

Policies and Tactics:
Effectiveness and Tactics of Gas Warfare by the British in the Great War

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Abstract:

This paper observes the effectiveness of poisonous gas used by the British Army from 1915 to 1917. This paper discusses the types of gas used, both lethal and non-lethal, and the deployment methods for the gas. This paper also talks about the evolution of technology used to deploy the gas during this time period. This paper also looks specifically at the battles of Loos and Arras, and at the number of casualties suffered as a result of the use of poisonous gas.

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Introduction

The assassination of Archduke Franz Ferdinand, heir to the Austro-Hungarian Empire, on June 28, 1914, gave the Austrians reason to take hostile action toward Serbia. In order to turn the war to their favor, the Austro-Hungarian government sought, and was granted, the support of Germany.¹ On July 19, the Austro-Hungarian government drew up an ultimatum for Serbia, calling for a condemnation of further anti-Austrian propaganda and support of terrorists' activities. The Austrians also called for the participation of Austrian officials in the Serbian judicial process of those discovered circulating anti-Austrian propaganda.² However, on the evening of July 23, the Austro-Hungarians delivered their ultimatum to Serbia, demanding an answer to the ultimatum within 48 hours.³

On July 25, Serbia began to mobilize its military, while at the same time they were sending a reply to Austro-Hungary, stating that the Serbs would comply with Austrian demands. However, they wanted the demand of the Austrians to participate in the judicial process to be submitted to the mediation of the International Tribunal at The Hague. The Austro-Hungarians were not pleased with the Serbian reply, and on July 28, 1914, they declared war on Serbia. In a matter of a week, the five European Empires (France, Germany, Great Britain, Russia, and Austro-Hungary) were at war with each other. On August 1, Germany declared war on Russia. Because of a protection treaty

¹Martin Gilbert, *The First World War: A Complete History*. (New York: Henry Holt and Company, 1994), 18

² Gilbert, 21

³ John Keegan, *The First World War*, (New York: Alfred A. Knopf, 1999), 56

signed between Russia and France, Germany also declared war on France on August 3⁴. The only empire left to join was Great Britain, which entered into the fighting when Germany invaded neutral Belgium, which was under the protection of the 1839 Treaty of London, on August 4.⁵ This was the beginning of the Great War that pitted the Allies (Great Britain supported by dominion troops from Canada, France, Russia and Italy, which joined in April 1915) versus the Central Powers (Germany, Bulgaria, Austria-Hungary and the Ottoman Empire).

The War on the Western Front

When Germany invaded Belgium on August 4, the Germans first hit the fortified town of Liège, which they took in a matter of days. The Belgian army was eventually forced north to Antwerp where they could consolidate their forces and gain the protection of a series of fortresses surrounding the city. The British attempted to halt the German advance through Belgium and into France at Mons on August 23-24. The British Expeditionary Force (BEF) only numbered four divisions compared to Germany's six divisions.⁶ The British, though they were outnumbered, inflicted heavy casualties on the German forces.⁷ Despite the apparent victory, the BEF received orders to retreat, bringing both the French and British forces to the outskirts of Paris.⁸ The British forces,

⁴ *Ibid*, 68-69

⁵ Gilbert, 33

⁶ Keegan, 98

⁷ *Ibid*, 99

⁸ *Ibid*, 100

in late August 1914, formed a barrier between Paris and the German army at the river Marne.⁹

During the Battle of the Marne, which lasted from September 6-10, the French and the British combined forces to press the German armies, under the direction of General Moltke, to withdraw to the area near the River Aisne. To solidify the German lines along the river, Moltke ordered his forces to dig trenches in order to make their line defensible. It was this order that initiated trench warfare and the stagnation of the lines. At this point in the conflict, General Moltke was dismissed from command and replaced with Prussian war minister, Erich von Falkenhayn. The Allies and the Germans, in their attempts to out-manuever each other and gain the advantage, headed north to Flanders.¹⁰ With every attempt by the Germans to circumnavigate the French forces, the French sent in new forces, further solidifying the lines into trench warfare. As German forces worked their way north in their 'race to the sea', they eventually met with the remainder of the Belgian forces and the British Expeditionary Force at the Belgian town of Ypres.¹¹ The battle that ensued on October 18, 1914, called the First Battle of Ypres, caused 250,000 casualties between the Germans, French, and the British and no breakthrough.

The Second Battle of Ypres

In late 1914, the Germans, looking for an effective way to break the stalemate along the Western Front, turned to the use of chemical weapons. Despite having authorization from German Chief of General Staff, General Erich von Falkenhayn, who

⁹ Gilbert, 70

¹⁰ Keegan, 122-123

¹¹ *Ibid*, 127

had command of the troops along the Western Front, many of the German army commanders refused to use poisonous gas weapons in their battle plans.¹² Most of the commanders feared that the use of poisonous weapons would break the international agreements set by the Hague Conventions of 1899 and 1907, which forbade the use of projectiles filled with asphyxiating gas.¹³ If the commanders broke the agreements, they feared the Allies would seek retribution on the German army with a comparable Allied attack. Only the commander of the Fourth German Army, Duke Albrecht of Wurttemberg, who faced the allied salient, a projection of forces into the enemy-held territory around Ypres, was willing to use gas. The Supreme German Command saw the use of gas as 'unchivalrous,' yet they were optimistic that new gas weapons could give them a great victory, starting with the capture of Ypres.¹⁴

The Germans began to install a large number of cylinders filled with 150 tons of chlorine gas along 4.5 miles of the Ypres salient on April 5, 1915.¹⁵ Once the infantry completed the installation of nearly 6,000 cylinders and the weather was favorable, the German special gas infantry released the 150 tons of gas onto the Canadian and French lines, beginning the Second Battle of Ypres. The French Algerian infantry were the first to encounter the chlorine gas cloud. The Canadians, alarmed at what happened, and waiting for a proper German attack, manned their firing step and began shooting into the cloud to prevent the Germans from taking the trench.¹⁶ The men in the trenches were unprepared for a chemical assault, and many of the British and Canadian forces were

¹² L.F. Haber, *The Poisonous Cloud: Chemical Warfare in the First World War*, (Oxford: Clarendon Press, 1986), 28

¹³ Daniel Patrick Jones, "The Role of Chemists in Research on War Gases in the United States During World War I," Ph.D. diss., University of Wisconsin, 1969, 48

¹⁴ . Haber, 28

¹⁵ *Ibid*, 31

¹⁶ *Ibid*

ordered to urinate on a handkerchief and hold it against their mouths', in order to provide some protection against the gas.¹⁷

