

Gassed

Gas! Gas! Quick, boys! — An ecstasy of fumbling,
Fitting the clumsy helmets [gas masks] just in time;
But someone still was yelling out and stumbling,
And flound'ring like a man in fire or lime....

Wilfred Owen, *Dulce et Decorum Est*, 1917¹(p117)

Sulfur mustard (2,2'-dichlorodiethyl sulfide), commonly known as mustard gas, was the "King of the War Gases."²(p120) It was first used as a tactical weapon and a weapon of terror in World War I. Although there were many deaths, the numbers of nonfatal casualties were far greater, and the suffering of soldiers was legendary. In the first 3 weeks of its use, there were 14000 nonfatal British casualties and 500 deaths, and large numbers were incapacitated. A vesicant, persistent gas, named for its odor, sulfur mustard's effects were not immediate, becoming apparent 4 to 12 hours after exposure. Among its effects were skin blisters the size of one's hand, blindness, and intractable vomiting and choking (often emerging after falling asleep on the night following exposure). With high concentrations, death generally occurred on the second or third day but could be drawn out over several weeks. John Singer Sargent's *Gassed*, which hangs in the Hall of Remembrance at the British War Museum, is one of the most memorable and unsettling images of a mustard gas attack.

The use of gas was an innovative tactic; gas was introduced at a time in World War I when both sides were hunkered down in trenches. Bombs were inaccurate, but gas, heavier than air, descended into the trenches, forcing the inhabitants out and exposing them to weapons fire (often deemed preferable to the agony of being gassed). Sulfur mustard was first used at the Ypres Salient (the part of the line of battle that projects closest to the enemy) in Belgium on July 12-13, 1917. That night the British 15th and 55th Divisions experienced 2000 casualties. "Most of the British soldiers did not realize that they had been gassed and went to sleep, only to find within hours that they had scorched lungs, blindness, and painful blisters."²(p260)

The use of sulfur mustard was immediately decried as inhumane and immoral, not worthy of use in war. Yet, by the war's end both sides used gas routinely; it was placed as a liquid in artillery shells, which were marked with yellow crosses, and it vaporized when the shells exploded, creating a yellow-green mist. Unlike chlorine, sulfur mustard is a persistent gas that contaminated the battlefield, lying dormant and deadly for days or weeks after the attack, making the area almost uninhabitable. Despite the innovative use of gas masks, sulfur mustard penetrated through clothing to the skin. Its effects were clearly psychological as well; posttraumatic stress disorder (PTSD), known then as shell shock or neurasthenia, was



a regular complication for those exposed. The writer Robert Graves,³ a victim of gas exposure, describes the long-term psychological effects: "Since 1916, the fear of gas obsessed me: any unusual smell, even the sudden strong scent of flowers in a garden, was enough to send me trembling."³(p200)

In histories of the first World War, the effects of gas sometimes have been minimized, but in retrospect the use of gas emerges as a critical element in the war. In the war's last 16 months, sulfur mustard accounted for over 4086 deaths among British troops, with 160526 nonfatal casualties. Reacting to the catastrophic numbers of chemical-warfare casualties, the 1922 Washington Treaty reemphasized the Hague Conference's earlier ban on the use of "noxious gases." In 1925, the Geneva Convention generalized this to a ban on the use of all chemical weapons. Despite these laws against the use of chemical weapons, they continued to be produced and used in various conflicts, such as those between Spain and Morocco (1923-1925) and between Italy and Ethiopia (1935-1936). However, World War II has been described as the "unfought chemical war."⁴(p1) Both sides had gas but it was not used and instead it served as a deterrent, with each side believing that the other might have the more deadly chemical weapon. As an infantry corporal in World War I, Adolph Hitler was temporarily blinded by mustard gas during the British bombardment at Werwick, Belgium,²(p208) and was hospitalized at Pasewalk, Pomerania, where he learned of the armistice. Whether his being gassed had a role in the German decision to withhold its use is still debated.

The United States committed to no first use of chemical weapons. However, because of concerns about possible first use by Germany, the US military conducted secret gas experiments involving US servicemen as human subjects. A 1993 Institute of Medicine report documented that over 60000 US servicemen were involved in chemical defense research.⁴(p1) At least 4000 of them were exposed to high concentrations of mustard agents or Lewisite in gas chambers and contaminated ground areas, often without appropriate informed consent.

