

WWI TECHNOLOGIES: JIGSAW READINGS

Poison Gas¹

"...[W]ar has nothing to do with chivalry anymore. The higher civilisation rises, the viler man becomes."
~General Karl von Einem, Commander, German Third Army in France

Of all the scientific advancements made during World War I (WWI), the weaponization of poisonous gas may be the most notorious. Images of thick clouds descending upon troops as they choke and struggle for air pervade the poetry and first-hand accounts of WWI. While the Germans were the first to use deadly poison gas in the war, it was a tactic eventually adopted by both the Central and Allied Powers. Bis (2-Chloroethyl) Sulfide, commonly referred to as **mustard gas**, is probably the most discussed; however, mustard gas was merely one of many toxic gases used in WWI.

Tear gas, which irritates the eyes, was first used by the French in August 1914. Although it was not very effective as a weapon, given that symptoms usually subsided in about 30 minutes, temporary blindness significantly affected the soldiers' abilities to stay in the field. Blind soldiers had to be escorted to a field hospital, where they remained, removed from the battlefield for six-to-eight weeks, requiring nursing care until they were able to return to the field. The effects of blindness, albeit temporary, on soldiers' morale were significant, instilling fear and reluctance to return to battle.

The next gas deployed in the search for the most effective weapon was **chlorine**, first used by the Germans at the Battle of Ypres in April 1915. Immediately damaging the eyes, nose, and especially the lungs, chlorine was so deadly that it killed nearly 1,100 people in its first use alone. **Phosphene** was a chemical that also attacked the lungs and caused victims to suffocate slowly over the course of a few days.

Unlike the previous gases that affected eyes, nose, and lungs, **mustard gas** is a vesicant, a chemical that causes burns and blisters all over the body. Masks could protect the eyes, nose, and lungs, but not the skin. Symptoms from mustard gas showed up a couple of hours after exposure and worsened over time. The majority of chemical weapon deaths during WWI were attributed to mustard gas.

Gases were normally deployed by artillery shells. Soldiers wore masks to protect themselves, but some gas could penetrate masks. When gas made it through a mask, soldiers usually removed them—making themselves even more vulnerable.

In addition to causing severe and painful physical harm, gas became a significant psychological weapon. The psychological effects of gas were profound. The symptoms were horrifying, striking fear into the hearts of many soldiers. Gas, which contributed to much of the anti-war sentiment that grew around WWI, was later prohibited when the League of Nations adopted the Geneva Protocol in 1925.

¹ 450 words

Machine Guns²

“They went down in the hundreds. You didn’t have to aim.”
~German soldier after the Battle of the Somme

While gas may have been the most infamous of weapons used in WWI, it was the machine gun that caused some of the most drastic changes to the way wars were fought. Many hallmarks of WWI—planes, tanks, trenches—were directly or indirectly connected to the machine gun.

When WWI began, war tactics generally revolved around **offense** strategies. Previous wars had demonstrated that enough men with enough “spirit” could win a battle by gaining a good position and charging the enemy. The machine gun, however, turned war tactics towards **defense**. Weighing around 140 pounds and requiring several men to carry them, the average machine gun had to be used from a fixed position. These massive guns could fire between 400 and 600 rounds per minute, a number that increased as the war went on. Because of their capacity to fire enormous numbers of rounds, the machine guns would overheat and required cooling to keep them from jamming. Within just two years, gun manufacturers had created a lighter machine that was much more easily transported and could be mounted on armored cars and eventually installed on airplanes, where the invention of the interrupter enabled pilots to repeat fire from the air.

Offered first to the British army, the machine gun was rejected because of its weight and its apparent unwieldiness. The Germans, however, adopted this defensive strategy early on, while the Allies stuck to more offensive tactics. This strategy would cost them lives and time. By the time the war broke out in 1914, the German army had over 12,000 weapons at their disposal. Eventually, the Germans amassed over 100,00 machine guns. In an effort to maintain a constant defensive position, machine guns would often be grouped together. The fire power of a machine gun was estimated to be the equivalent of 60-100 rifles.

At the battle of the Somme, a conflict which ran from July 1 to November 19, 1916, the British leveled an offensive attack against Germany and attempted to cross **no-man’s land**, the space between opposing trenches. By the time the battle ended, 419,654 British soldiers had been killed—mostly by machine guns.