The German use of gas brought a return of mobility to the lines which had not existed since the start of the war. The German commanders were astonished that the gas was so effective. However, most of the German infantry themselves were not supplied with proper protection from gas.¹⁸ The Germans also failed to allot for reserve infantry to carry on the offensive. These problems of improper planning prevented the Germans from filling a two-mile gap left in the Allied line by the retreating French forces. Instead the British infantry were able to fill the gap.¹⁹ The use of gas by the Germans further enforced the Allied notion that the Germans were uncivilized and pressed the British to respond in kind for fear of losing the technological edge and the morale of their infantry.²⁰ Some British officers felt that gas would bring about a new evolution in warfare by becoming an additional standard for the British army.²¹ However, the majority of British generals failed to take into account the drawbacks of the primitive deployment methods of gas weapons and the difficulties imposed on their use by wind and ground conditions. This paper will discuss two battles in which the British use of gas played a major role in determining the outcome of the battles, the Battle of Loos and the Battle of Arras. This paper will also address the evolution in offensive gas technology and the changes in policies for using gas that occurred prior each of these battles.

¹⁷ Max Arthur, ed., *Forgotten Voices of the Great War*, (London: Ebury Press, 2003), 79

¹⁸ Haber, 32

¹⁹ Albert Palazzo, *Seeking Victory on the Western Front: The British Army and Chemical Warfare in World War I*, (Lincoln: University of Nebraska Press, 2000), 41

²⁰ Palazzo, 44

²¹ W.R. Robertson to [Von Donop], 26 May 1915, General headquarters: British Army in the Field, Liddell Hart Centre for Military Archives, London, 1

Preparations for Retaliation

In the chaotic days after the Second Battle of Ypres, the British Secretary of State for War, Lord Kitchener, along with others in the War Office, began to organize and design plans for retaliation. The first step in this process was to create a new branch of the military, which would become known as the British Special Companies. This group was to conduct offensive gas operations and instruct the infantry in anti-gas protection.²² Major Charles Foulkes (Royal Engineer) was chosen by the War Office and General French, Commander of the BEF, to be the commanding officer of the new group.

In choosing Foulkes, they relied primarily on his previous experience and distinguished service in the British army, starting with the Boer War in 1899. The fact that Foulkes had no previous knowledge of chemicals and their properties did not concern those in the War Office or General French.²³ Foulkes, in order to compensate for his lack of knowledge and understanding of gas warfare, attended chemical experiments and interviewed chemical experts in Paris and London. After gaining some understanding of chemical warfare, he began pushing for the use of chlorine gas cylinders which would spray the gas across a field through a parapet pipe weighing 160 pounds each, as the only way to employ gas.²⁴ Foulkes determined that he would need around 640 men to carry out any gas operation using the gas-filled cylinders.

Long before Foulkes started making demands for manpower, the War Office asked the universities to make lists of those students most suitable for the new British

²²Donald Richter, *Chemical Soldiers: British gas Warfare in World War I*, (Kansas: University Press of Kansas, 1992) 17

²³*Ibid*, 18-20

²⁴Palazzo, 23

Special Companies. The army also searched the lists of those who had already enlisted in the hopes of finding men with chemical knowledge.²⁵ This initial group of university educated and enlisted men formed the Special Party which eventually expanded into the core of Special Companies. The official formation of the Special Companies occurred on June 16, 1915, when the War Office approved two companies totaling 670 men. After some brief military training the Companies were sent to France, just after the Second Battle of Ypres, to become anti-gas instructors and quell the fear of German gas use throughout the BEF.²⁶ By July of 1915 the group, along with new recruits now numbering around 400 men, was sent to Helfaut, France to receive more detailed training in chemical warfare.²⁷ From July until early September 1915, the men of the Special Brigade practiced for the planned retaliation at Helfaut against the Germans, originally scheduled for September 15, 1915. The group's training and preparation consisted of marching, revolver drill, lectures, or hands-on training with empty cylinders. The lectures provided them with information important to executing a gas cylinder operation, such as determining wind direction and velocity, chemical properties, judging distances, and protective practices.²⁸ On September 9, the War Office approved the addition of another company to the Special Brigade. This company was comprised of volunteers from the Artists' Rifles and from two regiments from the London Rifle Brigade. The longest period of training any soldier in these groups received was six weeks.²⁹ When the

²⁵ *Ibid*, 17

²⁶ Haber, 47-48

²⁷ Richter, 17; 28

²⁸ *Ibid*, 33

²⁹ Major-General C.H. Foulkes, "*Gas!*" *The Story of the Special Brigade*, (Edinburgh: Blackwood, 1934; Reprint, East Sussex: Naval and Military Press, 2001), 62

men finished their training on September 4, 1915, they were transported to the British lines surrounding Loos.

Battle of Loos: September 25, 1915

The Battle of Loos was a joint French and British offensive designed by Joseph Joffre, the French Commander-and-Chief, in July 1915. The attack was to be a two prong offensive that would overwhelm the German forces, causing confusion for the Germans in regards to where to place their reserves.³⁰ The British were hesitant to commit to the battle because they were concerned about Germany's strong and well organized defenses. German artillery held higher ground, allowing them to watch and fire at the British infantry as they advanced across "no man's land."³¹ General Sir Douglas Haig, the second in command of the BEF, was more concerned about having enough equipment and material to carry out such a large operation. Already, it was planned that gas should be used to help supplement the shortage of artillery shells and ammunition. The use of gas in a supportive role went against the knowledge gained by the British at the Second Battle of Ypres. During this time, gas warfare had been used to instill panic in the enemy infantry, and to create an opportunity for the British to advance.³²

By the beginning of September, Haig had changed his mind and gave support for the Loos offensive. As the date for the initiation of the offensive drew near, intelligence

³⁰ Palazzo, 54

³¹ Gen. Sir Hubert Gough, *The Fifth Army*,. (London: Hodder and Stoughton, 1931), 96

³² Palazzo, 59

reports changed, claiming that the Germans no longer had large reserves.³³ On September 18, the general headquarters (GHQ) laid out the general objectives of the battle: to break the German front, to prevent the German forces from reestablishing their line, and to defeat the divided German forces. They also wanted the gas to reach the German reserves, making them weak and easy to defeat. In order for this to happen, gas released from cylinders in the British front line needed the wind to carry it through a number of entrenched German lines.

