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The Impact of Chemical Weapons in World War I

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Introduction

World War I brought many new advances in technology to the world. These new technologies brought new methods to warfare and changed the way wars were fought forever. They introduced many new aspects to the battles fought during the war, and most of these technologies added to the efficiency of the killing of the troops fighting the war.

One of the most feared technologies that were developed during World War I was chemical weaponry. This new technology proved to be very efficient during the war, and continually instilled fear in the troops fighting the war. The physical effects caused by the weapons were devastating to the troops. Many considered exposure to the weapons a fate worse than death because of the immense pain caused. The physical pain caused by the weapons during battles was only a part of the anguish caused by the chemical weapons. The ignorance among the troops about the weapons also added to the overall effects of the weapons during the war.
The development of these weapons constituted much of the technological advances during the war by both sides. Thousands of different chemicals were being tested during the pre and early war years for their effectiveness against opposing armies. Many of these chemicals were already being produced in massive quantities for civilian use and were transformed into weapons during this time.

In this paper I will show two of the major changes due to the use of chemical weapons during World War I. The first being the tactical change brought because of the weapons. I will show this aspect through looking at the first battle where chemical weapons were used. I will also illustrate the advancement in the methods of deployment and the importance they had on the effectiveness of the weapons. I will show the different approaches, both offensive and defensive, to chemical warfare by the opposing sides of the war.

The second aspect I will explore is the ethical decisions made about using the weapons during the war. Many of the chemical companies made huge profits during the war years because of the production of the weapons and they gained from the deaths of thousands of troops. The armies deploying the weapons also saw the horrifying physical and devastating mental conditions caused by the weapons,
however the use of the weapons was continual throughout the war. In response to the weapons being used the development of the gas mask was the most evident defensive measure taken during the war, and the gas mask represented an ethical choice of protection for the troops. The gas mask also introduced a tactical change to the war because of the ineffectiveness of many of the gases used.

By using a topical approach I will show these different elements to illustrate the impact of chemical weapons during the war.
The Tactical Change Through the Battle at Ypres

The war brought many of the new technologies from the laboratory and testing process to the battlefield. Chemical weapons were among these new weapons. The battle at Ypres in 1915 was the first time these weapons were unleashed on the soldiers during the war. Up until this time the military leaders on both sides of the war were skeptical about using chemical weapons. According to Marshall, the Germans had prepared for the use of the weapons by a constant carronade for the two previous days.¹

The devastation caused by the gas at the battle at Ypres, both physical and tactical, was important to the further use of the weapons during the war. Martin Gilbert has noted that the use of the chemical weapons was devastating.² He states further that when the chemicals were released it made many of the men get into comatose and dying positions.³ This changed tactics in battle for the rest of the war.

The Battle at Ypres that took place on April 22, 1915 was the first instance in World War I where chemical

weapons played a key role in how the battle was fought. From there on the way the war was fought changed. Love states that, "Gas was often a double-edged sword capable of blowing back to its point of origin." Marshall and Hart also suggested that the use of chemical weapons at Ypres made an impact that changed the rest of the war. However Marshall also maintains that the change was not as effective as the armies had hoped. The development of the gas mask helped the armies on both sides alleviate the problems with gas.

As the sun set over the battlefield of Ypres in northern France the Allied troops began to smell a "devilish incense" and they had no idea what horror had just been released on them. The fog was a greenish-yellow haze that crept along the ground into the trenches. The gas quickly covered two French divisions and the men began to feel the immediate effects of Chlorine gas poisoning. The bombardment only lasted 15 minutes, but unleashed the gas on the men. The gas quickly made the men ineffective and this opened a breach in the northern flank for the Germans to exploit. Gilbert maintains that this caused a four

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3 Gilbert, pp. 144.
5 Marshall, pp. 107.
hundred yard gap in the allied lines and this created a huge tactical advantage for the Germans. Keith Robbins states that the Germans were not as hesitant to use the gas, however the Allies were most apprehensive. The other divisions that made up the front and south flanks were Canadian troops, and the Germans could easily begin pushing back the remaining forces. Most of the Canadian and British troops escaped from the gas, but the French suffered major losses.

The battle at Ypres raises many questions for historians. Why did the gas come as such a surprise from the Germans? How did the British troops make it out with very few casualties when the French suffered massive casualties?

Liddell Hart suggests one interpretation that German prisoners taken near the end of March of 1915 told the commanders about the cylinders of gas and how they were going to be deployed. The British and the Canadian forces took the information under advisement, but the French commanders didn’t pay much attention to it. The French did notify some of the field commanders, but made no official warning available to the troops.

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7 Marshall, 107.
8 Gilbert, pp. 144.
Gas weapons had been banned at the Hague Conference.\textsuperscript{11} The Hague Conference itself was set up to look at the way the war was fought. One of the main jobs of the conference was to look at the effects of the weapons. The Hague Conference set many new laws for warfare, known as the Hague Laws.\textsuperscript{12} The Hague outlawed many of the weapons including chemical weapons.

The \textit{New York Tribune} ran a series of stories on the battle at Ypres, and it was very clear they made the Germans look extremely barbaric. The paper explained and justified this attitude because of the banning at the Hague conference. The article also shows how many didn’t know what to expect because gas was such a new weapon. One of the article states, "The gaseous vapor which the Germans used against the French divisions near Ypres last Thursday, contrary to the rules of the Hague Convention, introduces a new element into warfare."\textsuperscript{13}

The Germans had 5700 cylinders worth of Chlorine gas. These cylinders were the first form of dispersion, and they were very effective because of the way it released the gas.

\textsuperscript{10} Hart, pp. 177
\textsuperscript{11} Love, pp.4
\textsuperscript{13} Will Irwin, "The Use of Poison Gas", The New York Tribune, 27 April 1915, pg. 2 (online at website: http://www.lib.byu.edu/~rdh/wwi/1915/chlorgas.html).
The dispersing of the gas was planned to be immediately followed by a bombardment of artillery shells, and strong infantry assaults. The Germans knew with the soldiers stunned they could move forward quickly. The gas was dispersed from the large canisters only feet in front of the German trenches. Along with the devastating effects of the gas, Love also points out that because the German gas moved closely to the ground many of the French, British, and Canadian troops were forced out in the open where they could be shot by the German infantry.\(^\text{14}\)

This use of the gas shows how it changed the way the battles were fought. The use of gas could not only immobilize the soldiers, but also draw them out from behind their cover. If the men chose to stay in the trenches they would have to face the effects of the gas. Many of the men who chose to remain in the trenches at Ypres died of suffocation. Even though most of the Canadian forces were able to escape from Ypres with their lives, nearly the entire 1\(^{\text{st}}\) Canadian division lost their lives from the gas.

