

## Mustard gas use in World War I: an ophthalmic perspective

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Soldiers from the British 55th (West Lancashire) Division temporarily blinded by tear gas near Bethune during the Battle of Estaires, April 10, 1918.

Source: This is photograph [Q 11586](#) from the collections of the [Imperial War Museums](#) (collection no. 1900-22). Link: <http://www.iwm.org.uk/collections/item/object/205193875>

“In the early hours of the 28<sup>th</sup> Oct. Cpl. Noel was on duty (test strip). The others were sitting or laying on the duckboards, in readiness to go out on the lines when required. Word was given to put gas masks on, as Fritz had mixed gas shells with a bombardment of high explosives, and then one gas shell arrived near our door. We all showed signs of being gassed. After a hectic night my eyes started to close and burn in the corners. I indulged in a series of bouts of coughing and sickness. On Oct 30 I was told to go and get my eyes dressed and bandaged at the 2<sup>nd</sup> Brigade. An AMC soldier told me vomiting would help. He places me with others in a single file and then told us to put our paws on the chap in front. Like this, blind, we scrambled along duckboards and stopped at a dressing station then were put on a horse then we were put on a horse-drawn ambulance, later changed into a motor ambulance near Ypres. We arrived at 2nd Canadian Clearing Station, and after being inoculated etc., I was placed on a stretcher, undressed, washed, eye dressed, had a terrific headache, was then placed on an ambulance train. Then my days were a repetition of doctor’s visits, eyes burning pretty bad, eye dressed twice before dinner, eyes dressed twice before dinner, eyes dressed before and after tea, indulged in coughing, restlessness, throughout the night, lost my voice to a whisper (later I was to receive a letter from Australia. It had been stamped 4.11.17 and signed “deceased” at the 22<sup>nd</sup> G.H.B. where I was still alive). A Scotch chap in the next bed informed me that the night sister had sat alongside me, and that I had been delicious. He wished me luck, and mentioned that the last that occupied my bed had passed out from gas....” as quoted in Adam-Smith (1978), p. 283-284.

## **History and use of mustard gas**

Mustard gas or mustard agent (dichloroethylsulfide) was first synthesized in 1822 and again in 1854. However, Victory Meyer finally identified it in 1886 (Sidell, Takafuji, & Franz, 1997, p. 10). The Germans first used mustard agent in World War 1 on 12-13 July 1917 against British troops at Ypres, Belgium (Derby, 1920, p. 20). Sometimes known as “yperite” (Hilmas, Smart, & Hill, 2008). Mustard gas eventually caused the most casualties in this war than all the other chemical agents combined including chlorine, phosgene and cyanogen chloride (Fitzgerald, 2008a; Hilmas et al., 2008, p. 21). The use of this agent completely changed gas warfare to date causing massive numbers in injuries, over 20,000 in the first six weeks of it’s use (Hilmas et al., 2008, p. 20). It has been estimated that up to 70% of chemical casualties in World War I were caused by mustard gas (Hurst et al., 2008, p. 262). Reported in the “Official History of the World” was that 75 to 90 % of all mustard gas injuries had some ocular involvement (Hughes, 1942, p. 583). By the time the Armistice, on the 11<sup>th</sup> November 1918, the use of chemical weapons (mustard gas as well as chlorine and phosgene) has resulted in more than 1.3 million casualties and approximately 90 000 deaths (Butler, 1919, p. 12; Fitzgerald, 2008b, p. 612).\*

Exposure to very little of the substance was effective in causing injury. Mustard gas did not need necessarily be inhaled to be effective as any contact with the skin was enough to cause massive blisters and burns (Derby, 1920; Wikimedia Foundation, 2013). In addition to that it caused temporary blindness and swelling of the conjunctiva and eyelids (Derby, 1920; Wikimedia Foundation, 2013). Actually as little as 0.07mg for 30 minutes and as much as 0.15mg for 10 minutes was enough to be lethal (Fitzgerald, 2008b, p. 613). Mustard gas was a vesicant, which caused large blisters on any area of contact (Fitzgerald, 2008b, p. 618). Even though it was used at the end of the war, it was then known there-after as “the king of the gases” as the complexity of treatment required in mustard gas injuries involved a new level of medical care and treatment (Fitzgerald, 2008b).

