practice attacks by subordinate commanders, platoons should be exercising meeting and negotiating centres of resistance. This will bring out the proper use for various weapons, and the co-operation of the different sections under the respective leaders.[55]

As a result, the Lewis Gun emerged as the vital key in increasing the fighting power of the infantry. It could suppress German fire, allowing far more tactical options on the battlefield. At Vimy, units were enthusiastic about the Lewis. According to the Royal Canadian Regiment, they "proved of the utmost value and we are of the opinion that they caused more casualties to the enemy than any other infantry weapon."[56] The 7th Battalion reported that the troops "have the greatest confidence in this weapon."[57] The 85th Battalion ascribed its unsupported but improbably successful attack on Hill 145 to "Companies providing their own covering fire by Lewis Guns firing from the hip and riflemen firing on the move."[58] This increased fighting power was not the result of new devices or existing ones with greater capabilities, but better organization, control, and tactical employment.

Case Study: Grenades and Rifle Grenades

By the Somme, the British had standardized on the Mills No. 5 Mark 1 grenade after using a variety of improvised devices of dubious utility.[59] Invented in January

[55] 25th Battalion War Diary, Canadian Corps G.776, 22 March 1917, RG9 III-D-3 v4933, LAC; David Charles Gregory Campbell, "The Divisional Experience in the C.E.F.: A Social and Operational History of the 2nd Canadian Division, 1915-1918," (PhD, University of Calgary, 2003), p. 300.
[56] Royal Canadian Regiment War Diary, Summary of Operations of The Royal Canadian Regiment, 13 April 1917, RG9 III-D-3 v4911, LAC.
[57] 7th Battalion War Diary, B.M.342 Report operations, 9th./20th. April 1917, 24 April 1917, RG9 III-D-3 v4917, LAC.
[58] 85th Battalion War Diary, Appendix A, April 1917 RG9 III-D-3 v4944, LAC.
[59] Operational orders and after action reports on the Somme used bombs and grenades interchangeably to describe the Mills grenade. To minimize confusion the article uses the term grenades, but those throwing them are bombers. The term grenadier was reserved exclusively for members of the British Army's prestigious Grenadier Guards regiment. Confusingly, men using rifle grenades were rifle grenadiers.

1915, the British manufactured over 75,000,000 Mills of all patterns during the war.[60] Weighing 638 grams, the grenade's primary components consisted of a segmented body filled with ammonal or amatol, a detonator, a lever, and a safety pin. The Mills was a reliable and effective weapon, and Commonwealth armies and others used it and its derivatives until well after the Second World War. The blast radius of the Mills grenade was greater than the distance a bomber could normally throw it. This meant the bomber had to take shelter as soon as they threw it or risk injury or death.

Illustration 3: Standard Grenades

Mills No. 5 hand grenade and Mills No. 23 rifle grenade used by the Canadian Corps with rod attached. ©Jean-Louis Dubois

The standard rifle grenade was the Mills No. 23, a variant of the No. 5, although there was a plethora of earlier and less successful models also available. To fire it, the rifle grenadier screwed a rod into the base of the grenade, and slid the rod down the barrel, and inserted a blank cartridge. They pulled the grenade's safety pin and fired with the rifle resting on the ground at an angle. The rods were heavy and repeated firing put an extreme stress on the barrel, such that it could not safely shoot ordinary ammunition. Rifle grenades provided indirect fire capabilities, although not particularly accurate, to the infantry with a range of 100 to 400 metres, with its effective range 150 metres.[61]

Saunders, "A Muse of Fire," 203.

[60] Ibid., 265.