After the first night of the battle, the breach left open by the French divisions that were devastated the day before meant that the Canadian troops had to go in and hold the Germans back. The Germans had advanced during the

\(^{14}\) Love, pp. 4.
night. This time the troops would be fighting in a forest instead of an open field. The hope by the Allied commanders was that the gas couldn’t float freely through the trees, like it had on the field. However, knowing the gas would not be as effective in the forest the Germans commanders planned to force an assault using artillery and infantry. This shows a massive change in the tactics used by the German army during the battle. The Canadians held the ground, until the next day when a breeze was able to carry the gas to the allied trenches.\textsuperscript{15} Some of the Canadian troops tried to prepare for the gas using dampened gauze, however this only allowed the soldiers to function to a short extent and eventually they had to pull back. Even though the gauze helped the men they did not keep the effects of the gas out, and many of the men who survived had respiratory-related health problems for the rest of their lives.

The 1\textsuperscript{st} Canadian division had 228 men that were injured by the gas, however of the men that did not die, Love illustrates that gas diminished their ability to fight and was a considerable factor to why they died at Ypres.\textsuperscript{16} Many of the men could not resist the urge to rip off the small

\textsuperscript{15} Love, pp. 6
\textsuperscript{16} Love, pp. 7
gauze they had covering their face to try and gasp for more air, and it is believed the German troops advanced quickly and fired from less then 100 yards. By the end of the battle at Ypres the Canadians had lost 5,975 men out of 18,000 in the division.

After the battle the Germans did not take full advantage of the new weapons. Many historians I have discussed like Marshall and Gilbert see Ypres as the testing ground for the new weapons, because they had never been tried before in battle.\textsuperscript{17} If the Germans had continued to move south they could have cut off over 50,000 Canadian and British troops. The Battle at Ypres was the worst one faced by the Canadian troops during the war. Much of the information that Love uses throughout his appraisal of the battle is from Canadian historians. Other historians like Gilbert and Robbins also recount the other loses of troops by the French and British, it is clear the use of gas at Ypres was devastating physically to the forces there.

One of the themes about the gas warfare that most of the historians like Gilbert, Robbins, Hart, and Marshall agree on is that the wind on the battlefield must be favorable for the gas to be effective. "...The attack was postponed repeatedly for favorable wind, and the attack
plan had to be adjusted...". This meant the battle of Ypres also acted as a testing ground for the cylinders containing the gas, as I will discuss next in the deployment section. It also was clear that to equalize the battlefield with chemical weapons the allies would have to put more concentration on developing a new gas mask.

The battle of Ypres was the first of many battles in the First World War that were impacted tremendously by the use of chemical warfare. The battlefield at Ypres was the site of three more battles itself before the end of the war. The tactics of fighting the war were changing for both sides and it was clear that the new chemical weapons could be advanced into something much more devastating. All of the sources that I have cited have shown that the use of the weapons at Ypres began a change in tactics in the war. Gilbert makes it clear, however, that while the creation of the gas mask put a stop to many of the effects of the gas, the symptoms were never totally alleviated.\textsuperscript{19} They still made an impact on the soldiers physically, and with the advent of Mustard gas the tactics in battle were changed.

\textsuperscript{17} Marshall, pp. 107.
\textsuperscript{18} Hart, pp. 178
\textsuperscript{19} Gilbert, pp. 146.
Deployment and Early Development of Chemical Weapons

The battle at Ypres saw the use of many new chemical weapons that were very new technologies. Before the war many of the chemicals that would eventually see the battlefield were being used in households around the world. The chemical industry was very new, and most of the chemicals being designed were for household or industrial use. For instance chlorine was used in different cleaning chemicals. When the war came along many of the different chemical companies saw their chance to capitalize on chemical weapons, even though most were banned at the Hague convention, as I discussed in the previous section. In the early days of World War I chemical weapons were still in the laboratory, and much of the military spending and concentration went to the development of these weapons. Both sides of the war were developing their own new chemical weapons. Unlike the development that took place for the gas mask, which was mainly defensive, the development of the different types of deployment methods was for offensive warfare. The first army to actually take

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the weapons from the laboratory to the field was the German army. However, the Allies were developing their own weapons. These new toxic agents included Phosgene, Hydrogen Cyanide, Cyanogen Chloride, Lewisite, Nitrogen Mustards, and Mustard Gas. All of these different types of chemicals had different effects on the human body, and I will go into more detail about the effects in a later section. These chemical weapons were effective in different ways, and all of them became useful throughout the war. There were over 3,000 different chemicals being researched by scientists for their use in weaponry, however only thirty ever saw battle, and even fewer were desired by the military in following wars. Many of the chemicals didn’t have the combat effectiveness desired by the different armies. The effectiveness was judged on the speed by which it affected the troops, and the physical effects it had.21

Much of the concentration of the development of the weapons went to the deployment of the weapons. The deployment was an important factor because it decided what terrain the weapons could be used on, and how much of a factor the wind would be when they were deployed.

Throughout peacetime after the war and during the Second World War the United States development of these weapons was constant, however these programs started during the World War I. The production remained constant because after the effectiveness seen in World War I the weapons could be used even more effectively in World War II.

In 1899, many of the different countries around the world met at the Hague Conference. One of the main concerns during the conference was the use of asphyxiating gas in shells.22 The United States proved to be one of the strongest objectors to the new chemical weapons. Historian Charles Heller explains the strong objections to chemical weapons by the United States because of the effects of the weapons. Most of the weapons of war used were brutal enough the United States government felt the use of these weapons would cause too much agony and horrible pain of the soldiers fighting the war.23 Chemical weapons were also an extremely new technology, and the United States was very apprehensive about using them. The main American groups against the use of chemical weapons included policy makers, military leaders, and peace advocates. Each had their own reasons for their opposition, but all of them wanted the
same things dealing with chemical weapons, which was their non-use during the war.

Even though the United States was very much against the use of the weapons, this did not stop many of the other counties from talking about the development of their own weapons. Later I will discuss the different laws written at the Hague Conference, but even the laws written at Hague didn't stop many countries from their production of the weapons. Many of the countries began developing their own weapons because they knew some countries wouldn't follow the Hague laws. France for instance was a country that publicly developed its own chemical weapons before World War I. France was the first country to openly develop the first gas filled grenade; the grenade itself was a new technology in 1913 and 1914, and adding this new twist to it only made it that much more terrible. The Germans were also developing chemicals during this time, however this research was a mainly done outside of the military, for industrial and household use. At the beginning of the war however, the Germans saw the effectiveness of these weapons

23 Heller, 4.
in trench style warfare. Many of the army policy makers on both sides of the war saw the indecisiveness of trench warfare, and a deadlock had been reached on the Western Front by late 1914. Other historians like Martin Gilbert and Donald Richter maintain that trench warfare was one of the many reason for the first use of chemical weapons by the Germans during the war.