In most military tests, protective clothing and gas masks were used, but exposure generally continued until the skin showed evidence of chemical burns. The Institute of Medicine committee found that exposure levels "were sufficiently high that even the most efficient gas mask would have leaked enough mustard gas or Lewisite to



cause inhalation and eye injuries.^{4(p3)} All those tested took an oath of secrecy to never reveal their exposure and almost all kept the secret for 40 years, but eventually the issue came to the attention of Veterans Affairs hospitals.^{4(p1)} In one of the most disgraceful acts of medical experimentation in that war, those servicemen who were exposed were not followed up after World War II, and no epidemiological studies were carried out on mustard agent-exposed persons (military and civilian) who worked in US arsenals that produced mustard agents and other chemicals.

Sulfur mustard is a radiomimetic alkylating agent whose toxicity is linked to its ability to cross-link DNA strands, leading to strand breakage.^{5,6} Mustards are mutagenic, carcinogenic, and cytotoxic and may initiate free radical-mediated oxidative stress. The Institute of Medicine report⁴ found evidence of such toxicity. They documented a causal relationship between exposure and respiratory cancers (nasopharyngeal, laryngeal, and lung), skin cancer, nonlymphocytic leukemia, chronic respiratory disease (asthma and emphysema), bone marrow suppression, and conjunctivitis. Moreover, a 50-year follow-up of a randomly selected sample of 363 surviving male veterans, drawn from a Veterans Affairs registry of those who participated in the secret military tests of mustard gas, revealed that the prevalence of a current diagnosis of PTSD was 32%.⁷ The prevalence of PTSD was linked to such risk and protective factors as volunteering, presence of physical symptoms during the tests, and prohibited disclosure. Those with a PTSD diagnosis reported poorer physical health.

After World War II, chemical weapons were used with impunity under Saddam Hussein against at least 60 000 Iranians during the Iran-Iraq war (1980-1988) and subsequently against Kurdish civilians in 1988 to terrorize these noncombatants. This was the most extensive use since World War I. It has resulted in contemporary documentation of the effects of mustard gas in Iran. Approximately 34 000 Iranians known to have sustained mustard-agent exposure during the Iran-Iraq war who survived over a decade afterward were screened for the most commonly occurring medical problems.⁸ These authors found chronic pulmonary (42.5%), ocular (39.3%), and skin

(24.5%) complications from exposure to sulfur mustard.⁸

In 1993, the Chemical Weapons Convention was promulgated, and verification of the destruction of such weapons was required. Before 1993, possession of chemical weapons was legal under international law, but “first use” was illegal. Once chemical weapons were used against soldiers, a country could retaliate, thus allowing these weapons to remain legal. Now, even responsive use is prohibited. The United States agreed to dispose of its unitary chemical weapons stockpile, binary chemical weapons, recovered chemical weapons, and former chemical weapon production facilities by April 29, 1997, and miscellaneous chemical warfare material by April 29, 2002.

John Singer Sargent’s *Gassed* vividly demonstrates the effects of sulfur mustard in World War I and in all subsequent conflicts where it was used. Commissioned in April, 1918, Sargent, then 62 years of age, was sent to France to find a suitable wartime subject. He was the son of an American surgeon and was a renowned portrait painter who turned away from portrait painting in 1907 to pursue other subjects. Among the last portraits of that period was his *Four Doctors* (1906)⁹ for the Johns Hopkins University (a portrait of Drs Welch, Osler, Halstead, and Kelly).

In *Gassed*, Sargent turned again to medicine but now to paint the consequences of the gas war. At Le Bac-de-Sud on the Arras-Doullens road in France, on August 21, 1918, he visited a casualty station shortly after a mustard gas attack.¹⁰ There he witnessed an orderly leading a line of soldiers, who had been blinded by mustard gas, to treatment. Sargent chose this event as his subject and created a naturalist allegorical frieze, under a sky whose color is reminiscent of mustard gas, that shows 2 groups of blinded soldiers guided by orderlies toward the first aid tent on the right; only the guy ropes of the tent are shown. A line of 9 victims of the gas attack, assisted by 2 orderlies, dominates the scene as they move forward along a boarded walkway among over 40 others lying on the ground in disarray and awaiting treatment. The 9 are shown in profile in groups of 3, carrying their gear and their guns, as they take uncertain steps staggering forward; the men in front are supported by an orderly. The



men lean on one another, each man's hand resting on the shoulder of the man in front. Their movement creates a powerful processional rhythm across the picture space as Sargent recreates their anguish and exhaustion, while life goes on as others in the company play a football game.