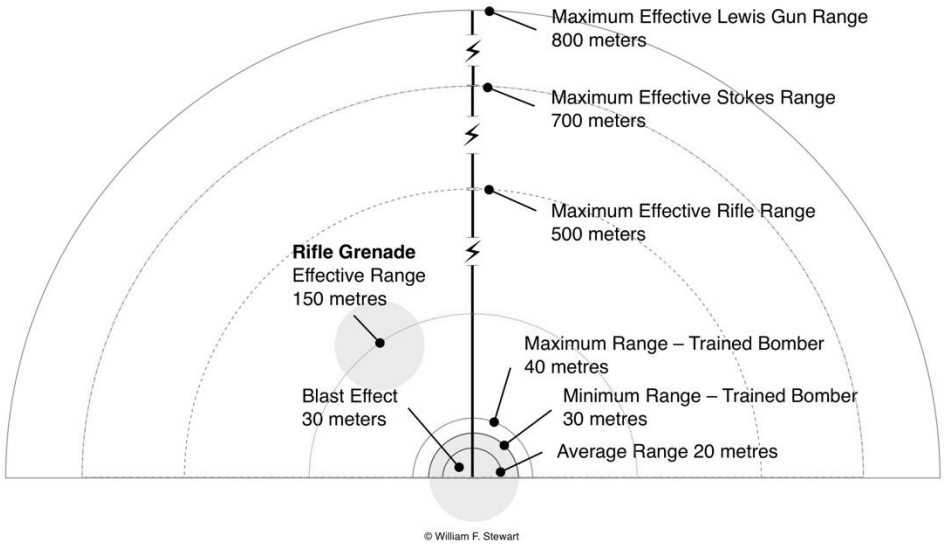
[61] Ibid., pp. 132-134.

Grenades possessed distinct advantages in the conditions of the First World War. Unlike rifle fire, which requires exposing the head and part of the torso to shoot, the bomber could remain sheltered while throwing the grenades. It was an impersonal weapon where the bomber did not have to see the enemy directly. With riflemen, only a portion would fire at an enemy because of an innate reluctance to kill that training was often unable to overcome.[62] Bombs were devastating in enclosed spaces like a trench or dugout. In trench fighting, the defender had all the advantages in a direct fire engagement where the attacker tried to advance along a trench. The defender could take cover while the attacker had to move out of cover to attack the defender. Bombs removed this advantage and equalized the situation, making it indispensable for trench fighting. It, also, took less time to develop rudimentary skills at bombing than accurate rifle fire. In 1917, Canadian training in England, called musketry, scheduled 153 hours for its instruction versus 12 for bombing.[63] Grenades had the merit of working in almost any condition—vital in situations where mud and water were ubiquitous, such as on the Somme in October and November 1916. Rifles, Lewis Guns, and pistols were likely to jam when the conditions were at their worst, while grenades continued to function.

Grenades also had significant disadvantages that allied with the organization of bombers contributed to a less effective infantry force on the Somme. Bombs had a limited range with the average soldier able to toss it fifteen to twenty meters while an experienced bomber could extend the range to thirty to forty meters.[64]

[62] Joanna Bourke, *An Intimate History of Killing: Face-to-Face Killing in Twentieth-Century Warfare,* (New York: Basic Books, 1999), pp. 60-63.
[63] Training in Canadian Reserve Battalions, Revised Edition, 1 October 1917, T-25-36 v1, RG9 III-B-1 v3111, LAC.
[64] Saunders, "A Muse of Fire," p. 200.

Illustration 4: Range Comparison



The nominal range of the SMLE rifle was around 500 metres although snipers were effective up to 1,000. Even with the lamentable training standards of the replacements on the Somme, the riflemen could far outrange the bomber in their ability to bring fire on the enemy. Additionally, bombing exhausted men faster than shooting. This was an important consideration when attackers had to cross long distances, encumbered with over 27 kilograms of gear and clothing and double that more in muddy conditions.

All these disadvantages contributed to a tendency for bombing attacks to degenerate into grenade duels where both sides blindly threw them from shelter bringing the advance to a standstill. The British 1916 bombing manual *SS 398* observed:

> experience has shown that no great or rapid progress can be made by bombing and an assault across the open after adequate preparation will usually be quicker and in the long run less costly operation than bombing attacks on a large scale.[65]

Bombers were to be of a cool and calm disposition, physically tough, and agile which meant even more troops siphoned away from the companies. With picked men required for Lewis Gun and Colt Machine Gun teams, snipers, signallers, and

[65] *The Training and Employment of Bombers - SS398*, (General Staff at GHQ, 1916), p. 20.

scouts/runners, battalions concentrated the majority of their best personnel in the specialist units to the detriment of the quality of personnel in the infantry. Moreover, these all trained separately from the line troops.[66]

In a typical Canadian attack on the Somme, each soldier carried 170 to 220 rounds per man, along with two Mills grenades.[67] At a sustained rate of fire of five rounds per minute, the average infantrymen could fire for 34 or 44 minutes before running out of ammunition.[68] Whereas, a soldier could easily expend the two Mills grenades in under a minute. The limit of two grenades per soldier was a function of its limited range and weight as each bomb weighed the same as 22 rounds, hence the logistical problem of supplying sufficient grenades in offensive situations.