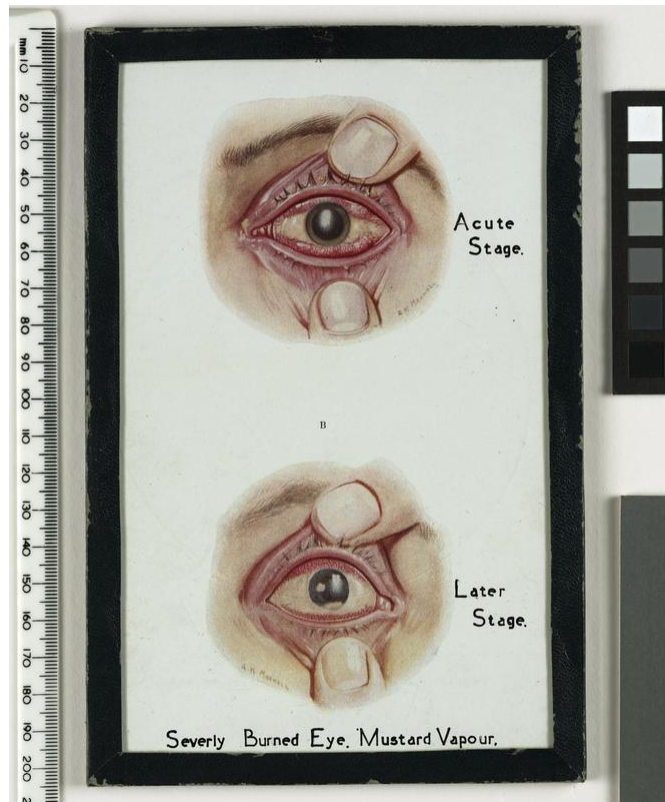
## **Injuries from mustard gas exposure**

Mustard gas remained potent in the ground for weeks after it was released (in trenches and dugouts) and made it difficult to capture trenches that were infected (Hilmas et al., 2008, p. 20). Mustard gas was toxic in concentrations that were undetectable at the time of exposure specifically by the sense of smell and an affected person suffered no discomfort at the time of exposure (Archive & Office, 1926). Although later troops were warned that mustard gas had the scent of garlic or horseradish (Fitzgerald, 2008b). The symptoms were not evident until hours later (Archive & Office, 1926).

Mustard gas temporarily blinded soldiers and caused a variety of other injuries (Hill, 2008, p. 83). In the milder cases of gas exposure, patients experienced profuse lacrimation and a large degree of injection of the conjunctiva (Derby, 1920, pp. 120-121). In more severe cases there was a large degree of irritation and redness as well as swelling and the formation of bullae (Derby, 1920, p. 120). There was also the presence of corneal lesions with varying degrees of severity as well as secondary conjunctivitis and corneal ulceration, which resulted sometimes in blindness (Derby, 1920, p. 121).

In addition it also caused some respiratory problems such as sneezing and an increase in nose and throat irritation and occasionally vomiting, amongst other injuries (Derby, 1920, p. 120). These included a range of mild to severe respiratory and skin conditions, amongst others (Sidell et al., 1997, p. 204).

Severely Burned Cornea Of The Eye. Mustard Vapour. Acute Stage. Later Stage.



Source: This is photograph [SUR 788](#) from the collections of the [Imperial War Museums](#). Link: <http://www.iwm.org.uk/collections/item/object/30025911>

## Protection

Protection and defense against Mustard gas came in the form of protective masks that covered the entire face and if were worn correctly could have protected the eyes and lungs (Momchilovich, 2012). As well as this other measures included permeable clothing treated against chemical weapons and impermeable clothing that was in-effect a plastic barrier (Momchilovich, 2012).