After watching a number of gas practice operations the summer before, many of the generals, especially Haig, had great confidence in the effectiveness of gas.³⁴ As the day of the battle approached, however, problems began to appear. One was a shortage of chlorine gas cylinders. Haig requested 7,000 gas cylinders from the Ministry of Munitions, but by the start of the battle only 5,000 had been received. Of these, 2,566 had arrived just before the start of the battle.³⁵ Once all the cylinders had been unloaded from their transports, the men began the arduous task of emplacing the 5,000 cylinders, each weighing 160 pounds, into a parapet at a depth of four feet at intervals of 25 yards [Appendix B, Figure 1; 2].³⁶ In all, 400 emplacements were set, each containing 11-13 cylinders. The task of hauling and installing the cylinders was performed by 400 men from the Special Brigade and an additional 4,000 men from the front line.³⁷

³³ Sir Archibald Montgomery-Massingberd, to IV Corps Headquarters, October 13, 1915. Liddell Hart Centre for Military Archives, London, 1

³⁴ *Ibid*, 61

³⁵ O.C. 187 co. R.E. to C.E. IV Corps, (n.d.), Liddell Hart Centre for Military Archives, London, 2

³⁶ *Ibid*, 3

³⁷ *Ibid*, 2

The Special Companies

On September 24, as the gas cylinders were being put in place, Foulkes and Haig watched the weather reports. The Special Companies placed 40 officers throughout the attack area who were ordered to report the wind velocity and direction to Foulkes and the chief meteorologist, Ernest Gold. In addition, the commanders also received reports from weather stations in England, Spain, and France.³⁸ Throughout September 24, the wind and weather were unfavorable for gas operations, but the chief meteorologist had hoped that a low front from Spain would cause the wind to shift slightly, making conditions more favorable.³⁹ By 9 pm, the conditions had improved enough to permit Haig to send a message at 9:45 pm approving the use of gas. On September 25, the time to release the gas cylinders, or zero hour, was communicated to the members of the Special Brigade between 3 and 4 am.⁴⁰

When day began to break on September 25, the wind once again began to shift and become unfavorable, especially toward the north near La Bassée Canal. With all the cylinders in place, and questions about the wind direction beginning to form, a stray German mortar shell fell on one of the cylinder emplacements. The cylinder ruptured, soaking the trench with liquid chlorine.⁴¹ Despite their concerns about wind direction, the BEF commanders decided to commence the general use of gas. At zero hour, 5:50am, the Special Companies opened the cylinders all along the seven-mile front.⁴²

³⁸ Palazzo, 67

³⁹ Haber, 56

⁴⁰ Lt. Gen. Sir Henry Rawlinson, Telephone Conversation, September 25 1915, Liddell Hart Centre for Military Archives, London, 1

⁴¹ *Ibid*

⁴² Richter, 61

Once the battle started, problems with the cylinders began to develop. The muddy and cramped environment of the trenches, along with the drop in temperature caused by the release of pressurized chlorine, hindered the release of gas upon the German trenches. After the men of the Special Companies had emptied one cylinder, they had to remove the parapet pipe and rejoin it to the next cylinder. This action allowed mud from the trench to get into the screw heads of the pipes, preventing a tight connection.⁴³ The loose connection allowed gas to leak into the trench. Furthermore, when the cylinders were changed, the pipes released what was left of the gas from the previous cylinder back into the trench. The constant cold that the pipes and connecting equipment were exposed to made some pipes burst and nuts warp, which made it difficult to connect the cylinders and filled the British trench with even more gas.⁴⁴

General Haig was optimistic that the Battle of Loos could be a success with the use of gas despite a lack of heavy artillery, ammunition, and men. The offensive bombardment of Loos from the British front began on September 21 and lasted until an hour before the gas assault. The artillery was to prepare for the assault on the German front line by destroying the barbed wire that was placed throughout the German line. The British, however, had no artillery capable of reaching the second German line and were depending on the gas to reach this goal, as well as to help neutralize the Germans remaining in the first and reserve lines.⁴⁵ The orders given to the men were intricate and stretched the men to their limits. (Fig. 1; 2).

⁴³ O.C. 187 co. R.E. to C.E. IV Corps, (n.d.), Liddell Hart Centre for Military Archives, London.

⁴⁴ *Ibid*, 69

⁴⁵ Gough, 105

Sir Hubert Gough's I Corps Battle of Loos Objectives (September 25, 1915)		
Units		Objectives
7th and 9th Divisions		Punch a hole into the North end of German lines Capture German second line from North Hulluch, St Elie and Haisnes Continue onto Haute Deule Canal
2nd Division		Capture enough ground to protect the northern flank but not to advance past the 7th and 9th Divisions

(Figure 1) ⁴⁶

General Sir Henry Rawlinson's IV Corps, Battle of Loos Objectives (September 25, 1915)		
Unit		Objectives
1st and 15th Division		Capture the German second line of trenches Advance to the outskirts of Loos
15th Division		Take Loos Take Hill 70 Take Cité St. Auguste
1st Division		Take Bois Hugo Take Southern Hulluch Move south to take Puits 13
47th Division		Form a defensive flank southwards, covering 1st and 15th Divisions Take the Double Cassier and Enclosure south of Loos Take the German Second line

(Figure 2) ⁴⁷

⁴⁶ *Ibid*, 104

⁴⁷ Lt. Gen. Sir Henry Rawlinson, Operational Order No. 35, 20 September 1915, Liddell Hart Centre for Military Archives, London, 3

Gas, the “Boomerang Ally”

Gas had a variety of effects on the two major corps. The 1st Corps was commanded by General Sir Hubert Gough and IV Corps was commanded by Sir Henry Rawlinson. In some instances, gas use benefited the outcome of the battle, yet in other cases it provided disastrous effects. In this section, I will first discuss how gas affected the 2nd and 1st Divisions and then I will discuss how the 7th and 47th Divisions were hindered in obtaining their objectives. The wind around the 2nd Division was blowing SSW at a light but varying strength.⁴⁸ The gas released by the British Special Companies traveled toward the northeast, blowing back into the small salient, and collecting in British trenches near La Bassée Canal causing the 2nd Division's southernmost brigade, the 5th, to be engulfed in gas.⁴⁹ The density of gas in the British trench was thick and those wearing protective 'P' anti-gas helmets which only provided protection for low concentrations of chlorine gas became casualties.

Once the call was given to the infantry to leave the trenches and advance, the remainder of the 2nd Division, those who had not been affected by the gas, entered into no man's land. Two or three northern battalions were stopped and driven back by German infantry and machine gun fire before they could reach the first German trench. The remaining brigade advanced all the way to the German second line, but they too eventually retreated to their starting positions. Observing the pinned down men, General Gough ordered the two virtually wiped out brigades to hold the line with as few men as possible, while the strongest remaining battalion was to move south into position behind

⁴⁸ Richter, 67

⁴⁹ *Ibid*, 71

7th Division near Vermelles to attack the next day.⁵⁰ With the 2nd Division out of action, the remaining two divisions of I Corps, the 7th and 9th, would have to continue the battle without any assistance or protection along their northern flank. For the I Corps, the common problem, aside from the gas, was that the limited number of artillery shells had little effect on the German barbed wire.