The bombs first issued to the army in 1914 and 1915 were dangerous as much to the bomber as the target. They required considerable training and practice to reduce the risk of misfires and premature explosions. As a result, the high command pulled the bombers out of the line infantry and concentrated them in company, battalion, and brigade bombing units. This made sense given the delicate and potentially lethal aspects of the contraptions in use. The introduction of the Mills grenade eliminated most of the requirement for extensive instruction in multiple types, and it was a more reliable, stable, and uncomplicated device. However, the authorities did not disband these specialist units so that, by the Somme, each battalion had its own bombing platoon and many companies had bombing sections. The result was issues for command and control.

After the Somme, the respondents universally praised the Mills grenade. Nevertheless, there was an over dependence on bombing to the detriment of the infantry's ability to fight on its own. Grenade fighting was slow and required a ready supply of them. In an attack, the German defenders were more easily resupplied than were the attacking Canadians.[69] While the grenade was over-used, responses from the questionnaire indicated 84% of the respondent formations either did not employ rifle grenades or did not comment on them. Only 16% claimed to have utilized them, and, in

[66] See for instance, 13th Battalion War Diary, 18-25 August 1916, RG9 III-D-3 v4922, LAC.
[67] *SS398*, p. 52.
[68] Pre-war British Regular infantry trained to fire 15 aimed rounds a minute, so given the fall in training standards a rate of 5 rounds per minute is reasonable.
[69] Stewart, *Neglected Campaign,* p. 219.

most cases, it was in isolated situations. Half of the 4th Division's responses did report using them. This suggests the 4th Division's pre-Somme training and service in the British II Corps led to a different appreciation of the weapon.[70] One battalion commander pointed out the rifle grenade rods were heavy to carry, and the soldiers 'lost' them as soon as an advance started.[71] Further, the severe losses on the Somme quickly depleted the trained rifle grenadiers and there was no time to train new men.[72] There were also complaints that Mills No. 23 was too cumbersome to use in offensive operations.[73] Overall, there was little understanding of the potential power of the rifle grenade in providing indirect fire support.

The solution was to re-integrate the bombers and rifle grenadiers into the infantry and make them into sections of the integrated platoon. It also meant more attention paid to training rifle grenadiers to address the problem of its inherent inaccuracy. Byng recognized the key to effective use of rifle grenades was accuracy that required constant practice in preparation for Vimy.[74] Grenades still had an important role to play in 1917, but it was a situational weapon and not a universal one such as on the Somme.

Use of rifle grenades at Vimy was dependent on the situation with units like the 5th Battalion calling it the most "effective weapon" in silencing enemy machine guns.[75] This was a notion endorsed by the 6th Brigade and 42nd Battalions.[76] While the 7th Battalion did not use them owing to the speed of its advance.[77] A resupply mission by the 42nd Battalion on 9 April demonstrated the significant change in the use of hand versus rifle grenades between the Somme and Vimy. The 42nd's adjutant sent up two and

[70] The 4th Division arrived on the Somme in mid-October and only briefly served in the Canadian Corps there. Ibid., p. 14.
[71] PPCLI Response, 20 November 1916, 4/1, RG9 III-C-3 v4153, LAC.
[72] 4th CMR Lessons Learned, Undated [November 1916], 4/1, RG9 III-C-3 v4153, LAC.
[73] For instance, 2nd Division Lessons from Somme, 25th November 1916, 20/5, RG9 III-C-3 v4089, LAC.
[74] 25th Bn. W.D., Canadian Corps G.776, 22 March 1917, LAC.
[75] 5th Battalion War Diary, Appendix, April 1917, RG9 III-D-3 v4916, LAC.
[76] 6th Brigade War Diary, Narrative of Offensive Operations on 9th and 10th April 1917, RG9 III-D-3 v4889, LAC; 42nd Battalion War Diary, 9 April 1917, LAC.
[77] 7th Battalion War Diary, B.M.342 Report operations, 9th./20th. April 1917, 24 April 1917, LAC.