Machine guns, along with artillery, effectively created **trench warfare**, one of the defining features of WWI, where both sides dug deep into the ground to create areas safe from machine gun and artillery fire. Machine guns were also used in conjunction with other WWI advancements, like **planes** and **tanks**. Although originally manufactured in 1914 as a defensive weapon, improvements that reduced overheating increased the number of rounds that could be fired, and reduction in the weight of the weapon ensured that the machine gun would become an impressive offensive weapon.

² 440 words

Airplanes³

“England is no longer, from a military point of view, an inaccessible island.”

~H.G. Wells

When WWI began in 1914, airplanes were still a very new invention. After all, the Wright brothers had flown the first airplane just eleven years earlier in 1903. However, over the course of the war, airplanes went from being highly limited in the functions they could perform to one of the major technologies of WWI.

Early in the war, most planes could only fly about 70 mph. They were able to sustain flight for about three hours. Both weaponless and slow, planes were used at first for **reconnaissance**: searching areas for enemy posts and returning with intelligence. However, this would soon change. Pilots soon started carrying hand guns and single-shot rifles aboard and shot at each other in the air or drop small bombs over the side of the plane onto enemy troops. These methods were relatively ineffective, so air combat wasn't a reliable tactic—until machine guns were actually mounted onto the plane.

An obvious problem arose at the prospect of mounting a machine gun onto the front of a plane: it fired directly at the propeller, resulting in a plane crash. This problem led to what is perhaps the most stunning advancement regarding aerial combat: the **interrupter**. The interrupter was a device which adjusted the timing of a machine gun so that it would only fire through the spaces between rotating propeller blades.

In addition to planes' becoming faster, the use of machine guns made aerial combat a much more prevalent tactic in WWI. Fighter plane pilots accepted the challenge to best the enemy in the air and dueled in what became known as **dogfights**. As pilots sharpened their skills and gained victories, they became known as **aces** and their heroism was celebrated and used as propaganda in their respective countries. The pilots' victories became legendary. **Manfred von Richthofen**, a German known as the “Red Knight,” painted his plane bright red and “downed” more planes than any other pilot in World War I. American **Eddie Rickenbacker** parlayed his automobile racing fame into a reputation as the “ace of aces.” Known as a daredevil, he singlehandedly engaged a fleet of seven German planes, downing two before he made a miraculous getaway. England's **Albert Ball** was a ferocious fighter in the air, engaging his enemies from below, using a tilting gun to shoot enemy planes out of the air. Deeply troubled by the violence of the war, he died at the age of twenty, tangling with two planes from the Red Baron's “Flying Circus.” **William Bishop**, a Canadian, quickly became known to German pilots as “Hell's Handmaiden” because of his outstanding marksmanship. He reportedly dropped tin cans from his cockpit and used them as targets as he dove toward the earth. Famed French aviator **Georges Guynemer** used a specially designed “single shot” cannon. Fearless, Guynemer survived seven plane crashes until he was shot down and killed in a mission over Belgium. He was recognized for having downed 54 enemy planes.

By the end of the war, strategic bombing did not bear the fruit that both sides had wished for. Aerial missions turned out to be mainly tactical despite the notoriety of the dogfights. The airplane's major contribution for both sides was aerial photography and troop reconnaissance. Anti-aircraft artillery defenses were largely unsuccessful; however, the seed was planted for airplanes as a significant weapon of war, which came to fruition in World War II and subsequent war efforts across the globe.

³ 568 words

Submarines⁴

“We need the most energetic, ruthless methods which can be adopted.”
~Field Marshal, German U-Boat Conference, August 31, 1916

At the time of the First World War, Britain’s Royal Navy was the largest and most powerful in the world. A major naval strategy of the Allied Powers was a blockade that cut off food and supplies from the Central Powers. This caused starvation and disease in those countries, especially Germany.

Germany’s major tactic in response to these blockades was known as **unrestricted submarine warfare**. Germany’s submarines, known as U-boats,⁵ were much more advanced than the submarines of other nations. For example, their Type 93 class submarines had deck guns, carried sixteen torpedoes, and could travel around 9,000 miles.