The 1st Division of IV Corps on the southern flank had similar problems as gas released from the south followed the wind and gas collected in their trenches. The winds along the front occupied by the IV Corps' 47th and the 15th Divisions, south of I Corps lines, were described by Rawlinson as "light but fairly favorable."⁵¹ However, the winds were still blowing too strongly from the south, causing the gas to float into the salient of the 1st Division.⁵² The southernmost brigade of 1st Division, the 2nd, was most affected by the gas, reporting that nearly 2,000 men were incapacitated by gas blowing back into their trenches.⁵³

The advance of I Division was delayed to allow the gas to drift away from their location. By 6:34 a.m. the 2nd Brigade started its advance, but was further held up at the first German line just south of Lone Tree because the German defenses had not been affected by the gas or by the four-day-long bombardment.⁵⁴ With 2nd Brigade stuck at the first German line at Lone Tree, and the 15th Division pressing south onto Bois Hugo, General Rawlinson feared that a gap in the line would form. A division of the line did occur at 9:30 a.m., causing Rawlinson to request the reserve forces of XI Corps and 3rd

⁵⁰ Gough, 111

⁵¹ Montgomery-Massingberd, Sir Archibald. "War Diary for, September 1-30, 1915. (typescript), 22-25 September, Liddell Hart Centre for Military Archives, London, 3

⁵² Rawlinson, Lt. Gen. Sir Henry. Telephone Conversation, September 25 1915. Liddell Hart Centre for Military Archives, London, 3

⁵³ *Ibid*

⁵⁴ Palazzo, 69

Calvary.⁵⁵ But his request was not honored; instead, command of XI Corps was given to Haig's First Army. It was not until 1 p.m., long after the reserve unit could have helped stop the gap from forming, that XI Corps was tasked to Rawlinson.⁵⁶

The 1st Brigade, north of 2nd Brigade, pressed through the gas cloud, protected by their 'P' helmets, and emerged from the cloud only to be caught by machine gun fire from the German trench.⁵⁷ By 3:10 p.m. the 1st Brigade was able to break through the second German line and attack the outskirts of Hulluch. The zone of barbed wire stopped many men approaching inner Hulluch, but a few were able to temporarily enter the village before they were forced back into their lines the next day.⁵⁸ For both 2nd and 1st Division fronts, gas quickly proved to cause chaos in battle, which further complicated the engagement. Because of shifting wind conditions, gas was able to inflict a high number of casualties in the brigades of 2nd and 1st Divisions, which prevented them from advancing and attaining their objectives. In a telephone conversation, Rawlinson noted the poor performance of the gas when he said that the "Germans [had] suffered more from artillery than gas."⁵⁹ Within an hour of this conversation, at 4:30 p.m., Rawlinson received reports that ammunition for 15-pounder field guns was running out.⁶⁰

⁵⁵ Rawlinson, Lt. Gen. Sir Henry. Telephone Conversation, September 25 1915. Liddell Hart Centre for Military Archives, London, 3

⁵⁶ *Ibid*, 4

⁵⁷ Palazzo, 70

⁵⁸ Rawlinson, Lt. Gen. Sir Henry. Telephone Conversation September 25 1915. Liddell Hart Centre for Military Archives, London, 5

⁵⁹ *Ibid*, 4

⁶⁰ *Ibid*, 6

In Conclusion of the Battle

The effects of gas at the Battle of Loos, coupled with the rush to retaliate against the Germans, prevented the Special Brigade from being given adequate training or access to sufficient number of quality gas cylinders. Better cylinders would have prevented gas from leaking into the trench because of faulty valves and joints.⁶¹ Gas cloud attacks also relied too heavily on wind, making them extremely difficult to coordinate with an infantry attack. The use of gas in unfavorable wind conditions prevented the majority of the 2nd Division from participating offensively in the battle of Loos. This stopped the 2nd Division from forming a defensive flank for the other divisions in I Corps. In the south, the wind blew gas into the salient of the 1st Division, forcing them to wait while the cloud moved past. This slowed the men of the 1st Division from keeping keep up with the 15th Division, causing a gap to form between the two divisions early in the battle. In order for a safe and successful gas attack, the British military needed a perfect wind, something impossible to guarantee no matter how much time was spent planning their attack. The British commanders also needed to use gas clouds along a smaller front where the variables of the wind would have played a smaller effect on the effectiveness of gas. The British commanders needed to use gas clouds less like artillery and more as a weapon to strike fear into the enemy. If the British would have used a larger scale artillery bombardment of the enemy area with a limited gas attack, it is possible that the battle could have been a success. Major General Foulkes, commander of the Special Companies saw the battle as a great success because he believed the Germans were

⁶¹ O.C. 187 co. R.E. to C.E. IV Corps, (n.d.), Liddell Hart Centre for Military Archives, London, 3

caught by surprise. Other commanders saw use of gas at the Battle of Loos as more of a problem than a solution to the stalemate and war of attrition. Many of the commanders in the field also did not like Foulkes reassigning their men to participate in the dangerous and laborious tasks of hauling gas cylinders to the front. These opinions forced Foulkes to appeal to the public to gather more support for further employment of gas.

Adaptations and Advances

The time between the end of the Battle of Loos and the start of the Battle of Arras in April 1917, significant developments British chemical warfare occurred. The British moved away from anti-gas helmets to a more modern type of respirator, providing better protection against higher concentrations of gas than before. The British also developed and employed many additional types of gases and projectiles. Men in the Special Companies and the BEF underwent more specialized training in the employment of and protection from gas.

Shortly after the Battle of Loos, Foulkes, under the advice of Howard Livens, an officer in the Special Companies, gave permission for the metal cylinder piping to be replaced with a rubber hose along with a four-way connection, fixing both the leaking problem of the metal pipes and the problem of gas leaks that occurred while changing a cylinder.⁶² In January 1915, Foulkes was granted with an expansion of the Special Companies, gaining 21 companies, bringing Special Companies up to brigade strength.