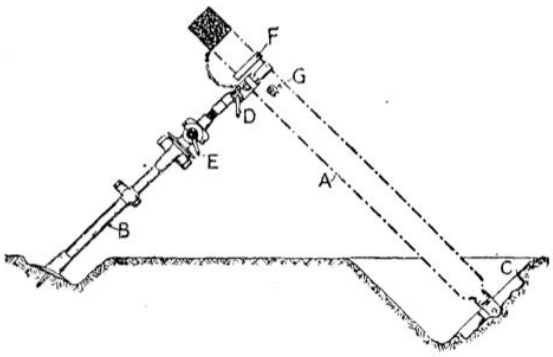
half times more rifle grenades than hand grenades.[78] On the Somme, battalions used or required few if any rifle grenades.

Case Study: Stokes Mortar

The previous two case studies highlighted how the Canadian Corps addressed the problems identified on the Somme. This study will show how it did not solve the issues with the 3" Stokes mortar.[79] Resembling a stovepipe with a heavy base and legs, together weighing 51.2 kilograms, it was mobile, but barely so.[80] It had a range of 700 metres, with a sustained rate of fire of 6-8 rounds per minute and a crash rate of 25. It was an effective weapon with its 4-kilogram round having an explosive filling greater than an 18-pounder shell, and virtually every combatant used a variant through the Second World War. For all its promise, it did not deliver during the war.

Illustration 5: Stokes Mortar

STOKES TRENCH MORTAR FITTED WITH MARK II STAND.



A—Barrel. B—Tubular Supporting Legs.
C—Base Plate, Mark I. D—Traversing Gear.
E—Elevating Gear. F—Stop Collar.
G—Stop Bolt.

Handbook of the M.L. Stokes 3-Inch Trench Mortar Equipments, Land Service, 1919.

[78] 42nd Battalion War Diary, 9 April 1917, LAC.
[79] By 1917, the BEF fielded three trench mortars, the 3" Stokes, the 6" Newton, and the 9.45" heavy nicknamed the "Flying Pig." The latter two were manned by the artillery and are outside the scope of this study.
[80] Saunders, "A Muse of Fire," p. 245.

Each infantry brigade had an eight-tube battery commanded by a captain. Each crew comprised an NCO and four other ranks.[81] The battery consisted of personnel seconded from the brigade's battalions, with them sloughing off their less inspired troops to the battery.[82] The infantry did not love the Stokes. In trench warfare conditions, its fire triggered a violent riposte after the Stokes' crew had left the scene leaving them to face the German fury. The 1919 semi-official report of the OMFC stated that one task of the battery commander was dealing with the infantry's disdain.[83] There was no dedicated supply column so the mortar crews had to carry forward their own ammunition. Further with only around 50 personnel, the battery had to manage the same administrative tasks as a battalion with 1,000 soldiers. It had no communications resources of its own and had to rely on the kindness of other units' signals. As a result, it was the brigade's stepchild.

Anthony Saunders in his thesis on British trench warfare munitions makes the claim British mortars, especially the Stokes and the 6" Newton, "were superior to German mortars in every respect."[84] They were in all their technical aspects, but informed observers then and now note the greater effectiveness of German trench mortars in offensive operations.[85] It was also used extensively for defensive purposes and as an anti-tank weapon. This speaks to the importance of examining more than just the weapons' specifications. By 1917, each German battalion had four "light" *minenwerfers* (it weighed almost twice that of the Stokes) unlike the British allotment of the equivalent of two per battalion.[86] This later changed to forming a mix regimental company of three medium and nine light *minenwerfers* to increase uniformity of training and application.[87] A horse or the crew could tow the light *minenwerfer* mounted on a low