The different leaders of the warring nations wanted to get back to the mobilized style of warfare. The different armies conceived many different types of alternative tactics and strategies. For instance the British looked at new bombing methods to overrun German positions to help relieve the stalemate. The first battle of Ypres saw this method work for the Germans. The different bombardment methods included long range cannon shelling and massive offensive runs by the different troops to overrun the German positions. Most of these strategies failed, and the Germans were making their own plans for an offensive. John Keegan and S.L.A. Marshall also say the stalemate caused by the trench warfare was also the reason for the massive development and advancement of the tank in World War I.

25 Richter, pp. 12.
26 Heller, pp. 83.
The German solution involved the use of chemical warfare. The Germans, seeing the shortcomings of the French developed grenades, decided to take another approach using artillery shells. The German High Command first decided to use "T-Shells" on the Eastern Front on January 31st 1915.28 "T-Shells" were a new type of artillery developed by the British; their purpose was to act like claymores, showering shrapnel all over the opposing army.29 The German officers were surprised to find the weapons were not as effective as they had hoped. The cold weather had neutralized the chemical agent used in the shells.

The Germans then wanted to find new and more effective ways to deploy the gas. The German High Command then looked to Professor Fritz Haber, to find a new way of deployment.30 Haber, believed that the "T-Shells" did not provide a high enough concentration of chemicals. He then suggested the use of large commercial gas cylinders as a delivery system. Haber said these canisters had two big advantages over the "T-Shells." The first was the amount of gas that could be deployed and the second was that the cylinders didn’t break the agreements reached at the Hague conference.31 The Hague Conference put forth many bans on certain weapons to be

28 Heller, 7.
used during the war. These included chemical weapons. However, the laws only outlawed liquid chemicals from hoses and not the gas warfare used by the Germans. In the first and Second Hague accords limited the use of the different chemicals in the war, these included Chlorine and Phosgene. They also outlawed the development of new chemicals strictly for warfare purposes. However, by the beginning of the war several amendments had been added to the laws made at Hague.

The first gas that was recommended by the industries in Germany for the army to use in the war was chlorine. It was already manufactured in large quantities for commercial use, and was very effective against the opposing armies. Chlorine met all of the military requirements: it was lethal and affected the opposing army immediately.

The gas from these cylinders was very effective for many different reasons. World War I was the first war where trench warfare was widely used. This literally meant the opposing armies were in dug out trenches not far apart from each other. In many instances the trenches were only five meters apart. The gas coming from these containers would

30 Heller, 7.
31 Heller, 7.
33 Heller, 7.
stay close to the ground and seep into the trenches almost immediately. The gases were released from "fox" holes and brought to the surface by long lead pipes. These gases could be used on almost any battlefield whether it was woods, underbrush, ravines-trenches, or dugouts.34

These cylinders were extremely effective at deploying the gas, however the first large canisters proved to have many problems. The most obvious problem with the canisters was the size and weight of them. The soldiers could not move the heavy canisters themselves because most of the canisters weighed close to one hundred and fifty pounds. Another problem with the canisters was if any type of fire hit them they could potentially explode and cause mass casualties for the troops deploying them.35 The canisters were so immobile that new ways of deployment of the gas had to found. Another big problem with the canisters was wind speed and direction played a big role in how effective the deployment was.

The armies on both sides including Germany and Britain then looked back to artillery as a type of deployment. Mortars, grenades, and land mines were all developed as gas weapons. By 1917 and 1918 the development

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34 Heller, 14.
of toxic gases had branched out into the development of incendiary weapons. Incendiary weapons are those that produce an extremely high-level heat or fire as a weapon. After World War I the development of the flame-thrower came from this early work on incendiary weapons. The British were the first to develop the gas mortars used during the war. The British developed a new delivery system from the mortars called "shots." The mortars were soon adopted by the United States and the 4.5-inch chemical mortar was developed by July 1918. This is clearly the evolution of the different deployment systems of the chemical weapons during the war.

The first regiment in the British army to use mortars the Gas Warfare Service (GWS), was established in 1918 and they also used a British-designed Stokes mortar. It was designed to shoot very high into the air at an extremely high velocity, and then used momentum to bring itself back to earth. These mortars took the problem of wind speed and direction out of the equation, and this form of deployment became the one most used. However the accuracy of these mortars was not very good, and this caused problems for hitting different important targets, and the different

15 Brophy, 167.
37 Heller, 14.
38 Brophy, 123.
strategies being developed for chemical weapons had to be adjusted.

Over half of the gas weapon attacks took place at night.\(^3\) To help warn the soldiers about the gas attacks during the night different warning systems were set up. The alarms themselves were special sirens that were thought to be very effective. These alarms had the intention of allowing the soldiers to get their safety gear on before the gas made it to them. Yet of all the soldiers asked about the alarms just over half of them said they heard the alarms.\(^4\) This system was mainly a defensive approach by the Allies.

Of the thirty different chemicals used during the war only about a dozen were ever desired by the military. The chemicals were many times grouped by the different effects they had on the human body. These different chemicals caused many different devastating effects to the human body, which I will illustrate in a later section. Without protection the gas affected virtually every soldier, depending of what type of gas was being used. However along with the development of the weapons came the defensive equipment with ways to protect the soldiers from the gas.

\(^3\)Donald Richter, Chemical Soldiers: British Gas Warfare in World War I, (London: Leo Cooper, 1994), 11.
\(^4\)Richter, 13.
In 1918 between 20 and 30 percent of all American casualties were from gas weapons. This number was cut down to 3 to 4 percent after the widespread use of gas masks. By the time the gas mask had been advanced from its first conception to a very effective defensive tool in late 1917 the war was almost over. However this laid the groundwork for masks used in subsequent wars.

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Different Types of Chemicals Weapons and Physical Effects of Gas Weapons

As I have illustrated in the previous sections, the chemical industry was a developing industry during the years leading to World War I. Many of the different chemicals used in the gas weapons were developed only a few years before the war. Many different chemical companies saw tremendous growth during the war years and many of the companies such as Du Pont made a tremendous amount of money from the production of chemical weapons. Many of the chemical weapons used are chemicals commonly used today. For instance the chlorine was one of the main chemicals used during the war, and today it is used in many different cleansers, and in pool care, even though it is now in a very different form.