⁶²Brig-Gen. C.H. Foulkes, [Unknown report] Dated: December 19, 1918. Liddell Hart Centre for Military Archive, London., 3

This increase in manpower gave Foulkes more flexibility in how to employ gas. Now, he was able to use gas cylinders and also the Stokes 4” trench mortar, and in spring 1917, the Livens Projector. Outside the realm of the Special Brigade, the British were able to develop gas shells for use by the Royal Artillery.

As the use of cylinders continued, it became increasingly difficult for Foulkes to assemble a carrying party, even if he if he was on good terms with the senior officer of a sector. This forced him in February 1917 to conduct a publicity campaign promoting the use of gas among the army commanders. The rallying process involved a number of steps. The first was to demonstrate that gas cylinders used in a trench did not create danger for its occupants. Foulkes conducted a number of lectures that showed the low number of occurrences that gas cylinders awaiting dispersal had been hit by artillery and mortar shells. He also compared this occurrence to the number of casualties and deaths caused by enemy fire striking a cylinder. In the summer of 1917, Foulkes helped create a series of articles called the “Monthly Summary of Gas Intelligence,” which consisted of extracts from interrogations of captured Germans who had been gassed.⁶³ For the British, these accounts made the effect of gas by the British appear more deadly than reality. This skewing was probably compounded by the German desire for the British to maintain their pursuit of gas.⁶⁴ In spring 1917, because army commanders still viewed the use of gas cylinders with distain, Foulkes was forced to change from the large 160 pound cylinders to a smaller 50 pound cylinder. These new cylinders were designed to be carried be carried in a sling by one person.⁶⁵ The concept was sound, but these new

⁶³Major-General C.H. Foulkes, *“Gas!” The Story of the Special Brigade*, (Edinburgh: Blackwood, 1934; Reprint, East Sussex: Naval and Military Press, 2001), 184

⁶⁴ Haber, 248

⁶⁵Richter, 184-85

cylinders still had many flaws. They were much more portable than the heavier type of cylinder but still could not be carried through the narrow communication trenches. The smaller cylinders also did not save that much in manpower. Since the cylinder was smaller, the Specials, without the help of infantry carrying parties, would have to make more trips back and forth to have the same amount of gas available, so this method of distribution potentially took longer to assemble as well as a shorter amount of time to empty.⁶⁶

Foulkes also tried to find a new way to discharge the cylinders without causing harm to the rest of the infantry. His new method involved loading cylinders under the fire step as before, but while the gas was discharging, the infantry remained in the support trenches away from the gas, and but would return once the gas had been released. After a while, the Germans put together what was about to happen when the infantry moved to the support trenches. The Germans then used that opportunity to conduct an artillery attack on the particular British trench, bombarding the gas officers who were going to release the gas toward the German lines.⁶⁷

While gas cylinders served as the vanguard of gas employment by the Special Brigade in the first years of British gas use, they also had a few companies that used the 4'' Stokes Mortar. This device saw some action in the Battle of Loos, but its purpose there was only to fire smoke bombs that would produce a smoke screen to provide cover for the advancing British infantry. It was not until spring 1916, during the Somme offensive that the mortars were equipped with SK, a tear producing gas. Compared to most howitzer shells filled with gas, a 4-inch mortar was able to shoot a higher

⁶⁶ Haber, 180

⁶⁷ Ibid

percentage of gas for the shells weight. A mortar was able to shoot 7.5lbs of phosgene, a lung inflammatory chemical, up to ranges of 840 yards. The mortar also had a higher rate of fire compared to a howitzer, but the mortar lacked the howitzers 26,000 yard a long ability.

Livens Projector

Although gas mortars saw use throughout the war, the creation of the Livens Projector was able launch the greatest amount of gas per weight of shell than any other weapon produced during the war. The Livens Projector first saw large-scale use during the Battle of Arras in April 1917, but Captain Percy Smith of the Special Brigade initiated its concept in mid-1915. When he hypothesized he might be able to launch a regular cylinder from a mortar, but he did not develop his idea further. The idea of launching a cylinder of gas was revisited by another officer in the Specials named Captain Strange, who produced a prototype and conducted experiments with the device, eventually succeeding in launching a ten gallon oil drum. Final evolution of the projector was undertaken of Captain Howard Livens of the Special Brigade. He completed work on his version of the projector in the winter of 1916.⁶⁸

The Livens projector was a simple design, consisting of three main parts: a base plate, tube, and a projectile weighing thirty pounds. The projector was designed to be light and easy to carry through the trenches to remove the need for assembling a carrying party for a cylinder. The smooth bore tube made it inaccurate, but successful employment of the projector relied on a launch of many gas projectiles to achieve a

⁶⁸ Foulkes, Major-General C.H. "Livens Projector." October 12, 1969. Liddell Hart Centre for Military Archive, London, 29

saturation effect. Livens first used black powder To propel the cylinders but as the British and German lines grew more distant from each other he switched to a cordite charge to increase range.⁶⁹

Because of the increase in range and the ability of the device to launch a large amount of gas compared to artillery, many in the Royal Artillery started to see the use of projectors as an infringement upon their area of responsibility and attempted to prevent the projectors' use. In order to bypass the Royal Artillery, Livens used his contacts in the general staff and camouflaged the names of material needed in to carry out projector attacks.⁷⁰ The projector's ability to launch a 30 pound projectile up to 400 yards would eventually compete directly with cylinders and mortars in gas operations.⁷¹ Commanders of infantry favored the projectors over gas cylinders because projectors did not require large carrying parties of infantry and the device was less affected by wind compared to a gas cloud.⁷² Years after the war, Foulkes admittedly states that he was not aware Livens development of the projector, but he supported the weapon because "it proved to be a most effective means of making a gas attack...."⁷³

As mentioned previously, the projector was designed for easy deployment and employment. When setting up for a barrage, the men of the Special Brigade would place the projectors on the ground between the support and the reserve trenches. Placement of the projectors took place only at night in order to provide some protection from Germans machine guns as the emplacement of the projectors happened above the protection of by

⁶⁹ Haber, 181

⁷⁰ Richter, 162

⁷¹ Ibid, 165

⁷² Ibid, 166

⁷³ Major-General C.H. Foulkes, "*Gas!*" *The Story of the Special Brigade*, (Edinburgh: Blackwood, 1934; Reprint, East Sussex: Naval and Military Press, 2001),167;172

the trenches.⁷⁴ Even though this method was easier and safer than setting up and using gas cylinders, the danger of getting shot was a constant threat.

