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The Development of Artillery During the War

By General McNaughton.*

I have come here to-day to talk to you about artillery, and in particular about the development of artillery material and organization which has taken place during the War; I intend to indicate broadly the principles governing its employment and to illustrate these by examples drawn from the actions fought by the Canadian Corps in France and Belgium.

If I have little to say about the Infantry and other arms you will, I hope, appreciate that it is not because I attach an undue importance to the role played by the Artillery. No one realizes better than the gunners themselves that they are an auxiliary arm and that their task is to assist the Infantry. In the last analysis it is the Infantry advance and their determination to apply the cold steel that alone captures ground and wins battles.

The fire power in the hands of the Infantry themselves, by reason of the modern magazine rifle and machine gun, renders direct assault impracticable for the Infantry alone; while the vast numbers of troops placed in the field in modern war results in there being no flanks round which to manoeuvre.

Those conditions, together with the increased power of resistance conferred on the defender by reason of field entrenchments and wire entanglements, soon brought the war in Europe into a stable condition, where the opposing armies faced one another along continuous lines from Switzerland to the English Channel.

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Each attempt to break the deadlock and obtain power of manoeuvre resulted in prohibitive casualties to the attacker.

The obvious solution of the difficulty lay in a preponderance of artillery sufficient to crush out of existence a wide section of the enemy's defensive system, entrenchments and defenders alike; thus creating a gap through which troops could be thrown to work round the exposed flanks.

The establishments of artillery based on pre-war requirements were far from adequate to permit of the accomplishment of that result, and all belligerents set to work to remedy the defect.

In the British Field Army we had to begin with the following natures of armament:

	Calibre	Weight of Shell	Range	
			Yards	Miles
	Inches	Lbs.		
Horse Artillery.....	3	13	5,500	3
Field Artillery.....	3.3	18	6,500	3.5
Field Howitzer.....	4.5	35	7,200	4
Heavy Artillery	5	60	10,000	5.5
Siege Artillery	6	100/120	6,000	3.5

The allotment of artillery per division worked out at about fifty-four field guns and four sixty-pounders; and I believe that I am correct in saying that the whole Siege Train capable of taking the field consisted of some three or four batteries of six inch howitzers and an Armoured Train equipped with antiquated six inch guns.

The total numbers of guns of all natures with the British Expeditionary Force in the fall of 1914 was 484.

Some idea of the growth of the artillery may be realized from the fact that at the time of the Armistice the British guns in batteries on the Western Front numbered 6,437.

On numerous occasions the Canadian Corps has been supported by over 750 guns and howitzers, while in the last organized fighting in which we took part—the attack on Mount Houy and the capture of Valenciennes on November 1st, 1918—the advance of one Infantry Brigade alone (the 10th) was supported by 248 guns and howitzers.

Not only did the number of our guns increase; but the range and shell power were increased also, as is shown in the following table:

IMPROVEMENT OF EXISTING PIECES.

Type	Range		
	1914*	1918	Future
18-Pdr.	6,500	9,500	....
60-Pdr.	10,000	15,000	....
6" How.	6,000	9,500	12,000

NEW WEAPONS INTRODUCED.

Type	Weight of Shell	Range		Remarks
		Yards	Miles	
	Lbs.			
8" How.	200	12,000	7	Travelling Carriage
9.2 "	290	13,000	7.5	Pedestal Mounting
12" "	750	14,000	8	Pedestal & Railway
15" "	1,400	10,500	6	Pedestal (obsolete)
6" gun	100	19,000	11	Travelling Carriage
9.2 "	380	23,000	13	Railway
12" "	850	30,000	17	"
14" "	1,586	34,000	20	"
18" How.	2,500	?	?	"
? gun	....	....	75/100	"
8" "	....	40/50,000	....	"

Remarkable as these improvements were, the German gun designers had an initial lead which we were never able to make up; and at the end of the War their weapons still outranged us on the average, gun for gun, by nearly thirty per cent.

COMPARISONS OF SOME GERMAN AND BRITISH GUNS.

German		British		Remarks
Type	Range	Type	Range	
10 cm. How.	11,000	4.5 How.	7,200	Medium Howitzers of both armies approximately same.
15 cm. gun	25,000	6" gun	19,000	
35.5 cm.	68,000	14" gun	34,000	
77 mm.	11,700	18 pdr.	9,500	
15 cm. How.	9,600	6" How.	9,500	Advantage with British.
21 cm. How.	11,000	8" How.	12,000	

At the beginning, while our heaviest piece in the field was the six inch, the Germans had the seventeen inch; and those who were in front of Ypres in April 1915 will remember what it feels like to be shot at by every calibre up to and including

the seventeen inch with nothing to reply with, except a few field guns,—and how exasperating it was to have German batteries come into action in full view and not be able to reach them, while their shells were exploding in and around one's own battery position.