Submarines proved to be an important new technology that could actually be deployed as a fighting vessel. Germany led the way in submarine technology and production. The first German submarine entered into service in 1906. When WWI broke out in 1914, just eight years later, the German fleet consisted of 30 ships. By the time the war ended in 1918, there were 350 in the fleet, with up to 61 at sea at any one time.

The U-boats wreaked havoc on enemy ships. Their goal was to cut off Allied supply lines and destroy their opponents’ ability to wage war by laying mines in the Baltic, Black Sea, English Channel, and the Mediterranean. The British navy developed a new kind of submarine – the enormous K-class boats. Their job was to serve alongside surface warships; however, they were slow to submerge and impossible to spot once they were underwater. These problems resulted in the accidental loss of five K-class boats that collided with one another underwater. In an effort to stop the German submarines from entering British ports, the Allies created barrages of mines, nets, and surface boats. The German U-boats would snag the nets and drag it behind the vessel, making it visible and vulnerable. The barrages were successful in deterring German submarines from the English Channel and the straits between Norway and the Orkney Islands and in the Strait of Otranto.

It was, however, the Germans’ use of submarines against neutral ships that drew the fury of the United States. This was unrestricted submarine warfare—German submarines attacking not only enemies but also merchant and passenger ships, often carrying civilians. Germany justified the attacks on merchant ships because they were, in fact, carrying supplies to the Allies. The 1915 sinking of the *Lusitania*, a passenger ship travelling from New York to England, caused such outrage that Germany briefly halted their policy of unrestricted submarine warfare. However, as Germany’s cause grew more desperate and the policy was resumed in 1917, the United States was finally prompted to join the war.

Realizing the value of the submarine – a stealthy underwater vessel, the Allied forces also incorporated submarines into their fleets -- but in significantly smaller numbers than Germany. France had the largest number of submarines –123. Russia had 41. Italy had 25. England had 57, but 40 of those were equipped only to serve around the British coastline. The United States, who entered the war when Germany sank the *Lusitania*, had 72 submarines in its fleet.

⁴ 547 words

⁵ The U-boat is a type of submarine invented by the Germans for use in World War I and World War II. The letter “U” in U-boat stands for *unterseeboot* or under-sea boat in English.

Artillery⁶

"...I could hear these shells coming over, I really began to know what fear was..."
~Quiren M. Groessi, Company F, 5th Wisconsin Regiment

While innovations in planes, machine guns, and gas played a large role in the war, it was artillery that caused the most casualties. These weapons fired mortar shells packed with concrete and shells packed with pieces of metal called shrapnel. There were many differences among these heavy firearms. There were different sizes of shells, lengths of barrels, and distances and trajectories the shells could be fired. Some shells, like mortars, would be fired upward and arc downward to be dropped right into enemy trenches. Like machine guns, most artillery was fired from a fixed position. Along with machine guns, artillery was a significant factor in the development of trench warfare.

There were two kinds of artillery: heavy artillery, which had the capacity to hurl giant shells across many miles, enabling the enemy to kill their opponents from a safe distance, and light artillery, designed to cover shorter distances, but to do extreme harm to infantry.

The heavy artillery was moved by tractor and placed in a stable place. Often several of these giant weapons were stationed together to increase the firing capacity. Howitzers were mortar-style weapons that had shorter barrels and were angled more steeply than light artillery weapons. The mortars they launched could destroy building and landscape miles away. These weapons could fire indirectly, the ammunition arching and curving, landing on the opponents from unexpected angles. The ammunition fired by these weapons were high-explosive rounds, which exploded with incredible force when they came in contact with a solid surface like a building or the ground.

Light artillery could be carried by soldiers or secured to wagons and pulled by horses. Belgian and French soldiers often moved their light artillery in gun carts pulled by large, strong dogs. These weapons were more likely to use shrapnel as ammunition – small pieces of metal and steel balls packed tightly into the shell casings. The explosive capacity was sufficient to propel the shells, but their purpose was to kill infantry by piercing the skin and flesh and breaking bones. The explosion propelled the lethal shrapnel into the lines of enemy soldiers, doing extreme bodily harm.

Many newer technologies in artillery were used or improved in WWI. For example, the French relied on the relatively new 1898 invention of barrel recoil. Most artillery guns were forced backward each time they fired and had to be manually returned to their position afterward. Recoil technology used a barrel that included brakes which absorbed the force from firing the gun, allowing it to fire without being forced backwards.