The different chemicals being developed at this time had many effects on the soldiers on which they were deployed. Researchers on both sides of the war were also developing different chemical weapons, and each saw the potential for devastation from chemical weapons. These weapons could be deployed against apposing armies, and cause massive suffering and death. Their different effects
on the human body categorized the weapons from both sides. These categories included eye irritants, lung irritants, nasal irritants, and skin irritants.\textsuperscript{42} Some of the gases fit into more than one of the categories, however this proved to be the best way of categorization.

Eye irritants were gases that mainly affected the eyes of the troops and caused many different symptoms.

These eye irritants included:

- Brombenzyl Cyanide
- Bomacetone
- Chloracetophene
- Chloropicrin
- Xylyl Bromide
- Dichlorethylsulphide (Mustard Gas)\textsuperscript{43}

Some of the effects of these gases would be instantaneous and others took hours or even days to surface. The eye irritants had several different effects on the eye. Many of the weapons felt like a sharp blow to the eyes, acting much like the mace or tear gas of today, even if the exposure was very limited. Most soldiers found the pain almost instantly unbearable.\textsuperscript{44} Other effects that eye irritants could also cause severe damage to the cornea, and in many cases prolonged exposure could cause blindness.


\textsuperscript{44} Bradley, pp. 82.
Most of the chemicals stimulated the tear ducts, and massive amounts of tears would be produced, making the soldiers almost completely blind. Most of the eye irritants also damaged the tissue around the eye. Most eye irritant gases were felt immediately by troops when they were exposed to the gas.\textsuperscript{45} Xylyl Bromide was a very popular tearing agent because it was easily made in a brewing process. Most of the chemicals were made through long processes and required special facilities, however the process to produce Xylyl Bromide was extremely simple compared to the production of many of the other chemicals used.\textsuperscript{46}

Even though eye irritants caused massive damage to the soldiers, they were not considered the most effective chemical weapons available. Lung irritants proved to be the most effective way to neutralize troops. Lung irritants caused a large number of the deaths from chemical weapons.\textsuperscript{47} The most well known gas of the lung irritant gases in World War I was chlorine gas. However, there were several other lung irritants used in the war. These chemicals included:

- Chlorine, Bromide
- Phosgene
- Trichlormethylsulphide
- Chloropicrin

\textsuperscript{45} Bradley, pp. 82
\textsuperscript{46} Bradley, pp. 82.
\textsuperscript{47} Bradley, pp. 83.
-Mustard Gas

Chlorine has been used throughout the history of warfare and was not new to World War I. However, World War I was the first time this weapon was used on a very large, strategic military scale. Most of the previous instances of chlorine use were isolated, however the information on these instances is limited because most were not recorded.

Chlorine is a highly effective reactive agent. It, like most other chemical weapons causes irritation and kills tissue. Chlorine is very effective because it causes an instantaneous reaction in the respiratory system. It immediately attacks the system, causing massive coughing spasms, and many times violent vomiting. It also destroys all of the tissue inside the lung, mainly the lining, and in most cases the damage caused by lung irritants is irreversible and sometimes fatal. The chemical reaction is caused when the chemical is mixed with the moisture from the respiratory system or the eyes and produces hydrochloric acid in the lung.

Chloropicrin has many of the same effects chlorine gas does, such as severe coughing and violent retching. The

48 Bradley, pp. 83.
49 Bradley, pp. 83.
The main difference between the two is that instead of an instantaneous reaction that is found in chlorine, Chloropicrin has a delayed reaction. Chloropicrin also causes massive liver damage.\(^{51}\)

Even though it is not the most well known, phosgene is considered to be the most effective lung irritant. When the troops were first exposed to phosgene gas it caused an immediate gripping feeling within the chest. This effect passes rather quickly, but it is very effective in stunning troops for a short time. When the chemicals stunned the troops they could not fight against the opposing army because of the tremendous physical effects they caused. Sometime after the exposure it then causes massive damage to the lungs and respiratory system. Many of the effects of phosgene are the same as chlorine, but on a much more intensified level. Phosgene was one of the most widely used lung irritants in World War I.\(^{52}\)

Another type of irritant much like the lung irritants was the nasal irritant chemicals. These nasal irritants had many of the same effects as the lung irritants, however in many cases the chemicals were not in gas form. Many of the


\(^{51}\) Bradley, pp. 83.

\(^{52}\) Bradley, pp. 84.
nasal irritants came in the form of smoke instead of gases. The most common effect of these different smokes was to make breathing much more difficult for those affected by them. Instead of mainly affecting the lungs, the different smokes irritated the mouth, nose and throat. One of the most common of these smokes was phenychlorasin. It caused violent coughing and sneezing attacks, sometimes for hours.\textsuperscript{53} The smokes were not very effective during battle, and they were seldom used throughout the war. Gas masks easily filtered these different smokes.\textsuperscript{54}

Skin irritants cause the most evident physical damage among all of the different chemical weapons. With the exception of the lung irritant weapons, the skin irritants were the most effective chemical weapons used during the war.\textsuperscript{55} The most common and most devastating of these skin irritant weapons was mustard gas. Mustard gas was considered by many to be the most effective of all chemical weapons used during the war. Many called mustard gas the "king" of all the chemical weapons.\textsuperscript{56} It was considered to be the king of the weapons because it affected almost every

\textsuperscript{53} Bradley, pp. 85.
\textsuperscript{55} Bradley, pp. 85
part of the body and caused disabling damage to the bodies of the soldiers. The gas causes extensive blistering and burns on the surface of the skin and demands immediate medical attention. It also effectively destroyed many of the other parts of the body. These different parts included the eyes, nose, and lungs. The effects of the mustard gas can also take up to two or three days before affecting the soldiers. It is a very heavy gas and was very effective in trench warfare. The reason for its name of mustard gas was because of it smell and color.\textsuperscript{57}

Of all the different gases used in World War I, mustard gas was continually the most feared among the troops on both sides of the war. Mustard gas, much like the other irritants, attacked the moist parts of the body. However, it was much more devastating because it affected all of the soldiers skin. The main concentrations of the burns were found in the moistest parts of the body. In many cases it would cause massive damage to the underarms and groin, along with the eyes and lungs.\textsuperscript{58}

Unlike the other irritants, the gas mask offered little or no protection from mustard gas. Mustard gas was very heavy and in many cases was almost an oily substance.

when it came in contact with the human body. Wherever the oily substance came into contact with skin it would produce massive burn-like blisters. The gas could stay in a very confined area hours and even days after it was dispersed. Many times during battle the gas would be fired and it would not cause an immediate reaction. This meant the soldiers might only have suspected they were being bombarded with normal artillery, and the gas would take effect sometime later. When it finally took effect the troops could be overrun by the other army.