[81] *Light Trench Mortar, War Establishments Part VII, General, 1916*, (His Majesty's Stationary Office, 1916).
[82] Trench Mortars, 101, RG24 v1862, LAC; Trench Mortar, O-1-83, RG9 III-B-1 v972, LAC.
[83] *Report of the Ministry, Overseas Military Forces of Canada, 1918,* (London: Printed by authority of the Ministry, Overseas Military Forces of Canada, 1919), p. 238.
[84] Saunders, "A Muse of Fire," p. 160.
[85] Shelford Bidwell and Dominick Graham, *Fire-Power: British Army Weapons and Theories of War, 1904-1945,* (London: Allen and Unwin, 1982), pp. 123-4; Griffith, *Battle Tactics,* p. 116.
[86] Cron, *Imperial German Army*, p. 163.
[87] W. Balck, *Development of Tactics--World War,* (Fort Leavenworth, Kansas,: General Service Schools Press, 1922), p. 324; David Stone, *The Kaiser's Army: The German Army in World War One,* (Bloomsbury Press: London, 2015), pp. 242-3.

wagon. Despite this greater mobility, German documents referred to the problems of keeping up with the infantry in the rapid advances during the battle.[88]

On the Somme, brigades usually assigned two trench mortars to each assault battalion, which they left at their headquarters for defensive purposes.[89] With battalion headquarters typically well behind the line, they could not fire on the enemy positions. The mortars seldom participated in the advance and when they did often, the result was frustration. For instance, on the abortive attack on 8 October on Regina Trench, the commander of the 49th Battalion ordered a mortar to fire at a German strongpoint. It did so with such little effect it solicited the complaint that the crews and mortars were always 'in one place, the gun in another, and the ammunition elsewhere'.[90]

Despite the promise of the weapon, only 13% of the corps' post-Somme questionnaire respondents reported using it.[91] They regarded it as an excellent defensive device, but three flaws prevented its offensive use. The respondents identified these as issues with its tactical mobility, personnel/organization, and logistics. In the heavy mud conditions of the Somme, it was too slow and cumbersome to keep up in an advance and difficult to find solid ground to fire it.[92] The 49th Battalion's response explained that the trench mortars would never be efficient until:

> made a separate service and unit, and securing a proper proportion of good officers and men direct from the base. Good personnel in the Stokes Guns would get over the problem of transport and ammunition supply.[93]

The 4th CMR strongly suggested that the trench mortars become part of the battalion to address the problems of organization, supply, and personnel.[94]

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[88] Notes on Recent Fighting No. 14, 7 June 1918, O-3-30, RG9 III-B-1 v2279, LAC.
[89] 6th Brigade OO No, 116, 14 September 1916, MG30 E5 v4, Bovey Fonds; LAC; 2nd Brigade War Diary, Report of 2nd Canadian Infantry Brigade Action of 26th & 27th September 1916, LAC; 1st Brigade War Diary, 1st Brigade OO 94, 7 October 1916, RG9 III-D-3 v4867, LAC.
[90] 49th Report, LAC.
[91] 75% reported not using and another 12% provided no response.
[92] For instance see, Reply to G.10-320, 20 November 1916, 11/3, RG9 III-C-3 v4026, LAC; 10th Brigade Report on Your G-52-1, ? December 1916, 44/1, RG9 III-C-1 v3843, LAC; 5th Battalion Response, 20 November 1916, 19/8, RG9 III-C-3 v4051, LAC.
[93] 49th Battalion Reference Corps G.428, 12 November 1916, 4/1, RG9 III-C-3 v4089, LAC.
[94] 4th CMR Lessons Learned, Undated [November 1916], LAC.

In offensive operations, by far the biggest complaint was logistics. With its high rate of fire, a crew of five, each carrying up to four rounds, would expend their ammunition in three minutes at the sustained rate of fire. There was no dedicated supply column, as in the artillery, so the mortar depended on the efforts of an already overtaxed crew hauling its heavy components. Some units thought it had potential if the problem of ammunition supply was resolved.[95] Others dismissed its value as telling off infantry to move rounds in an attack was not worth the effort.[96] On the Somme, battalions often went into battle severely under-strength. For instance, the 5th Brigade attacked with a trench strength of 1,134 men on 1 October and the 3rd Division went into battle on 8 October with battalions of 400 to 500 men.[97] Hence, battalion commanders were loath to lose more bayonets to hauling Stokes mortar ammunition. This was not universal, as a few units, such as the 5th CMR, 4th Brigade, and 6th Brigade, gained firepower by assigning up to ten men per gun to carry rounds.[98]