Men of the Special Brigade soon devised a new way to setup the projectors while retaining some protection. Shallow trenches were added to the existing trenches and the tube and base plates were set up close together in these shallow pits. This form of setup was rehearsed by the men of the Special Brigade until one officer and three men could ready seventeen projectors in fifty minutes. However, the practice of grouping the projectors together damaged the tubes, because when fired collectively, the percussive force would bounce the tubes against each other, cracking the casings. To counter this, a company decided to coil rope around the tube which prevented any damage to the tubes.⁷⁵ It was common for projectors set up in the standard fashion to bury themselves into the soft ground from the recoil of the weapon. The extra work of wrapping rope around the tubes did not required more effort as placing the projectors on the ground.

The inaccuracy of the Livens Projector was both beneficial and a detrimental. Projectiles fired from the Livens Projectors had difficulty landing on their detonators because they flew end over end instead of in a tight spiral. This caused the projectors to land as duds or on an occasion, to fall short of hitting the German trenches.⁷⁶ However, the unpredictable and hap hazard flight path of projectiles launched from Livens Projectors made it difficult for the German infantry to identify where the cylinders might land, enabling the British to create a constant element of surprise. Germans became fearful of gas projectors, which would upset their daily routines in the trench, forcing

⁷⁴ Haber, 183

⁷⁵ Richter, 187

⁷⁶ Foulkes, Major-General C.H. "Livens Projector." October 12, 1969. Liddell Hart Centre for Military Archive, London, 27-28; 32

them to remain constantly vigilant for possible projector attacks to prevent casualties by surprise. This greatly affected the gas discipline enforced by German officers onto their men. The Germans began to recommend that all the infantry to carry the canister filter from their gas respirators. This would allow the infantry to breathe while they retrieved their respirators. Because of the British use of Livens Projector and of gas artillery shells, The Germans also required their infantry to wear their respirators when British fired artillery shells into German lines.

Just as the Livens Projector saw final development in 1916, gas shells also began to develop. At first, shells were filled with a tear-producing gas but as the war and technology progressed the British were able to fill shells with lethal gases. Gas shells were used to a limited degree during the Battle of the Somme in July 1916. The possibility of launching gas with the aid of artillery or projectors gave gas a new dimension that permitted safer execution than the cylinders. Gas shells and projectors appeared to provide better results but even they had some limiting qualities. The use of gas was then modified to support the Royal Artillery's (RA) Objective of neutralizing the enemy, instead of following the Special Brigade's objective of killing the enemy.

Gas Shell

At a conference in April 1916, General Rawlinson, now commanding the Fourth Army, stated that artillery firing gas shells need to be used for counter-battery work and for the use against locations fortified with machine guns. As a test, Rawlinson wanted to use the tear gas chemical SK to test how well gas shells could prevent an artillery battery

from firing at the British infantry as they advanced. Rawlinson's theory was that the gas could work in two ways, either denying access to the artillery from resupply, buying the infantry time as they crossed into no man's land or impairing the accuracy of the artillery because the gunners would be forced to don their gas masks.⁷⁷ Rawlinson hoped that by protecting the advancing infantry from artillery and machine gun emplacements, the infantry could make a breakthrough as they had planned to do at the Battle of Loos. However, this use of artillery did not appear to help the British advance at the Battle of the Somme, as the RA was not in possession of enough gas shells to conduct a proper bombardment of local villages to be effective.⁷⁸

Planners of the Somme offensive saw the use of gas shells as the next big military advance. General Sir Douglas Haig began to request a supply of lethal gas shells to nullify any defensive fire, allowing infantry to breakthrough the German line.⁷⁹ The idea behind using gas instead of regular high explosive (HE) rounds was that the gas had a broader area of effect, making it easier to hit a target. Unlike cylinders, gas shells provided a large increase in range and added a degree of precision. Gas shells had one disadvantage over most other offensive gas devices, they had a very limited carrying capacity. The first gas shell was nothing more than a typical artillery shell casing filled with gas instead of HE. The thick wall of the shell casing greatly reduced the shell's capacity for carrying enough gas to be an effective weapon. In 1917, the British introduced a new, modified special artillery shell designed to carry a larger amount of gas. This shell had thinner walls, effectively doubling the capacity of the shells. The shells also had to contain a lining to prevent the corrosive chemicals from leaking

⁷⁷ Palazzo, 100

⁷⁸ Ibid, 99

⁷⁹ Richter, 130

through it. Early shells were lined with lead, but ceramic and eventually glass linings were developed.⁸⁰ The British primarily used two types of gases, lethal phosgene and chloropicrin, a tear gas, to fill their shells.⁸¹

One of the main problems with gas shells was matching the correct specific gravity of HE so the shell would be more stable in flight. The British chose phosgene and chloropicrin because they had a similar density to HE in a shell.⁸² Some space was left in the shells to allow the gas to expand. Each of the countries using gas shells used different methods to fill their shells. The French method of loading a shells with chemicals from the top was the easiest way to fill their gas shells. The British, on the other hand, loaded the gas through the side of the shell and required a device to measure the amount of gas put into the shell. The need to constantly measure and maintain safety during the process of filling a shell further complicated shell production, something many manufacturers were trying to avoid, since they had just began making enough shells to match the needs of the BEF. Even with all these modifications, shells stilled wobbled in flight. They also produced a peculiar sound as they flew through the air. The instability of the shell while it was in flight often caused it to improperly detonate, dispersing gas in the wrong area.⁸³ The tell-tail noise that the gas shell made while in flight also provided a warning to the Germans as to the type of shell it was. There were also instances in which gas shells would burst just after leaving the muzzle of an artillery piece, dispersing its contents over the British men and equipment.

⁸⁰ Haber, 64

⁸¹ *Ibid*, 86

⁸² *Ibid*, 65

⁸³ Lewis, J.W. Diary for 1917, April 1917, Special Collections, Imperial War Museum, London.,

The use of a standard field gun made it possible to bombard an area four miles away with gas, while a British howitzer was capable reaching a target ten miles away. The advantage of the field gun was that it could fire more rapidly, the popular French 75 mm field gun being able to fire between fifteen to twenty rounds a minute. The British 4.5" howitzer could only fire four rounds a minute. A small artillery piece could fire shells more rapidly but would need more shells to saturate an area. A heavier gun had to fire at least 27 rounds into a specific area to have significant effect.⁸⁴ The smallest artillery piece was a 7.7cm (3") field gun, its shells filled with three-quarters of an imperial pint of gas. The chart below shows the varied capacity of the British gas shells used during the war.