Artillery—heavy artillery, in particular,—contributed to the defensive nature of the war, as it was often fired from a fixed position to cut off enemy advances and fire upon other trenches. Light artillery was used to do maximum damage to soldiers in enemy sights.

⁶ 455 Words

Tanks⁷

“It was rather terrifying to see this thing coming and you knew that you couldn’t stop it.”

~Andrew Bain, British Officer

With its focus on defense, trench warfare in Europe caused a kind of stalemate. The invention of the tank was an attempt to introduce a weapon that could roll through the countryside smashing whatever was in its way and destroying enemy trenches.

It was the British who came up with the idea of a tank, or “land boat,” as they called it. In fact, it was only called a tank to keep the idea secret from enemies—a name presumably chosen because the early models looked like a large tank made to store water.

Originally thought to be the perfect weapon to maneuver enemy trenches, the tank presented a number of problems. The weight and lack of traction prevented easy movement across the battlefield. Weapons designers eventually solved the movement and weight problem by adding caterpillar tracks. The vehicle could move and have additional armor and armaments.

The first tank was invented by the British in 1915 and was named Little Willie. It was incredibly slow and could not handle the rough terrain of trenches. Even its successor—Big Willie—which also struggled to cross trenches, was prone to malfunction and often overheated. Slow moving and frequently unreliable, tanks went through major improvements throughout the war. For example, the Mark IV, introduced in 1917, could travel 4 MPH (twice as fast as the Little Willie), had four Lewis machine guns and two 6-pounder guns.

Mark IV was a male tank. “Male” tanks weighed 32 tons and were equipped with 6-pounder naval guns and four Lewis machine guns. The companion “female” tanks weighed 28 tons and were equipped with six Lewis guns. British tank commanders typically preferred a male tank to a female tank because of the additional weight and added armaments. The first machine gun to be fired from an aircraft, the Lewis machine gun was the weapon mounted on British tanks. The Lewis, known as the Belgian Rattlesnake, was able to fire 500-600 rounds per minute. It weighed only 28 pounds, about half the weight of its counterparts. Germans, who came into combat with the Belgians in 1914, called the Lewis, the preferred weapon of the Belgian Army, the “Belgian Rattlesnake” because of its maneuverability and rapid and accurate fire.

The design and construction of the tanks went through many incarnations before they were battle-ready. Initially, they were launched in September 1916 at the Battle of the Somme. Of the 49 tanks first launched, only 32 made it through the first attack; only nine made it across “no-man’s land.” The first battle where tanks made a great impact was not until 1917 at the Battle of Cambrai. By July 1918, the French deployed almost 500 tanks at the Battle of Soissons. Like the Allied countries, Germany manufactured its own tanks, and the first tank-versus-tank battle took place in April 1918. Three German tanks engaged three British tanks. The Allies tanks did not fare well in the battle; however, the Australian infantry brigades pushed the Germans back, enabling the British units to recapture Villers-Bretonneaux. So despite the effort and engineering put into tank design and manufacture, this battle was won by infantry in hand-to-hand combat using traditional weapons. Eye-witness reports indicate that “Those Germans who were not captured or killed were then pushed back towards the woods adjacent to Villers-Bretonneaux.”

While tanks were one of the major military advancements of WWI, they were not the war-ending invention some thought they would be. It wasn’t until WWII that tanks became a prominent and powerful force rolling menacingly across many fields of battle.

⁷ 504 Words

REFERENCES

Poison Gas

- Centers for Disease Control and Prevention. (n.d.). *Sulfur Mustard: Blister agent*.
https://www.cdc.gov/niosh/ershdb/emergencyresponsecard_29750008.html
- Everts, S. (2015, May 11). *A brief history of chemical war*. Science History.
<https://www.sciencehistory.org/distillations/a-brief-history-of-chemical-war>
- Patton, J. (n.d.). *Gas in the great war*. University of Kansas Medical Center.
<https://www.kumc.edu/wwi/medicine/gas-in-the-great-war.html>
- Pruszewics, M. (2015, Jan 30). *How deadly was the poison gas of WWI*. BBC World Service.
bbc.com/news/magazine-31042472

Machine Guns

- Cornish, P. (2015, Dec 2). *Machine gun*. Encyclopedia of the First World War.
https://encyclopedia.1914-1918-online.net/article/machine_gun
- First World War.com. (2009, Aug 22). *Weapons of war - Machine guns*.
<https://www.firstworldwar.com/weaponry/machineguns.htm>
- Nothstine, M. J. (2016). *Lessons from the past: The development of the machine gun and its impact on the great war*. Infantry Magazine, 52 - 57.