Both sides had developed different gases for chemical warfare, however many of the gases on both sides were the same. The Germans developed most of the weapons used in the war; the Allies took more of a defensive position of chemical warfare. The Germans developed the following weapons:

- Benzyl Bromide (tearing agent)
- Dichlormethylether (tearing agent)
- Diphenychloroarsine (asphyxiating agent)
- Xylyl Bromide (tearing agent)\(^\text{59}\)

The allies also developed their own chemical weapons and gases:

- Cyanogen (Cyanide)
- Ethyl Iodoacetate (British tearing agent)\(^\text{60}\)

\(^{58}\) Iavarone, pp. 7.
\(^{59}\) Iaverone, pp. 5.
\(^{60}\) Iaverone, pp. 5.
Both sides of the war also shared many of the same chemical weapons also. These gases included:

- Bromacetone (tearing agent)
- Carbonyl Chloride (phosgene)
- Chlorine (asphyxiate agent)
- Chloropicrin (tearing, lung irritant)
- Dichloroethylethylsulphide (Mustard Gas, blistering agent)\(^{61}\)

All of these weapons were clearly devastating physically to those effected by them, they also caused massive fear in the troops because of the drawn out effects of many of the gases. The troops were not the only ones affected by the gas. Animals and plant life were also affected. A New York Times article even depicts the dumping of the gas out at sea.\(^{62}\) It was clear the different armies using the weapons didn’t understand the environmental danger the weapons posed. Major (P) Charles E. Heller best described the impact of the weapons during the war, “Of all the weapons used during World War I, none stimulated public revulsion more then poison gas...”\(^{63}\)

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\(^{61}\) Iaverone, pp. 5.


The Chemical Companies during World War I and the
Question of Ethics

World War I was the dawn for many new different technologies in warfare. These new technologies also brought many different ethical questions about their use in warfare. Along with the question of their use in battle the implications of war profiteering also contributed to the growth of these new and more effective weapons. Unlike the other new weapons of the time, chemical weapons brought a new terror that could not be touched or seen. The physiological effects that I have discussed in previous sections were not the only reason for the feeling of terror among the troops. The threat of the efficiency of these weapons was also a very real terror, the use of these chemicals also separated the troops even more and in a certain aspect dehumanized war even more then before. In the case of chemical weapons many of the chemicals brought a distinct smell, and in many instances these weapons were unstoppable. Even though the Allies first took a defensive stand on the production of chemical weapons it was clear after the battle at Ypres, offensive measures would have to be taken.
As I have illustrated, many of the chemicals used in the war were new to the world, and most of them were developed either for industrial or household purposes. Many companies manufactured these chemicals, and when the war began they began to manufacture the chemical weapons. Up until the United States entered the war the armed forces had no interest in manufacturing or using chemical weapons. The news coming from the battles prior to the involvement of the United States soured the idea of use of chemical weapons by the Allied forces. When the United States did enter the war, ignorance of not knowing how to manufacture the weapons was quickly stripped away. The use of the chemical weapons, first by the Germans, decided the use of the chemical weapons by the United States. The early production of gas was publicized mainly as a defensive measure, and the development of gas masks coincided with the development of the weapons.

One of the main companies contributing to the development of the new weapons was Dow Chemical. Even though this raised the profits and production for the chemical company the founder, Herbert Dow, stated, "It was

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the worst thing I ever had to do."66 The ethical question devastated Dow and the rest of his family. His children remember their father feeling like he had to do his duty, but never being at rest with the production of the war gases. However, this was only the public stands by Dow. Along with doing his duty the profits for his company during the war were staggering, over 50 million dollars. Even though this may have been a tough decision for Dow it is clear he had the future of his company always on his mind. After the war the company had grown over twice its size from before the war, and expanded to a larger chemical producer.67

Dow’s lifelong friend A.W. Smith received word in October 1917, from the director of the United States Bureau of mines, that because of the introduction of chemical weapons by the Germans, it was of national urgency to develop its own knowledge of gas warfare. Smith soon put more than two thirds of his time into researching gas-related equipment. However, he focused most of his attention on the production of a more effective gas mask.

Dow company historian E.N. Brandt maintains that Smith was extremely concerned about the ethical question of the

66 Brandt, pp. 85.
chemical weapons on the allied troops, even though he was
making a lot of money. His own personal goal to develop the
most protective gas mask possible became one of his top
priorities. The two initial problems he faced were to make
non-fogging eyepieces and to find the most absorbent
materials to be put into the masks.68 Both Smith and Dow
were thrust into the chemical warfare program. At this
point the production of weapons was not made public, and it
was hidden for the duration of the war. Civilian personnel
did the initial research done for the chemical weapons
program, but they were quickly put under military rules.69
This civilian work force quickly grew and it was the
popular belief among them that their research would help
win the war.

Dow and Smith went in separate directions by the end
of the war. Smith moved on to developing other new military
technologies, and Dow concentrated on the production of
chemical weapons. The different tearing agents made at the
Dow plant were sent to training camps all over the United
States so the troops going over seas could be trained on

67 "Report of the Special Committee on Investigation of the Munitions Industry (The Nye Report), Us
Congress, Senate, 74th Congress, 2nd sess., February 1936," http://www.mtholyoke.edu/acad/intel/nye.html,
1998.
68 Brandt, pp. 86.
69 Brandt, pp. 86.
using gas masks. After the introduction of mustard gas by the Germans at Ypres in 1915, both Smith and Dow were brought back together and met in Washington to work on the problem of developing the United States' own mustard gas in late 1916. Many of the French troops called mustard gas "Yeprite" because of the battle at Ypres. The Allies agreed that the Germans could not be left with the monopoly of mustard gas. Most of the personnel affiliated with the war considered mustard gas to be the "king" of the chemical weapons. Soon after the decision was made Smith and Dow went to work on a crash program of developing mustard gas.