Then, too, in the matter of ammunition the Germans had the lead. While we were under limitations of three rounds per gun per day for our field pieces, he appeared to have plenty of reserve stocks—and he certainly used them.

I am afraid that in the early days the artillery situation was not such as to inspire confidence in the minds of our infantry, Picture to yourself the case of an infantry officer pointing out to a gunner the location of a nest of German machine guns which are worrying the men in the line. The gunner admits it is a good target and he would like to engage it, but—"No ammunition." The retort of the infantryman is likely to be, "What are you doing in the Great War anyway?" and the result, if the gunner is a bit touchy, is to permanently damage liaison.

As the war went on, we got more and more ammunition, but we suffered considerably from lack of standardization. In the early summer of 1915 we had four different types of field-gun shrapnel in our limbers at the same time, with a variation of range of anything up to 400 yards. In 1916, in the 4.5 howitzers, we had three types of propellant in use simultaneously—Cordite, Ballistite and N.C.T.—all with different temperature and moisture coefficients, and all giving results varying in a most obscure way with the wear of the howitzer. Charges originally shipped in lots of similar manufacture got mixed up on the Lines of Communication. Shell varied in weight; driving-bands were of many varieties.

The battery officers have, in any event, to make corrections for:

Temperature of air and charge
Barometer
Velocity and direction of wind
Wear of gun
Type of fuse

and when the already difficult task is further complicated by lack of standardization in propellant, driving-band, and shell; the task of exact shooting is rendered almost impossible. In 1918, the lack of standardization had become one of the serious limiting factors in the tactical employment of artillery.

I mention those facts for the benefit of those who, in the event of another war, will be responsible for the manufacture of munitions; and in the hope that, in that event, due attention will be given to the necessity for thorough standardization.

As the number of guns available began to increase, the existing artillery units had to be expanded and new ones raised. Technical skill had to be developed and previous lessons and teachings modified to suit the changed conditions. The Field and Horse gunners, accustomed to fighting under circumstances which enabled them to observe every round, had to cease from scoffing at corrections for temperature, barometer, etc.; and the Heavy Artillery, used to the utmost deliberation, had to learn speed, accuracy of fire on unseen targets, and to acquire the ability to shoot close over the heads of our own infantry. In addition, an organization had to be built up which could effectively handle large masses of artillery.

At the Somme, in 1916, we had any quantity of guns and ammunition; but many of our battery officers and higher commanders were inexperienced; our artillery Intelligence organization was in its infancy; the methods of co-operation between aircraft and the artillery command were rudimentary. Although, as Ludendorf admits, we did considerable harm to the Germans, the results indicated that *there was not that happy combination in the employment of the artillery in support of the other arms which leads to easy success in battle.* The lessons were invaluable, but the cost in life was terrific. It was largely because the British General Staff read those lessons correctly and had the courage of their convictions to effect the necessary reorganization that later we were able to beat the Germans, despite the fact that in the technical matters of guns and ammunition they still maintained their lead.

Put shortly, the situation in 1917 and onward was, that the Germans had the advantage in quality of artillery material; we, in quantity, organization, and tactical employment.

General Byng, the Commander of the Canadian Corps, was one of the first to grasp the significance of the lessons of the Somme; and, with Major-General Sir Edward Morrison, set about perfecting our artillery organization. That attitude was maintained when Sir Arthur Currie succeeded General Byng in the command.

I feel safe in saying that by 1917 the organization of the Canadian Corps Artillery had reached an advanced state, and that our lead over similar organizations was maintained to the end of the war. The credit for that is largely due to our Corps Commander; who, in developing his policy of giving his

infantry the maximum of support, was invariably sympathetic in his attitude towards the Canadian gunners and gave us the necessary means and encouragement to surmount the difficulties which from time to time faced us.

I said a moment ago that one of the great advantages we had over the German was in organization. This will be realized from the fact that his artillery was invariably organized and fought on a Divisional Front; and as a consequence he experienced great difficulty in bringing to bear, at any given time and place, an adequate volume of fire. So, too, his artillery Intelligence was collected and co-ordinated on a Divisional Front, and he experienced difficulty in passing his information to adjacent formations; and while his Intelligence Service undoubtedly acquired a mass of valuable data, there did not appear to be a suitable chain of artillery command through which its value could be fully exploited.

During battle, we, on the other hand, organized and fought as a Corps, with the result that the whole force of our Artillery within range was immediately available to support any sector of our front; and the whole of our Intelligence System was centred on those who had the means at their disposal to take immediate and effective action.

Artillery Intelligence is required: first, for immediate action; and secondly, for compilation, study, and deduction with a view to subsequent action.