Airplanes

- Andrews, E. (2014). *Six famous WWI fighter aces*. History. <https://www.history.com/news/6-famous-wwi-fighter-aces>
- BBC. (2014, Oct 20). *How WWI changed aviation forever*. Viewpoint.
<https://www.bbc.com/news/magazine-29612707>
- Keich, C., & Blair, J. (2017, Dec 7). *What role did aircraft play at the outbreak of war?* Imperial War Museums. <https://www.iwm.org.uk/learning/resources/what-impact-did-the-first-world-war-have-on-aircraft-and-aerial-warfare>
- Lallanilla, M. (2014, 13 May). *The science of World War I: Airplanes*. Live Science.
<https://www.livescience.com/45567-world-war-i-airplanes-bombers-red-baron.html>
- Wells, M. (2016, Mar 31). *Aircraft, fighter and pursuit*. International Encyclopedia of the First World War. https://encyclopedia.1914-1918-online.net/article/aircraft_fighter_and_pursuit

Submarines

- History. (2016, Nov 16). *Germans unleash U-boats*. <https://www.history.com/this-day-in-history/germans-unleash-u-boats>
- Knighton, A. (2017, Sep 27). *Warfare under the waves—Submarines in the first world war*. War History Online. <https://www.warhistoryonline.com/world-war-i/submarines-first-world-war.html>
- Lye, H. (2019, Dec 9). *A History of submarines: From U-boat to dreadnought*. Naval Technology. <https://www.naval-technology.com/features/a-history-of-submarines-from-u-boat-to-dreadnought/>

The National Archives (n.d.). *Spotlights on history: The blockade of Germany*.
<http://www.nationalarchives.gov.uk/pathways/firstworldwar/spotlights/blockade.htm>
The National WWI Museum and Memorial. (n.d.). *Unrestricted U-Boat warfare: The German naval tactic of WWI*. <https://www.theworldwar.org/learn/wwi/unrestricted-u-boat-warfare>

Artillery

Alberts, K. (2012). *The Belgian rattlesnake: Why the Lewis gun was feared and revered for three decades*. Guns.Com. <https://www.guns.com/news/2012/10/05/lewis-machine-gun>
Knighton, A. (2017). *Big guns—The devastating field artillery of WWI*. War History Online. <https://www.warhistoryonline.com/world-war-i/big-guns-the-devastating-field-artillery-of-ww1.html#:~:text=Big%20Guns%20-%20The%20Devastating%20Field%20Artillery%20of,...%206%20Field%20Artillery%20in%20the%20Field.%20>
The National WWI Museum and Memorial. (n.d.). *Artillery: Modern weaponry of WWI*. <https://www.theworldwar.org/learn/wwi/artillery>
Storz, D. (2014, December 16). *Artillery*. International Encyclopedia of the First World War. <https://encyclopedia.1914-1918-online.net/article/artillery>
Yale University Library Online Exhibitions. (n.d.). *Medicine in World War 1: War injuries*. <https://onlineexhibits.library.yale.edu/s/wwi-medicine/page/war-injuries>

Tanks

History. (2009, Nov 24). *This day in history: First tank produced*. <https://www.history.com/this-day-in-history/first-tank-produced>
Terrel, E. (2016, September 30). *World War I: The Tech of the tank*. Library of Congress. https://blogs.loc.gov/inside_adams/2016/09/world-war-i-the-tech-of-the-tank/
The Imperial War Museums. (n.d.). *How Britain invented the tank in the first world war*. <https://www.iwm.org.uk/history/how-britain-invented-the-tank-in-the-first-world-war>
The Tank Museum. (n.d.) *Mark IV*. https://tankmuseum.org/ttank_collection/mark-iv/
Wikipedia. (n.d.). *The second battle of Villers-Bretonneaux*. https://en.wikipedia.org/wiki/Second_Battle_of_Villers-Bretonneux