At Vimy, some battalions employed the Stokes more often than on the Somme. This highlights the sometimes pernicious effects of command autonomy. Units differed in the extent to which they used it and whether they supplemented its crews with additional carriers. The 4th Division made limited use of it with only the 12th Brigade employing four in the initial attack.[99] Four brigades (1st, 2nd, 6th, and 7th Brigades) assigned additional personnel to the Stokes crews ranging from 2 to 25 more, while the other eight did not.[100] Overall, while a higher percentage of formations used the Stokes, the corps had not addressed the basic problems identified on the Somme. Again in the aftermath, battalion commanders gave mixed views of its value. The commander of the

[95] See for instance, 2nd Division Lessons from Somme, 25th November 1916, LAC; 7th Canadian Infantry Brigade BMS 1042, 22 November 1916, 4/1, RG9 III-C-3 v4153, LAC.
[96] Lessons Learned from Operations on the Somme. 2nd CMR, 14 Nov 1916, 9/6, RG9 III-C-3 v4162, LAC; 10th Brigade Report on Your G-52-1, ? December 1916, LAC.
[97] 5th Brigade, B.M. 357, 30 September 1916, MG30 E46 v2, Turner Fonds; LAC; Stewart, *Neglected Campaign,* p. 203.
[98] 5th CMR Lessons Learned, 20 November 1916], 4/1, RG9 III-C-3 v4153, LAC; 6th Brigade, Lessons to Be Derived from Operations on the Somme, 23 November 1916, 20/5, RG9 III-C-3 v4089, LAC; 4th Canadian Infantry Brigade Response, Undated [November 1916], 20/5, RG9 III-C-3 v4089, LAC.
[99] 12th Brigade War Diary, 12 Brigade OO No.60, 3 April 1917, RG9 III-D-3 v4907, LAC.
[100] The 2nd CIB attached 25 men to each of the four Stokes crews advancing with the infantry. 2nd Brigade War Diary, Report of 2 Brigade, Action of April 9th 1917, LAC.

3rd Battalion complained "I saw little evidence of their use," and they "were practically useless to me throughout the operation."[101]

The Stokes mortar was an instance where the Canadians never solved the fundamental organizational, mobility, and personnel problems with the weapon. Even into 1918, there were still calls within the Canadian Corps to break up the Stokes mortar battery and assign them to the infantry battalions.[102] The complaints were similar to previous ones it could not move without assistance, was too small to be administered, could not be supplied in open warfare, and lacked proper signals resources.[103] Attempts by the corps to solicit further ideas on improving its portability and ammunition supply all foundered on a shortage of horses and refusal to change the basic organization.[104] Attempts to make the artillery's 6" Newton mortar during the Hundred Days were panned as not worth the effort, as they were too slow, immobile, and lacked the necessary range.[105] While a superb weapon with a long future ahead of it, the Stokes was an excellent example where poor deployment decisions limited its technical superiority.

Importance of Infantry Weapons at Vimy

At Vimy, other than at Hill 145, the guns pulverized the German front lines and shattered the defenders.[106] The infantry had little trouble in capturing those positions. Later in the day when the artillery had less of an effect and the initial shock of the offensive had worn off the new organization and tactics paid off. Then, the ability to assault strongpoints with an integrated weapon system resulted in greater success than

[101] 3rd Battalion War Diary, "C" Observations, April 1917, RG9 III-D-3 v4914, LAC.
[102] 2nd Brigade War Diary, Notes on Commanding Officer's Conference Held at the Bde HQ, 8 July 1918, RG9 III-D-3 v4873, LAC.
[103] For instance, see 2nd Brigade S.C. 364, 21 May 1918, 32/10, RG9 III-C-3 v4056, LAC; 4th Division War Diary, 4th Canadian Division Narrative of Operations, Battle of Amiens, August 8th to August 13th, 1918, RG9 III-D-3 v4861, LAC; 3rd Brigade War Diary, Narrative of Events - 26th August - 3rd September 1918, RG9 III-D-3 v4878, LAC.
[104] Canadian Corps, G.692/1-17, 21 June 1918, LAC.
[105] See for instance, 1st Division Artillery War Diary, 1st Division artillery Report on Operations 28 August to 4th September, ? September 1918, RG9 III-D-3 v4959, LAC.
[106] Geoffrey Hayes et al., *Vimy Ridge: A Canadian Reassessment*, (Waterloo, Ont.: Wilfrid Laurier University Press, 2007), pp. 176-7.