Different Shells and their Amount⁸⁵

Caliber of Artillery		Type of Artillery	Capacity	
Metric	US		Imperial Measure	US
7.7cm	3"	Field Gun	.75 pint	.5 quart
10cm	4"	heavy Field Gun	1.5 pints	1 quart
10.5cm	4.2"	Field Howitzer	2 pints	1.2 quart
15cm	5.5"	Heavy Field Howitzer	5-6 pints	3-3.5
21cm	8.5"	Howitzer	10-12 pints	6-7 quarts

⁸⁴ *Ibid*, 64

⁸⁵ Strutt, P. "Notes on Anti-Gas Course," May 1918. Special Collections, Imperial War Museum, London, 7

Special Training

During the time between the Battle of Loos and Battle of Arras, gas became an integral part of fighting in the trenches. Gas not only affected the infantry on the battlefield but also off as men were trained in gas warfare. Their training covered the advances made by the British in protective devices as well as the British offensive gas capabilities. In between these two battles, the Special Brigade also underwent some changes in their equipment and in the policies and tactics used.

In order to fix the problems encountered at the Battle of Loos, Foulkes announced to the gas officers that they were in complete control of the deployment of gas cylinders and not any of the infantry officers. Foulkes also ordered his men to modify parts of the cylinder assembly. One modification that Foulkes wanted was to cut the pipe connecting to the cylinder from ten feet to five. This change in pipe length would make it easier to handle the pipe in the trenches when the men traveled with them and when they attached them to cylinders. The second modification to the cylinder assembly came by the advisement of Howard Livens, calling for the replacement of the parapet pipe with a rubber hose. This modification also granted an ease of transport as well as prevent gas from leaking from it as the metal pipes did as the Battle of Loos.

After the Special Companies made these changes to the cylinders and allowed the gas officers absolute say in employing gas, they attempted to launch a gas cloud attack against the Hohenzellern Redoubt area on October 13, 1915. The attack was to retake the ground the British lost in the days after the Battle of Loos. Despite all of the changes made to the cylinders to prevent leaks, the trenches still filled with fumes of chlorine gas.

The trenches were crowded with infantry, further increasing the effects of the slightest amount of gas. In some locations the men were so overcrowded that they were unable to “take preventive measures.”⁸⁶ The operation was a failure, prompting Foulkes to say: “The battle of 13th October was even more disappointing in its results than that of 25th September, and once again nearly all the ground gained in the first assault was lost subsequently,....”⁸⁷

Foulkes’ mind during 1916 and 1917 was focused on finding a way to use gas to get the best result. He saw the keys for the success of gas employment to be: exhaust the mask, penetrate the mask, and surprise.⁸⁸ The principle method of offensive gas Foulkes wanted to employ was to use a large quantity of gas to make the Germans keep their respirators on for as long as possible, eventually overwhelming the German gas respirator. The only way this could be achieved, according to Foulkes, was to use a large amount of gas cylinders, “more than what could be convenient,” to create a constant stream of gas.⁸⁹ During breaks in the gas cloud, the British would also employ smoke to make it difficult for the Germans to tell when gas had stopped or was on break.

Only partial penetration of the German respirators was possible. One such chemical was chloropicrin also known as SK, this chemical was both a lethal and a tear-causing agent. Its lethal properties were similar to that of phosgene or chlorine, in that it caused an inflammation of the lung tissue. But unlike phosgene or chlorine, it was not as lethal, and required a high concentration to kill. Aside from causing the lungs to inflame, chloropicrin produced heavy coughing and vomiting, which would cause a German

⁸⁶ Richter, 96

⁸⁷ Foulkes, 89

⁸⁸ Palazzo

⁸⁹ C.H. Foulkes “Chemical warfare: Smoke in War” [n.d], 4

infantry to remove their masks. With their mask removed, the German infantrymen were susceptible to other gases. To achieve surprise the Special Brigade relied on the use of such weapons as the four inch Stokes mortar, Livens Projector, and artillery firing gas shells. Gas cloud attacks at night were known to happen from time to time in order to achieve surprise.

Infantry Training

After the Second Battle of Ypres, gas advisors gave crash courses in gas defense to the infantry. Eventually, in 1916, the BEF instituted formal training for the infantry when they created the first gas school meant to inform noncommissioned officers (NCOs) about gas and to build confidence in the respirator design. Divisional and battalion level NCOs trained for two weeks before they returned to their units to provide gas instruction to their fellow infantry. Regimental officers also received special training by gas advisors, but their training was significantly shorter than that of the NCOs. The officers training was geared toward making them more knowledgeable about gas defense, allowing them to make regular inspections of their infantry's gas equipment, and to maintain a strong gas discipline by performing gas drills.⁹⁰

The training covered many subjects, from determining the best conditions and locations for the use of gas, to the advantages and disadvantages of British respirators. According to lectures notes, the best conditions for using gas were during early summer when the air was warm and the wind was still. These conditions enabled the gas to linger in an area longer, causing more casualties. Of equal importance was knowing the areas

⁹⁰ Haber, 136

most likely to receive a gas attack, including wooded areas and dugouts. The woods made effective targets because gassed infantry could easily become disoriented and lost. Dugouts provided an area for gas to collect in dangerous concentrations for as long as an hour after a gas attack. The instructors also taught regimental officers how to correctly estimate wind speed by observing their surroundings so they would know if a gas attack was possible. The instruction men received about gas masks were more often overview of the history of the gas masks used during the war, listing the advantages and disadvantages of each style. Instructors also went through the different parts of the Small Box respirator describing the care needed to maintain their masks.⁹¹

Between 1916 and 1917, the British infantry gained more knowledge about the appropriate ways to employ gas. Their instruction also helped them become more acquainted with their respirators. The Special Brigade in early 1915 corrected the assembly problems of the gas cylinders. These corrections still were not able to fix the problem completely, which allowed gas to continue to leak into the trenches. The Special Brigade also developed the Livens Projector which made gas easier and safer to use. Foulkes used the projector and the gas cylinders to develop a policy of gas assault by using a large quantity of gas in the hopes of overwhelming the German respirator.

⁹¹ Strutt, P. "Notes on Anti-Gas Course," May 1918. Special Collections, Imperial War Museum, London, 13-20

Battle of Arras, 1917

All of the advancements made by the British in gas weaponry, education, and policies came together at the Battle of Arras on April 9, 1917. The Battle of Arras was much like the Battle of Loos, in that it was a joint offensive between the French and the British. Again the French hoped their army, under the command of General Robert Nivelle, could break through the German lines in one large attack. They then planned to cut through the German reserves, allowing both the French and British infantry to maneuver their forces and rout the German army. Sir Douglas Haig, now British commander of the BEF, was not as optimistic about the outcome of the battle. The British hoped simply to gain Vimy Ridge northeast of Arras and to eliminate the salient around Bapaune in this new offensive.