The entire time Dow was developing the different chemical weapons, he also concentrated on the development of new medical technologies. He then created the Dow medical department located on the same grounds as the chemical factory. Things were going well for Dow until an accident at the training facility happened, killing one soldier because of exposure to gas from a faulty canister. One of the top officials at Dow was accused of incompetence because of the accident, and Dow himself went on an

70 Brandt, pp. 87.
72 Brandt, pp. 87.
74 Brandt, pp. 92.
aggressive campaign to defend him. Even though his efforts saved the official, the production of Mustard gas was moved from Dow chemical to a new plant designed by Smith.\textsuperscript{75}

At this time much of the manufacturing of the chemical weapons was also taking place at the Edgewood Arsenal in Maryland. Edgewood itself produced between 20 and 30 percent of all the United States chemical weapons in 1918 and it was a government installation. The construction of the plant finished in mid summer of 1917. Many of the different gases used in the war were produced at Edgewood; it was not until the spring of 1918 that the production of mustard gas had started. At the peak of the production at Edgewood the chemical weapons personnel numbered 7,400 people.\textsuperscript{76} The Edgewood installation itself was enormous. It consisted of 21 miles of standard railroad track, and 15 miles of narrow gauge railroad track. The arsenal was also near two waterways, because this was a crucial element in the production of the chemicals, and there were 558 building on the grounds at Edgewood. These buildings included three field hospitals, one complete hospital, and a Y.W.C.A.\textsuperscript{77}

\textsuperscript{75} Brandt, pp. 95.
\textsuperscript{77} Crowell, pp. 398.
Soon after the Allied victory Dow assessed his company. He was more then satisfied with the contribution that his company made to the war effort, and he took certain comfort from knowing he helped with the war. Dow's wartime products varied and contributed to many different departments. These departments included the ordinance department, aircraft department, and the Navy, along with the Chemical Warfare Division. He was completely compensated after the war. Dow took most of the money made from the war and took care of his employees by building them new homes and communities. Dow felt an obligation to do something good with the money earned from the war, and it was clear he always felt good about doing his part, but terrible about the part he had to play.

Even though Brandt does not include the financial status of the Dow Company, during the war it should be said that Dow made a lot of money from the production of the chemical weapons and many profited from the death of the soldiers at the hands of chemical weapons. However, Dow was not the only case of a chemical company making huge profits from chemical weapons. Another company that took part in the production of the different chemical weapons was the Du Pont Chemical Company.

78 Brandt, pp. 96.
World War I was called the "chemists' war" and World War II was called the "physicists' war." For example a New York Times article credited chemical weapons with more American deaths in France than grenades and missiles.\footnote{Taylor, pp. 44.} As a result of the war many of the chemical companies production within America shot up. This was also going on in Britain. From 1913 to 1920 the production of dyestuffs shot up from 4,000 tons in 1913 to 22,500 tons in 1920.\footnote{Taylor, pp. 44.} This constituted a large portion of the materials needed to produce chemical weapons. In America the change in production was even larger. Seven different firms in the United States went from producing 3,000 tons of dyes in 1913, to 29,000 tons in 1920.\footnote{Taylor, pp. 44.} This production capitalized over 3 million dollars, and many of the companies strengthened tremendously during the time of World War I.

Du Pont and Allied Chemical and Dye companies were the two largest and produced the most for export. By 1920 the production at the Du Pont chemical plant was almost four times as large as it was before the war.\footnote{Taylor, pp. 44.} Du Pont took a different road then most of the other chemical producers during the war. The other large producers were Allied

\footnote{Taylor, pp. 44.}
\footnote{Taylor, pp. 44.}
Chemical and Dye in America, Imperial Chemical Industries in Britain, and I.G. Farben in Germany. These went into the further development of the existing chemicals of the time. Du Pont's board of directors saw more profit in developing new chemicals for the war. Du Pont earned huge war profits and was the largest supplier of smokeless powder and high explosives for the Allies during the war. It was clear that a lot of money was being made from the chemicals, a New York Times story boasted about how "Toxic War Gases" would help the industry.

Du Pont board of director's took the opportunity of the war to develop these new chemicals to ensure a financial future for the company. Another Du Pont historian David A. Hounshell states that Du Pont saw the decades around the war as the experimental era. In 1913, Du Pont shipped 20,000 tons of chemicals to Britain, valued at over 9 million dollars, and made up 80 percent of Du Pont's total market. Britain was not ready for the amount of chemical production the war called for, so they looked to many outside countries to supply them. In 1918 Du Pont

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83 Taylor, pp. 44.
86 Taylor, 45.
87 Hounshell, 11.
88 Taylor, 45.
went public that they were producing the chemical weapons. The production of the different chemical weapons had to be done very quickly, and new processes had to be developed to produce the different weapons at a faster rate. This makes it clear that Du Pont was very aware of the money being made from the chemicals being sent over seas. Even though the chemicals were causing massive suffering during the war the production by Du Pont never dropped. Du Pont and other chemical companies believed the speed up production was one of the crowning achievements during the war.\textsuperscript{89} The production advancement done by the Du Pont Company during World War I laid the groundwork for the production and development of synthetic rubber, synthetic fuels, and the entire field of petrochemicals.\textsuperscript{90}

Du Pont's work and advancements during the war were clearly only for financial gain. Taylor points out that the decisions made by Du Pont's board were strictly financial. They never took the effects of the weapons into account, like the Dow chemical company did. Du Pont's reported gross profits from 1917-1918 equaled more then 599 millions dollars.\textsuperscript{91} This huge gain in company profit allowed the Du Pont Company to look into new ventures, one of these being

\textsuperscript{89} Taylor, 50.
\textsuperscript{90} Taylor, 51.
\textsuperscript{91} Taylor, 71.
the General Motors Corporation. Du Pont's chemical production during World War I made them one of the strongest chemical producers in the world, and established them as a strong company super power. Hounshell states throughout his analysis of Du Pont that the money made from the production of the chemicals solidified Du Pont as a power in the chemical industry.

The production of the chemical and other weapons by the large companies during the war brought many questions after the war was over. To answer some of these questions a special committee was formed in the United States Senate. The Committee was called the Nye committee, named after a Senator from North Dakota named Gerald Nye. Nye was the chair of the committee, and its primary goal was to look at the munitions industry during the war. The committee looked at the preparedness and elite mobilization practices of the war. The investigation of the munitions industry included, but was not limited to, the sales, manufacturing, exports and imports, and relevant legislation and treaties. The investigation took place during the spring of 1926. Koistinen states that the Nye committee reports

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92 Taylor, 71.
93 Taylor, 73.
95 Koistinen, pp. 254.
stand alone on the interwar studies of the economics of modern warfare. Since the Nye committees' analysis many scholars have questioned the results because of the intemperance of Nye himself.96

The Nye committee inquiries can be broken up into three separate sections. The first was the web of business, governmental, and extra governmental ties at home and abroad for the munitions industry. The second dealt with the role of different American financial houses, including J.P. Morgan & Company. The third was the secretary of war's plans for mobilization and the actual mobilization.97