on the Somme. There were many examples of courageous soldiers taking on a strongpoint with just bombs, bullets, and bayonets, but a combination of the platoons' infantry weapons overcame most of them. As Tim Cook described:

> the Canadian advance had been irresistible. Infantry platoons, firing on and pinning the enemy down, and then destroying strong points from the flanks, allowed the Canadians to punch deep into the defenders' lines.[107]

The Canadians did not attempt this tactic on the Somme.[108] Following Vimy, three of the four division commanders enthusiastically endorsed the platoon organization with only the commander of the 3rd Division asserting the battle was not a thorough test.[109] Overall, the new approach to infantry weapons was a critical element in the increased effectiveness of the Canadian Corps in offensive operations.

The new organization and tactics were not a universal panacea, however. Battalions still suffered heavy casualties with units losing fifty percent or more of the attackers, albeit gaining their objectives. Where the artillery bombardment and barrage failed, such as on the Hill 145 sector, defenders would stop the Canadian attacks and inflict staggering losses.[110] The 87th Battalion lost 60% of its men committed to the assault on Hill 145.[111] Even during the Hundred Days, the 4th Division again, could not advance against a strong enemy machine gun defence without artillery support in the later stages of its attack on the Drocourt-Quéant line on 2 September 1918. Masses of machine guns in depth stopped cold all attempts at fire and manoeuvre.[112] This when the Germans' morale was far weaker and the Canadian training and tactics more advanced.

The paper has demonstrated the importance of infantry weapons in offensive operations in a war where artillery had a hegemonic role. It also analyzed how

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[107] Tim Cook, *Shock Troops: Canadians Fighting the Great War, 1917-1918,* (Toronto: Viking Canada, 2008), p. 127.
[108] Stewart, *Neglected Campaign,* p. 286.
[109] Kenneth Radley, "First Canadian Division, C.E.F., 1914-1918: Ducimus (We Lead)," (PhD, Carleton University, 2000), p. 187.
[110] Hayes et al., *Vimy Ridge: A Canadian Reassessment*, pp. 218-9.
[111] Geoffrey Jackson, "The British Empire on the Western Front: A Transnational Study of the 62nd West Riding Division and the Canadian 4th Division," (PhD, University of Calgary, 2013), p. 142.
[112] See for instance, 4th Division War Diary, 4th Canadian Division Report on Operations Scarpe, Sept. 2nd - 4th, 1918, LAC.

relatively obscure decisions by the army in the deployment and employment of new weapons had outsized consequences on its effectiveness in the field. In two of the cases, the Canadian Corps addressed the issues with deployment and employment highlighted in the Somme campaign by Vimy. Revising these decisions enabled unlocking that potential with no substantial changes to the weapons themselves.

The corps and the BEF did not solve the challenges with the Stokes mortar. Despite its technical excellence, the Stokes did not fulfill its promise owing to the ongoing issues of mobility, staffing, and supply. It was a prime example of the significance of analyzing all the aspects of a weapon and not just its feeds and speeds. These matters are less engaging and difficult to uncover in the archival record but should carry equal weight in the historical analysis. It is only through a thorough understanding of the weapon in all its dimensions that historians can provide an accurate appraisal of it. As Brigadier-General Ross Hayter pleaded after the Drocourt-Quéant operation, "It cannot be too strongly urged that steps be taken immediately to provide transport for 3" Stokes Mortars."[113] This was an example of when the 'whole product' was not delivered and it affected the weapon's battlefield performance.

[113] 10th Brigade War Diary, 10th CIB Narrative of Operations Battle of Arras, 14 September 1918, RG9 III-D-3 v4903, LAC.