Tents and a soccer game are shown in the background; a soccer ball is seen rising into the air in the gap between an orderly and the man in front of him (**Thumbnail**). From the right, another group of 8 men and 2 orderlies advances obliquely from the direction of the setting sun, with the moon rising in the background. The guy ropes of the unseen first aid tent provide the only harbinger of hope. Biplanes overhead provide the only evidence of ongoing military action. There is no evidence of sentimentality, as Sargent felt the war needed no dramatization by him. He draws on "religious associations of the processional form to give his painting spiritual weight and meaning."^{11(p265)} The painting (7.5 ft × 20 ft), completed in March, 1919, was voted picture of the year by the Royal Academy of the Arts, London, England, in 1919. Yet it did not receive universal praise; E. M. Forster felt it was too heroic and that it did not sufficiently emphasize the obscenity of the war.¹²

The agony of a mustard gas attack led to strong criticism of those who glorified war. As a young woman, Vera Brittain (1893-1970),¹³ later a writer and journalist, was a nurse's aid in a British volunteer aid detachment. She wrote to her mother:

I wish those people who write so glibly about this being a holy war, and the orators who talk so much about going on no matter how long the war lasts and what it may mean, could see a case—to say nothing of 10 cases of mustard gas in its early stages—could see the poor things all burnt and blistered all over with great suppurating blisters, with blind eyes—sometimes temporarily [sic], some times permanently—all sticky and stuck together, and always fighting for breath, their voices a mere whis-

per, saying their throats are closing and they know that they will choke.^{13(p395)}

This same sentiment was most powerfully expressed by the war poet, Wilfred Owen, whose poems serve as the text for Benjamin Britten's *War Requiem*. Owen returned to the war after discharge from the Craiglockhart war hospital in Scotland following treatment for "shell shock" because he felt it was his duty to do so. No passivist, he earned the military cross for bravery in the last months of the war and died in battle the week before the war ended. In the gas fields, he could no longer see any glory in war and wrote this poem in protest against those who glorified it, especially writers of books for children. In *Dulce et Decorum Est*,^{14(p117)} he describes a fellow soldier in the aftermath of a mustard gas attack:

In some smothering dreams you too could pace
Behind the wagon we threw him in...
If you could hear, at every jolt, the blood
Come gargling from the froth-corrupted lungs,
Obscene as cancer, bitter as the cud
Of vile, incurable sores on innocent tongues,
My friend, you would not tell with such high zest
To children ardent for some desperate glory,
The old Lie; Dulce et Decorum est
Pro patria mori.*

*Sweet it is and honorable to die for one's country.^{14(p22)} (Taken from an ode by the Roman poet Horace [*Odes*, III ii 13] that was read by generations of English school boys and frequently placed on memorial plaques.)

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REFERENCES

1. Stallworthy J. *The Poems of Wilfred Owen*. New York, NY: W W Norton & Co; 1986.
2. Cook T. *No Place to Run: The Canadian Corps and Gas Warfare in the First World War*. Vancouver, British Columbia: UBC Press; 1999.
3. Graves R. *Goodbye to All That*. London, England: Penguin; 1929.
4. Pechura CM, Rall P, eds. *Veterans at Risk: The Health Effects of Mustard Gas and Lewisite*. Washington, DC: National Academy Press; 1993.
5. Borak J, Sidell FR. Agents of chemical warfare: sulfur mustard. *Ann Emerg Med*. 1992;21:303-308.
6. Dacre JC, Goldman M. Toxicology and pharmacology of the chemical warfare agent sulfur mustard. *Pharmacol Rev*. 1996;48:289-326.
7. Schnurr PP, Ford JD, Friedman MJ, Green BL, Dain BJ, Sengupta A. Predictors and outcomes of posttraumatic stress disorder in World War II veterans exposed to mustard gas. *J Consult Clin Psychol*. 2000;68:258-268.
8. Khateri S, Ghanei M, Keshavarz S, Soroush M, Haines D. Incidence of lung, eye, and skin lesions as late complications in 34,000 Iranians with wartime exposure to mustard agent. *J Occup Environ Med*. 2003;45:1136-1143.
9. Southgate T. The four doctors. *JAMA*. 1989;261:3060.
10. Olson S. *John Singer Sargent: His Portrait*. New York, NY: St Martin's Griffin; 1986.
11. Kilmurray E, Ormond R. *John Singer Sargent*. eds. Washington, DC: National Gallery of Art; 1999.
12. Forster EM. Me, them and you. In: *Abinger Harvest*. London, England: Edward Arnold & Co; 1936.
13. Brittain V. *Testament of Youth: An Autobiographical Study of the Years 1900-1925*. New York, NY: MacMillan; 1937.
14. West D. *Horace Odes III Dulce Periculum*. New York, NY: Oxford University Press; 2002.