The findings of the Nye committee were not good for the munitions companies, including Du Pont.98 The findings suggested the companies underminded peace by working against disarmament, arms control, and arms embargos.99 They also found that Du Pont, with several other companies, conspired to share patents, divided markets and profit pools, circumvent embargos, and oppose arms control measures.100 They broke many different laws to make a huge amount of profits during the war. Other crimes committed by

96 Koistinen, pp. 254.
97 Koistinen, pp. 256.
99 Koistinen, pp. 257.
100 Koistinen, pp. 257.
the companies found by the Nye committee included, gun running by selling illegally through intermediaries, and falsifying documents. 101

It was clear from the Nye committee findings that munitions companies like Du Pont made a tremendous amount of money from the war, and ignored any moral or ethical obligations that have to do with weapons production. In the month of October 1917 over 24 thousand Americans died due to exposure to chemical weapons. 102 Beyond the questions associated with money it was clear the different chemical producers were also not concerned with the suffering their products caused in the war. Many of the board members at Du Pont justified the production of the weapons by stating they were helping the war effort.

As stated earlier much of the public was kept in the dark about the chemical production, and there was not more American opposition to the weapons because the war was being fought far from America. If the war had been fought closer to the United States there would have been protests concerning the production of chemical because the public would have been able to see the immediate effects of the weapons. It also may have changed the ideals of the

101 Koistinen, pp. 257.
decision makers at the chemical companies because the soldiers being effected by their weapons would not have been a half a world away. Throughout the course of the war over 70 thousand Americans died because chemical weapons. Unfortunately this ethical question of chemical warfare was not raised until after the war had ended.


103 Gilcrest, 273.
Gas Masks and other Gas Defense Equipment

When chemical weapons were introduced to the war many questions arose about the effects the weapons would have on combatants. The gas mask was first developed because of the concern of the men working with the gas. Many of the ethical questions were raised because of the chemical weapons and as I have mentioned in earlier sections, there was tremendous work on perfecting a gas mask for the Allied troops. The stand by the Allies at the beginning of the war was mainly defensive and the gas mask was a direct result of the defensive measures taken. The gas mask also constituted a change in the tactics of chemical warfare. Skin agents, like mustard gas, were also used widely after the development of the gas mask. The gas mask was the most effective way for the troops to protect themselves against the new chemical agents. The gas masks also allowed the troops working around the weapons to work in a safer environment.

The different types of canisters used to hold the weapons were not safe and very dangerous. This made many of the soldiers very reluctant to work around the chemicals. Another reason for the development of the gas masks was to take a defensive approach to the chemical warfare. Many of
the different countries involved in the war had problems fighting using the gas. The first ones to use the gas were the Germans at the battle of Ypres. The United States and the Allies took more of a reserved approach, which included more intensive development on the gas mask. It took until almost the end of the war before the first effective version of the gas mask was developed.\textsuperscript{105}

During the summer of 1917 the news from the front was one of wonder about chemical weapons. The French and British governments controlled what news was printed in the papers. However the United States newspapers were much more liberal and sent back more uncensored news from the front. Both the British and the French were worried and scared about the picture being painted about chemical warfare for the public. The American troops on their way to war were well aware of the reality of chemical warfare.\textsuperscript{106} After secret chemicals and experiments were made public in technical journals the true news of chemical warfare was more abundant.

The testing that was going on was also made public. These tests included the effects of the war gases had on animals, such as birds, dogs, cats, and horses, and how

\textsuperscript{105} Gilbert, pp. 95.
different masks could help the animals survive or not be affected. Horse gas masks were developed during the war to protect the calvary during gas attacks.¹⁰⁷ For instance an article that was in the New York Times was titled "Gas Killed 756 Americans", and it was very open about the men that were being killed by the gas. Even though most of the articles were on the back pages of the front section, it still was not hidden from the American public. A sub heading that says, "Average age of our soldiers who died in France was 23 years old" follows the top heading.¹⁰⁸

This news coming back from the front contributed to the concentration on gas defense equipment development. The production of gas masks in America began in 1917. The United States turned out 5,250,000 gas masks considered to be the best in the world.¹⁰⁹ Out of all the gas masks produced before the armistice over 4 million of them went overseas. The gas masks that were sent were not only for the American forces, but all of the Allies as well. Almost every other country within the Allied forces put a lot of effort in perfecting the gas mask.¹¹⁰ The gas mask was not

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¹⁰⁹ Crowell, 410.
¹¹⁰ Crowell, 411.
only to protect the Allied troops from gas attacks, but also protect the troops from the gas when it was being deployed. The different Allied military powers felt it would be more effective to have the troops protected from the gas and it would give them an advantage over the German troops.\textsuperscript{111}

The Germans put little concentration into the protection devices and the American gas masks were considered to be over 20 times better than the German masks.\textsuperscript{112} There was never a reported case of an American soldier dying due to an American gas mask failing. The job of developing the masks for the American troops was given to the Surgeon General of the United States. The development of the gas mask came a long way from its beginnings by the end of the war. The earliest forms of gas masks were simply wet towels placed over the heads of the soldiers. Another early form was cotton and wool wrapped around the soldiers' faces. This also brought on many other types of screens used for protection against the gas weapons.\textsuperscript{113} In later development many different types of designs were tested to find out which was the most

\textsuperscript{112} Crowell, 411.
effective to protect the soldiers. The designs had many
different aspects to them, some were like hoods, and other
only covered the mouths of the soldiers. Many of the first
gas masks had separate respirators, which hung around the
necks of the troops. These masks had eleven main parts
that consisted of knap sacks, rubber hoses, face and
mouthpieces, and an elastic strap to hold the sack tightly
around the soldiers' head. Different scientists working on
the development decided that the separation of the mask and
the respirator box was not the most effective way to
protect the soldiers. The box itself was clumsy and many
felt it could not withstand the pounding of battle.

The development of the gas mask was done through
cooperation between the American and British governments.
The French, like the Germans, spent very little time on
defensive equipment, concentrating more on offensive
aspects of chemical warfare. One of the biggest problems
with developing the masks was the quantity needed. The
scientists developing the masks also were laying the
foundation for later versions of the masks, however this
caus3d the problem of developing new technology and working

113 Donald Richter, Chemical Soldiers: British Gas Warfare in World War I, (London: Leo Cooper, 1994),
pp. 11.
114 Ivarone, "Trenches on the Web", Chemical Warfare.
115 Crowell, 410.
116 Crowell, 411.
through many mistakes. The gas masks were first modeled after the British small pox masks that were not very effective.\textsuperscript{117} The small pox masks were mainly designed to protect the doctors and nurses from direct contact with the airborne diseases, however they were not made to filter out toxic chemicals in the air. Many of the chemicals that were being produced for the chemical weapons were also very acidic and the masks could not filter them out because of their heavy moisture.\textsuperscript{118} These first small pox masks laid the much-needed groundwork for the later masks.