A Canadian soldier with mustard gas burns, ca. 1917-1918

Source: Library and Archives Canada / C-080027 from Wikipedia Commons. Link: [http://en.wikipedia.org/wiki/File:Mustard\\_gas\\_burns.jpg](http://en.wikipedia.org/wiki/File:Mustard_gas_burns.jpg)

## **Medical treatment**

Soldiers exposed to mustard gas needed to bathe with hot soap and water to remove traces of the gas, if this was within 30 minutes of exposure, blistering could be avoided (Fitzgerald, 2008b). Trained doctors (and medics) managed portable shower units when administered assisting in alleviating the effect (Fitzgerald, 2008b).

Naturally, an ophthalmologist should have been consulted regarding treatment if it was at all possible (Sidell et al., 1997, p. 215). Then soldiers were treated with bathing solutions were a mixture of sodium bicarbonate and this bathing included an initial thorough washing out of the eyes (Derby, 1920, p. 123). As is basic practice with eye injuries, the eyes were irrigated or washed out to remove any remaining trace of mustard gas from both the lashes as well as on the surface of the eye (Sidell et al., 1997, p. 214). This was practiced to prevent infection and possible scarring (Sidell et al., 1997, p. 214).

Thereafter frequent bathing with a lukewarm solution of boric acid or salt solution or 1% sodium bicarbonate solution (Derby, 1920, p. 123). "A drop of oil should be instilled in the eye" stated Derby (1920), p. 123, particularly Albolene or vegetable oil such as castor oil was also effective . Albolene was found later to be more irritating and was used for milder cases (Derby, 1920, p. 123).

Treatment of secondary infections of the conjunctival sac included washing the eyes with a weak antiseptic solution- either argyrols or protargol (Derby, 1920).

More severe eye injuries were usually hospitalized and daily care for these patients meant they received at least one daily irrigation of the eyes plus depending on the severity of their case other treatments (Sidell et al., 1997, p. 215)

## **Long term effects of exposure and chronic eye disease**

Some studies show that there is a casual connection between mustard gas and some chronic conditions such as skin cancer and asthma and other respiratory diseases (Smith et al., 2008, p. 313). Chronic eye conditions that have a casual connection to mustard exposure could be chronic conjunctivitis, recurrent corneal ulcerative disease and delayed recurrent keratitis page (Smith et al., 2008, p.314).

Those that sustained severe ocular injuries, the cause being exposure to high volumes of mustard gas, experienced difficulties after the initial effects have subsided. In some cases, after 10 to 25 years after the exposure, some patients experienced recurrent or persistent corneal ulceration and chronic conjunctivitis and corneal clouding often accompanied this (Smith et al., 2008, p.314).

According to Smith et al. (2008), p.314 "10% of those soldiers with a severe eye injury in World War I had both the cornea and the conjunctiva involved". These individuals developed delayed keratitis from 8 to 25 years later (Smith et al., 2008, p.314).

### **Another personal account of a soldier's experiences**

“The one wound that terrified all men was to be gassed. The fear of this silent weapon did almost as much damage as did the actual gas. They were, to a man, terrified of it. The physical effects were bronchitis, emphysema, fibrosis of the lungs, asthma, vertigo, palpitations, pulse rate up to 13, vomiting, pain after food, streaming, painful eyes and temporary blindness. Although 16 496 men were gassed, only 323 died before 1920.

These mists of death began in France on 22 April 1915 (before the Australians attacked Gallipoli). Near Langemarck, in Belgium, the Germans used poison gas for the first time. ‘The diffusion of asphyxiating or deleterious gases’ has been outlawed at the pre-war Hague Convention, but both sides were ready with stocks and a determination to use it. It was sent over the trenches, one side to the other, at any time the wind was favourable. Sometimes the gas swept down as the men went over the mud and into action. Oliver Hoskin was blinded as he got into No Man’s Land. His mates rolled in him in a blanket and put him by a bank and said they’d come back for him, and he lay there in his blindness hearing them all go away – and then the battle afar off, and then, nothing. ‘I thought I would never be found.’ But when night fell he heard them calling and he answered. They had crept out of their lines to bring him in. ‘Our respirators – we called them “gaspirators” were simply chemically impregnated pieces of cloth kept in a protective pouch and we were informed that if the cloth dried out urine could revive the anti-gas properties in an emergency,’ Jim McPhee says. At first, the signaling apparatus for giving the alarm when gas was detected was crude. Gongs made from empty shell cases beaten on with an iron bolt, rattles, klaxons, anything to warn the men in the front line. Later, the British Strombus Horn which could be heard five miles away was used.” As quoted by Adam-Smith (1978), p. 336.

