Chlorine

History

World War I was the first time that two modern industrialized countries went to war. Modern weapons were used, often for the first time in war, with devastating effects. Examples are the tank, the airplane, improved artillery and especially the machine gun. Officers quickly learned that to charge an enemy under murderous machine gun fire caused much different results than previous wars. Different rules had to apply. A series of trenches were built and very little movement occurred in the line for months.

The German High Command, in frustration, decided to use poison gas to change the face of combat and permit penetration of the enemy line with little or no opposition. These gases were meant to act as terror weapons and immobilize and confuse the enemy, not cause a high mortality rate. They were the brainstorm of two civilians, Walter Nernst and Fritz Haber of the Kaiser Wilhelm Institute. Both were famous scientists and after the war, both men won Nobel Prizes in chemistry. On January 3rd 1915 The German gas units employed shells with a tearing agent, xylol bromide, on the Russian front.

Their first use of a gas against the western front was at Bixschoote, Langemarck near Ypres, Belgium. This was known as the second battle of Ypres. The goal of the Germans was Calais, France. The Germans patiently waited for three weeks until the wind conditions were proper and at 1700 hours on April 22 1915, 168 tons of chlorine gas were released from 520 cylinders over a 5-mile front. The greenish gas, heavier than air, gently rolled into the trenches of the unsuspecting French and Algerian troops causing much death and confusion.

Otto Dix, the German Gas Attack (1924)

Newspaper articles describing the attack at Langemarck expressed the horror and surprise of the event better than any text of medicine or toxicology:

"The nature of the gasses carried by the German asphyxiating shells remain a mystery. Whatever gas it is, it spreads rapidly and remains close to the ground. It is believed not to be specially deadly -- one that rather over powers its victims and puts them hors de combat without killing many. Its effect at Bixschoote may have been due to panic caused by the novelty of the device. Its composition and manner of discharge are probably no mystery to the scientific artillerymen of the Allies. That such devices might be used in war has been known for a long time, but the positive prohibitions of The Hague Conference have prevented the more civilized nations of Europe from going far with experiments in this line." As reported by the New York Tribune April 25, 1915.

"The] vapor settled to the ground like a swamp mist and drifted toward the French trenches on a brisk wind. Its effect on the French was a violent nausea and faintness, followed by an utter collapse. It is believed that the Germans, who charged in behind the vapor, met no resistance at all, the French at their front being virtually paralyzed."

"Everything indicates long and thorough preparation for this attack. The work of sending out the vapor was done from the advanced German trenches. Men garbed in a dress resembling the harness of a diver and armed with retorts or generators about three feet high and connected with ordinary hose pipe turned the vapor loose towards the French lines. Some witnesses maintain that the Germans sprayed the earth before the trenches with a fluid which, being ignited, sent up the fumes. The German troops, who followed up this advantage with a direct attack, held inspirators in their mouths, thus preventing them from being overcome by the fumes.

In addition to this, the Germans appear to have fired ordinary explosive shells loaded with some chemical which had a paralyzing effect on all the men in the region of the explosion. Some chemical in the composition of those shells produced violent watering of the eyes, so that the men overcome by them were practically blinded for some hours.

The effect of the noxious trench gas seems to be slow in wearing away. The men come out of their nausea in a state of utter collapse. Some of the rescued have already died from the aftereffects. How many of the men left unconscious in the trenches when the French broke died from the fumes it is impossible to say, since those trenches were at once occupied by the Germans.

This new form of attack needs for success a favorable wind. Twice in the day that followed the Germans tried trench vapor on the Canadians, who made on the right of the French position a stand which will probably be remembered as one of the heroic episodes of this war. In both cases the wind was not favorable, and the Canadians managed to stick through it. The noxious, explosive bombs were, however, used continually against the Canadian forces and caused some losses." [1]

The use of gas at Langemarck -reported by the New York Tribune, April 27th 1915.

On September 25 1915, the British returned the favor using chlorine gas at Loos. Unfortunately another problem of the use of gases was established at that time. The winds shifted and some English troops were gassed as well. Gases proved difficult to deploy with predictability. To reduce this risk artillery shells were utilized and Livens projectors employed. Projectors were football-sized canisters, containing the 1.5 gallons of the gas, that were protected by mortar into the enemy's trenches. The various shell types were known as yellow cross and white cross.

The earliest gas masks were merely pieces of gauze with strings to act as ties. It was quickly leaned that making them wet helped to make them more efficient. Canister gas masks were developed originally for chlorine gas attacks and they were moderately effective. Around that time however a more deadly agent phosgene in 1916 was used which was only partially effectively filtered with the gas masks of the day.

There were over 60 chemicals experimented with in World War I. These were divided into three main types. Lachrymators, Asphyxiants and Blister agents. Chlorine (military designation Cl), Phosgene (CG) and Diphosgene (DP) were classified as asphyxiants. Chlorine is lethal at a dose of 1: 5000 gas/air. Phosgene (carbonyl chloride) is twice as lethal at 1:10,000 parts gas/air. Another chlorine compound known as trichloromethylchloroformate also known as Diphosgene was first used by Germany in May, 1916, and was the most deadly of these agents. Diphosgene could not be filtered by a gas mask of the day. In World War I chlorine is credited with 1,976 British deaths and 162,457 non-fatal casualties. Of American troops, 1843 soldiers were exposed to chlorine gas though over 70,000 were poisoned by gas attacks. As they entered later in the war, Mustard gas was more common. The after effects contributed to more deaths in the years that followed.

Chlorine gas was discovered by Carl Scheele, a Swedish chemist in 1774. He also discovered hydrogen cyanide in 1782. Sir Humphy Davy synthesized phosgene in 1812. The properties of almost all the gases used in world war I were discovered in the 18th and 19th century and well known by the turn of the century. [2]

Modern exposure to chlorine in not infrequent. Anyone who chlorinates his or her pool realizes the sharp acrid and irritating smell of chlorine. In a gaseous form it can reach both the upper and lower airways as it is only moderately soluble in water. After a brief delay chlorine can cause mild to very serious ocular and respiratory symptoms and even death. Five-year cumulative data (1988-1992) from the American Association of Poison Controls Centers' National Data Collection System revealed 27,788 exposures to chlorine. Of these exposures, the outcome was categorized in 21,437 cases; 40 resulted in a major effect, 2091

resulted in a moderate effect, 17,024 resulted in a minor effect, and 2099 had no effect. Three fatalities occurred. [3] Internationally, chlorine is the singe most common cause of toxic chemical release incidents. It is readily available in many industries with poor security and may be a terrorist chemical agent.

References:

1. **http://raven.cc.ukans.edu/~kansite/ww_one/copyrite.htm. This is the Great War Primary Document Archive from the University of Kansas.**
2. **Textbook of Military Medicine. Medical Aspects of Chemical and Biologic Warfare. Eds. Zajtchuk R, Bellamy R. 1997 Office of the Surgeon General, Department of the Army. Borden Institute. Walter Reed Medical Center. Washington**
3. **Eli Segal. eMedicine Journal, May 23 2001, Volume 2 Number 5**