The perfect mask was considered the one that completely eliminated all effects of the chemicals to the soldier’s eyes, nose, and face. Fitting the different components in a manner that was truly effective also proved to be a problem. The eyepieces offered one of these problems. Designers had to find a substance that was transparent, but extremely durable. A substance called triplex glass was decided on to be used for the eyepieces of the gas masks because it met the different requirements that were necessary.\textsuperscript{119} Sealing the different parts of the

\textsuperscript{117} Ivarone, “Trenches on the Web”, Chemical Warfare.
\textsuperscript{119} Crowell, 418.
mask was a problem because they had to fit together tightly to prevent air from passing through.

The most prominent scientists of the time were at work on the masks and they began to develop new, more effective substances to go into the masks. Several different American companies patented many of the new technologies. Crowell speculates that many new technologies came from this production. As I stated in the previous sections, A.W. Smith who worked for the Dow Chemical Company also devoted a lot of his efforts on developing a more perfect gas mask.\textsuperscript{120} For instance the eyepieces may have started plastic companies on their way to production. Many of the companies were also making a lot of money from the production of the chemicals, one of the largest being Du Pont. Many of the different substances were those people wouldn't think would go into gas masks. For instance charcoal was used in the respirator boxes, because charcoal was very absorbent with certain gases like chlorine, and phosgene, however because of the different effects on the body from mustard gas the masks proved to be useless.\textsuperscript{121} Perfecting the use of the charcoal went through several different stages. Designers

\textsuperscript{120} E.N. Brandt, pp. 87.  
\textsuperscript{121} Crowell, 416
found that the densest carbon would be the most effective for the gas masks. Another strange substance used in the respirator boxes was nutshells.\textsuperscript{122} The demand for the different nutshells was so large the US government had to go to other tropical countries to supply their needs. The government also went to the public to help by saving the different shells and pits for production.\textsuperscript{123}

Even though there was never a reported case of an American death due to a faulty gas mask that does not mean there were no problems with the masks. There were times when gas masks were sent to the front and they had to be sent back because there were defects in them. A \textit{New York Times} article recounted an instance of this during 1918.\textsuperscript{124} The article illustrates how several thousand gas masks sent abroad were defective and had to be sent back to the United States to be tested and repaired. This article also shows that there was a lot not known about the chemicals and many were afraid the American troops had bad safety equipment. Another instance when masks had to be sent back was in late 1918 when several thousand masks had to be sent back for a breathing mechanism defect. The soldiers were being suffocated because the respirator was not allowing enough

\textsuperscript{122} Crowell, 418.
\textsuperscript{123} Crowell, 422.
air to pass through, and the soldiers had to remove the
mask to breath.\textsuperscript{125}

Another concern from gas warfare was for the animals
used during the war. For much of the war the use of horses
was very important, and the gas affected animals like
humans. Horses were still widely used because the
automobile was a new technology and the tank had nowhere
near the effectiveness of later designs. The end of the war
had changed the design of the early tank and it proved to
be more effective, however horses still played an extremely
important role in the war. Special gas masks were made for
the horses used in the war. Over three hundred thousand
horse gas masks were produced for the war.\textsuperscript{126}

There were also many different types of defense
equipment developed during the war. Special blankets were
developed to keep the different gases out of the dugouts
and foxholes. The blankets were treated with different
chemicals to repel the gas. Different types of creams and
ointments were also developed during the war to aid the
soldiers from the chemical weapons. The most frequently
used ointment called Sag Paste was used over the last part

\textsuperscript{125} Ivarone, "Trenches on the Web," \textit{Chemical Warfare}.
\textsuperscript{126} Major(P) Charles E. Heller, \textit{Leavenworth Papers No.10; Chemical Warfare in World War I: The
American Experience, 1917-1918.} (Fort Leavenworth, Kansas; Combat Studies Institute, 1984), Pg.79
of the war, and over twelve hundred tons were shipped overseas.\footnote{Crowell 430.}

In the sources I have shown in this section, such as Ivarone and Crowell, it is clear the gas mask made an impact on the war both tactically and ethically. The gas mask made it possible for many lives to be saved from the different war gases used. The defensive position taken by the Allied forces was the main reason for the development of the gas mask, and it is clear it was an ethical decision to develop the gas mask. It is clear if the gas mask had not been developed a much larger number of casualties would have been due to chemical weapons.
Conclusion

In this paper, I have explored many of the different aspects of chemical warfare during World War I through the tactical changes and the ethical challenges of the war. In researching for this project it has become clear to me that chemical warfare had an impact on the war. Most of the historians I have studied have agreed that chemical warfare did not change the outcome of the war, but still played a significant role in how the war was fought. Chemical warfare had a profound impact on the troops fighting the war. It is clear the men fighting the war were forever changed by their exposure to the horror of chemical weapons, and many of the producers of the weapons gained a lot by its production and use. In all of the sources I have looked at it is clear chemical weapons made an impact on multiple levels. All of the different nations in the war took their own stance on chemical weapons some offensive and some defensive, but it was clear the positions changed throughout the war. As I have illustrated throughout this paper the introduction of the chemical weapons during the war impacted many of the tactical decisions made by the opposing sides.

The ethical questions raised by the use of the chemical weapons have continued until today and have been
evident in all the wars since. It could even be compared to the most destructive force ever used in the Atomic bomb. The development of newer chemical weapons such as Napalm, and deforesting agents has made it clear World War I chemical weapons laid the groundwork for several other weapons used in the wars since. Operation Ranch Hand in Vietnam is a strong example of this. The issues about chemical weapons still seem to be as important today as they were during the years of World War I. New medical technologies have also displayed many of the after effects of the weapons and it is clear many more ethical questions have been raised in the decades since World War I.

Both the tactical aspects and the ethical questions were present at the time of the war and remained after the war ended. There has never been a war fought like World War I, and I believe the chemical weapons developed during the war are a large part of the reason why. The ethical questions linked to them were asked by some, but not by many. As an evolving society one of the things that we have to make decisions about is the limits of technology. We must also ask, "If we can, should we?" It boggles my mind that the world was a dark enough place for such a horror to be unleashed. My only hope is that the people not only in
this country, but every country around the world can learn from past mistakes.
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