**\*Actual numbers of casualties in WW1 is disputed in some of the literature.**

## Reference list

- Adam-Smith, P. (1978). *The ANZACS*. West Melbourne: Thomas Nelson Australia Pty Ltd.
- Archive, G. W. P. D., & Office, U. A. S. G. s. (1926). *The Medical Department of the United States in the World War, Volume XIV, Medical Aspects of Gas Warfare*. Arizona, USA: GWPDA, Inc.
- Otis Historical Archives, National Museum of Health and Medicine.
- Butler, T. H. (1919). Plastic surgery of the eyelids after war injuries. *Archives of Ophthalmology*, 48(2), 103-110.
- Derby, G. S. (1920). Ocular manifestations following exposure to various types of poisonous gases. *Archives of Ophthalmology*, 49(2), 119-130.
- Fitzgerald, G. J. (2008a). Chemical warfare and medical response during World War I. *American Journal of Public Health*, 98(4), 611-635.
- Fitzgerald, G. J. (2008b). Chemical Warfare and Medical Response During World War I. *American Journal of Public Health*, 98(4), 611-625. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2376985/>  
doi:10.2105/AJPH.2007.11930
- Hill, J., Benjamin A. (2008). *History of the Medical Management of Chemical Casualties* Medical aspects of chemical warfare (pp. 77-114). Washington, DC, USA: Office of The Surgeon General.
- Hilmas, C. J., Smart, J. K., & Hill, J., Benjamin A., . (2008). *History of chemical warfare* Medical aspects of chemical warfare (pp. 9-76). Washington DC, USA: Office of The Surgeon General. Retrieved from [https://ke.army.mil/bordeninstitute/published\\_volumes/chemwarfare/CHAP2\\_Pg\\_09-76.pdf](https://ke.army.mil/bordeninstitute/published_volumes/chemwarfare/CHAP2_Pg_09-76.pdf).
- Hughes, W. F. (1942). Mustard gas injures to the eyes. *Archives of Ophthalmology*, 27(3), 582-601.
- Hurst, C. G., Petrali, J. P., Barillo, D. J., Graham, J. S., Smith, W. J., Urbanetti, J. S., & Sidell, F. R. (2008). Vesiciants. In S. D. Tuorinsky (Ed.), *Medical aspects of chemical warfare* (pp. 259-310). Washington, DC, USA: Office of The Surgeon General.
- Momchilovich, S. (2012, 20 December 2012). *Chemical warfare in World War 1*. Retrieved 21.03.2013, from [http://prezi.com/wvov\\_h5btcak/germanychemwarfare/](http://prezi.com/wvov_h5btcak/germanychemwarfare/)
- Sidell, F. R., Takafuji, E. T., & Franz, D. R. (1997). *Medical Aspects of Chemical and Biological Warfare*
- Smith, W. J., Clark, M. G., Talbot, T. B., Patricia Ann Caple, Sidell, F. R., & Hurst, C. G. (2008). *Long-Term Health Effects of Chemical Threat Agents* Medical aspects of chemical warfare (pp. 311-338). Washington DC, USA: Office of The Surgeon General. Retrieved from [https://ke.army.mil/bordeninstitute/published\\_volumes/chemwarfare/Ch9\\_Pgs311-338.pdf](https://ke.army.mil/bordeninstitute/published_volumes/chemwarfare/Ch9_Pgs311-338.pdf).
- Wikimedia Foundation, I. (2013, 1 April 2013). *Chemical weapons in World War 1*. Retrieved 21.03.2013, from [http://en.wikipedia.org/wiki/Chemical\\_weapons\\_in\\_World\\_War\\_I](http://en.wikipedia.org/wiki/Chemical_weapons_in_World_War_I)