In the time at our disposal to-day I can only briefly refer to the principal sources of Artillery Intelligence, which are:—

Aeroplane observation
Photographs
Survey Sections
Sound-ranging groups
Ground observers
Officers' patrols
Répatries
Prisoners
Espionage
Balloons

In order to make the Intelligence derived from these sources immediately available to the Artillery, very elaborate communications are required. In fact, the whole system was only possible because our Canadian Signal Service was so thoroughly efficient.

In handling Artillery in the field, the first consideration is that its fire must do the utmost possible to assist our Infantry

to get forward. Exact Intelligence and a careful study of the enemy's dispositions enables the Artillery Commander to form his plan with that end in view. He must foresee just which factors of the enemy's defence organization are dangerous, and when. Hostile artillery, machine-guns, trenches, wire, mortars, enemy reserves, etc.,—all must be given attention at the proper time. Wherever Intelligence is indefinite, inaccuracy must be made up by volume of fire.

In practice, the various conditions are met about as follows:

Initially, and during the advance, the whole of the Field Artillery and a part of the Heavy are on barrage work, carrying out a plan issued by the G.O.C., R.A., of the Corps, and co-ordinated with flanking Corps by the Army. The inner fringe of the barrage is laid in front of the Infantry, and throughout the attack goes forward according to the pre-arranged plan. It usually consists of 18-pdr. shrapnel fired directly over the heads of our troops, and in some of our operations has reached a density of one 18-pdr. per nine yards of front, firing four rounds per minute. You will appreciate the accuracy demanded from our Field Batteries when you realize that they are called on to burst their shell so that the mean point of impact of their shrapnel bullets shall be 200 yards in front of our advancing Infantry, the range being anything from 1,500 to 4,500, or more, yards.

The 4.5 field howitzers, firing High Explosive shells, are employed on machine-gun nests, strong points, etc., and fire on points in rear of the 18-pdrs. targets. The six inch howitzers operate on similar targets still further in rear.

The idea of the barrage is to tie the enemy to the ground, to inflict casualties, and to demoralize him and prevent his using his rifles, machine-guns, trench mortars, etc.; and to screen the advance of our infantry by a wall of bursting shell, smoke, and dust.

The Heavy Artillery, not scheduled for the barrage, works directly under the Intelligence Centre at the Heavy Artillery Headquarters and is engaged in dealing with the enemy's artillery, exploiting targets of opportunity, harassing the enemy's line of retreat, his reserve troops, his railheads where reinforcements may be arriving, his aerodromes, etc.

As the attack progresses, and the end of the pre-arranged barrages are reached, a portion of the Field Artillery reverts temporarily to the control of the Divisions and moves forward

to work directly with the attacking Infantry. The remainder goes into Reserve. The Heavy Artillery which has been employed in the barrage moves forward to be in position to deal with the enemy's artillery as soon as it again comes into action. The Artillery on counter-battery work initially becomes available as a reserve of fire-power to be turned on any threatened sector as required.

You will realize that the whole method of employment of Artillery has been in continuous development and we have had a succession of limiting factors to contend with. At Vimy, in April 1917, for instance; it was Observation of Fire, and Intelligence; at Hill 70, in August of the same year, Life of Guns; at Paschendael, in November, wear and tear on artillery personnel; at Amiens, in August 1918, available positions for deployment; and, during the later phases of the advance, transportation of ammunition from railhead to the guns. Throughout, as our Artillery Intelligence system was perfected, the need for increased accuracy was felt.

The policy of our Corps Commander was invariably to give his Infantry the maximum possible of Artillery support, and never to employ men where shells would do the work. The motto of the Canadian Artillery has been to shoot the "ultimate round," and how well our gunners achieved this task may be seen from the figures of ammunition expenditure for some of our major operations.

	Days	Field Guns	H'vy	Total	Thou. of R'nds	Tons	Tons Day
Paschendael	30	360	220	580	1,453	40,908	1,370
Amiens	16	408	236	644	409	....	....
Monchy	6	504	270	774	300	....	....
Drocourt-Queant	27	528	234	762	786	....	....
Bourlon	12	522	262	784	1,067	....	....
Cambrai	23	334	262	596	519	....	....
Valenciennes to Mons	12	312	174	486	215	....	....
Amiens to Mons	100	....	....	....	3,296	73,100	731

As an illustration of the effect of ammunition expenditure in reducing casualties and increasing results (without, in any way, wishing to draw unkind comparisons with our neighbors on the south) I quote the figures of the Argonne-Meuse offensive in contrast to the last hundred days fighting of the Canadian Corps:

	American	Canadian	Remarks
Maximum number of guns	3,928	784	2417 American, remainder French Artillery.
Divisions	22	4	
Troops — Divisional and Corps	650,000	105,000	
Guns per 1000 troops	6.1	7.5	
Duration of operations	47 days	100 days	Canadian includes marching.
Ammunition Expenditure (rounds)	4,214,000	3,296,000	American figures include French Artillery.
Ammunition Expenditure per day	90,000	32,960	
Ammunition Expenditure per day per 1000 troops	138	313	Ratio: Canadian 2.3, American 1.
Ammunition Expenditure per gun (max.) per day	23	42	Ratio: Canadian 1.8, American 1.
Battle casualties	100,000	45,830	
Prisoners	16,000	31,537	
Guns captured	468	623	
Machine guns captured	2,864	2,842	
Trench mortars captured	177	336	
Territory freed (square miles)	610	500	
Villages freed	150	228	
German divisions met and defeated	46	47	American Forces 22 divisions and 4 French divisions. Canadians partially engaged 21 other German divisions.
Casualties per German division defeated	2,170	975	French casualties not included. Ratio: American 2.2, Canadian 1.
Maximum advance	34 miles	86 miles	Canadian does not include marching Arras to Amiens and back.
Average daily rate	.72 miles	.86 miles	

Both Canadian and American Forces used about the same proportion of guns to Infantry; but the ammunition expenditure per 1,000 Infantry per day was about two and one-half times as great in the Canadian as in the American. This expenditure was more than justified, as the Canadians had less than half the American casualties per German Division defeated.

I may say that this enormous ammunition expenditure by the Canadian Corps and the satisfactory results achieved were only possible because our leaders arranged their plans of attack in such a way that the maximum Artillery support could be developed in the intimate assistance of our assaulting Infantry.

From an Artillery point of view, one of the most interesting operations of the Canadian Corps was the attack carried out on the morning of November 1st, 1918, by the 10th Infantry Brigade against Mount Houy, the key to Valenciennes. The 10th Brigade advanced with its left flank on the Canal De L'Escaut, and its right covered by the advance of the XXII Corps. On a front of about 2,000 yards, the depth of penetration was some 4,000 yards; taking 190 minutes, including pauses. As the initial forming-up line was on a slight salient, the direction of the advance was practically parallel to our own front.

The attack was supported by eight Brigades of Field Artillery and six Brigades of Heavy Artillery; or roughly, 144 18-pdrs., 48 4.5 howitzers and 104 heavy guns and howitzers. Some eighty machine-guns were also employed.

The ammunition expenditure was as follows:

Field	56,200 rds.	620 tons
Heavy	31,500 rds.	1,520 tons
Total	87,700 rds.	2,140 tons

That is approximately one ton per yard of Front, or one and one-half tons per Infantry soldier employed. That was the most intense barrage ever employed in support of any of the operations of the Canadian Corps. All objectives were taken on time.

Enemy killed	800	Our killed	60
Wounded prisoners ...	75	Our wounded	380
Unwounded prisoners .	1,379	Our missing	61
	2,254		501

I have gone rather at length into the capture of Valenciennes because I regard that operation as a type of what we would have tried to do in the Campaign of 1919 should we have had to fight.

As a further illustration by which the comparative expenditure may be judged: at Waterloo, in 1815, the expenditure was 9,000 rounds, having a total weight of 37 tons. Compare that with the average daily expenditure of the Canadian Corps at Paschendael; 48,500 rounds, weighing 1,370 tons. In the South African War, the expenditure was 273,000 rounds, weighing 2,800 tons—not much in excess of our Valenciennes operation, or equal to about two average days of the Paschendael fighting.

I have been talking about the Artillery generally, and many British Batteries, Field, Heavy and Siege—and some South African—have helped us from time to time. But I wish to add a special word about our own Canadian gunners. The Canadians took naturally to gunnery; our Battery Commanders, Section Officers, N.C.O's and gunners, developed extraordinary skill, efficiency, and dependability. If, in support of our Infantry, there was ever a particularly difficult or dangerous task to be performed, a Canadian Battery was called on to do it.

On only two occasions were any of our guns in German hands. The first was at Ypres, in 1915, when the London 4.7 battery, an English Battery attached to us, was over-run, due to the Germans breaking through on our left. The second was at Sanctuary Wood in 1916, when two of our forward guns were taken. On each occasion the guns were recovered in the subsequent fighting. I mention that, not in praise of our Artillery, but as a tribute to the work of the Infantry, and as reason for the confidence our gunners had when Canadian Infantry were in front of them.

Now, in conclusion I wish to emphasize that the employment of the Artillery in the Field was not perfected by any of the belligerents in a day. At the beginning, neither side knew much about it. In the war of the future it will not do to be unprepared. The country which goes into the field with its Artillery in shape and ready to use from the very beginning, will surely win. Let us hope that in the organization of our Canadian Militia Forces the technical knowledge which our men have gained will be kept alive, and that the lessons and experience purchased in this war at the expense of so much blood and vast treasure will not be lost to us in a time of greater need.