In February 1917, the German forces conducted a planned withdrawal to fortified locations further east, called the Hindenburg Line. This convinced the allied commanders that Germany was close to surrendering, so they altered their original plans for the offensive. In reality, the Germans were strengthening their defenses by creating a “flexible defense.” In a “flexible defense”, the Germans lightly held the front line and then counterattacked with great force, driving the attackers from the lines.⁹² The British decided to strike between “Arras and Vimy with the greatest possible strength with the view of penetrating [the German] defenses...”⁹³

In March, the British began their preparations for the Arras offensive by conducting a number of raids along the German lines and stockpiling equipment. On the

⁹² Tim Cook, *No Place to Run: The Canadian Corps and Gas Warfare in the First World War*, (Toronto: UBC Press, 1999), 106.

⁹³ Palazzo, 114

morning of March 1, 1917, the Canadian Corps, with the assistance of a company from Special Brigade, used gas cylinders to assist with preliminary reconnaissance of the German position on Vimy Ridge. The weather was poor but the wind was favorable enough to open up the cylinders containing White Star, a mixture of 50 percent phosgene and 50 percent chlorine. Shellfire burst several of the pipes while the discharge of gas was taking place and the trench filled with gas. The wind once again changed direction forcing the gas officers to cancel the use of more gas. The cancellation allowed the Germans to reorganize and prepare for the Canadian reconnaissance force. When the Canadians left the safety of their trench, they came under heavy fire from machine guns causing them to withdraw to home positions after suffering heavy losses.⁹⁴

By March 25, the 160 batteries of artillery, which were to go to participate in the British attack along Arras, began to receive their first allotment of shells. Each battery was furnished with 6,800 shrapnel and lyddite shells and 4,000 gas shells.⁹⁵ At the start of the battle, the First Army possessed 40,000 gas shells and the Third Army had 60,000 ready for use by the Royal Artillery.⁹⁶ Gas officers of the Special Brigade once again came to the battle unprepared. From January through February of 1917, they trained on the Livens Projector, but they used dummy projectiles of wood rather than real projectors. The real projectiles did not arrive in France until early April, days before they were to be used in the Arras offensive. While projectors were designed for ease of use,

⁹⁴ Richter, 175

⁹⁵ Lewis, J.W. Diary for 1917, April 1917, Special Collections, Imperial War Museum, London,

⁹⁶ Palazzo 124

the inexperienced Specials forgot to plan for real battlefield conditions.⁹⁷ Once the gas officers received their supply of projectiles, they went to work emplacing them.

One of the first locations the British used the Livens Projectors was between the French towns of Tilloy and Thelus. The five mile stretch between Tilloy and Thelus contained some 2,300 projectors with projectiles filled with White Star. These projectors were fired on April 4, 1917 in preparation for the Arras offensive. Also taking part in the preliminaries of the Battle of Arras was the Royal Artillery. The artillery used two different types of gas shells, one was filled with a mixture an arsenious chloride and phosgene while the other was filled with a arsenious chloride, chloroform, and hydrogen cyanide. On April 9, the last gas bombardment occurred before the infantry advance took place. The assault began at 2:30 am and lasted until 6:30 am, continuing through a snowstorm in which winds gushed up to 13 mph.⁹⁸ The infantry of Third Army were able to occupy up to the second German line but were stopped by the third German line. Despite the heavy use of gas shells and projectors, the British forces were unable to breakthrough the German line. By nightfall all the land captured by the Third Army was regained by the Germans.⁹⁹ As the preparations for the Arras offensive were being deployed, the Special Brigade was ordered to launch their Livens Projectors against Bullecourt. The Special Brigade sent two companies to arrange 320 projectors into firing position facing Bullecourt.¹⁰⁰ The men had a difficult time assembling and transporting the projectors because of poor ground conditions, but the shoot was viewed as a

⁹⁷ Richter, 180

⁹⁸ Montgomery-Massingberd, Sir Archibald. War Diary for April 1-30, 1917, Liddell Hart Centre for Military Archives, London, 4

⁹⁹ Albert Palazzo,, 115

¹⁰⁰ Donald Richter, 179-180

mechanical success. Even though the operation of the projectors went perfectly, the men were still repulsed because the projectors had little effect on the German infantry.

At the same time as the result of the assaults along the entire British front the Canadians conducted an assault on Vimy Ridge. Initially the Special Brigade installed 600 projectors in support of the Canadian advance. However, none of these projectors saw use because the weather conditions made it impossible launch them. Instead of gaining support from gas the Canadians used regular HE artillery to weaken the German forces on the ridge. The Canadian Corps captured and retained most of the ridge on April 9th. The remainder of the ridge they were able to take the next day.¹⁰¹ The Canadians, because of their previous bad experience of with the use of gas in March, used only regular artillery shells. High explosive artillery shells again proved more effective at inflicting casualties than the use of gas. Yet the British pursued gas despite its drawbacks and complications.

In conclusion, the British first used poison gas as a retaliatory agent against Germany's use of the gas in the Second Battle of Ypres. Later they attempted to use gas in the hopes of breaking German lines, returning to a war of movement. The British tried to break through the German lines at the Battle of Loos they failed miserably. The British forces were too quickly assembled and too poorly trained and equipped to act as a functional, efficient combatants. These factors, along with poor decisions and misguided orders from General Haig, maintained the constant failure of gas elements in battle. In both of the battles, the generals used gas in conditions where weather and wind was unfavorable, causing the gas to have no effect at all or to do more harm than good.

¹⁰¹ Albert Palazzo, 116

Appendix: Glossary

Glossary

Army Corps: formation consisting of two or more divisions¹⁰²

Battalion: Infantry unit of three or four companies, totaling around a thousand men

Battery: an artillery unit, consisting of four to sixteen guns

Brigade: a subunit of a division, made up of four to six battalions

British Expeditionary Force: the initial British six divisions of the British regular army sent to France at the beginning of the war.

Breakthrough: the perceiving of the enemy's defensive line to allow operations in the open country beyond

Division: the smallest military unit consisting of all arms and organized for independent Action.

General headquarters: the department of the Commander in Chief responsible of the planning and conduct of military operations.

Hindenburg Line: A prepared section of Defensive line that the Germans withdrew to in March 1917

Noncommissioned officer: a junior officer in a section or squad

Redoubt: A fort or a fort system that usually consist of an enclosed defensive emplacement outside a larger fort. It is used to protect soldiers outside the main line of defense.

Salient: A projection of forces into the enemy held territory.

¹⁰² J.M. Winter, 69. All terms derived from this text.

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