

The role of chemical defence in chemical warfare, chemical deterrence, and chemical disarmament¹

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Chemical defence serves essential functions in chemical warfare, in chemical deterrence, and in chemical disarmament. A factor of central importance in each of these roles is the high degree of protection against chemical weapons that can be achieved by practical measures of chemical defence. This sets chemical weapons apart from conventional weapons, against which no comparable degree of protection of combatants can generally be achieved. The unique effectiveness of chemical defence has important implications for warfare, deterrence and disarmament.

In chemical warfare, a good chemical defence greatly limits the damage inflicted by chemical attack. Historically, this was seen in the dramatic effect that antichemical protection, chiefly the gas mask, had in limiting the importance of chemical weapons in World War I. Developments since then – greatly-improved masks, protective clothing, detectors and other equipment and doctrine – have further increased the margin of protection and the ascendancy of the defence.

In addition, chemical defence deters the initiation of chemical warfare. The better a force is protected against chemicals, the less incentive there is for a chemically-armed adversary to initiate chemical warfare. Examination of official documents shows that such defensive deterrence operated in the European theatre in World War II, where both sides knew the other was well equipped for chemical defence and neither side used chemicals. Indeed, chemical warfare has never been initiated against forces with good antichemical protection.

Chemical defence can also act as a disincentive to the proliferation of chemical weapons. If good antichemical protection is generally available, the acquisition of chemical weapons becomes less cost effective, whether for first use or for retaliation in kind. Evidence for the operation, albeit imperfect, of such defensive stability is seen in the fact that nearly all modern military establishments deploy gas masks and other antichemical protective

equipment, while few have actually stockpiled chemical weapons.

Finally, chemical defence has an essential role in chemical disarmament. There are three reasons why this is so. First, the prevalence of good chemical defence favours compliance with a chemical disarmament treaty by making chemical weapons less militarily useful, thereby reducing the incentive for having them. Second, the prevalence of chemical defence facilitates verification. The more effective the defences he faces, the more largescale and therefore more liable to detection are the preparations the would-be violator is forced to make in order to achieve military significance. Third, should violations nevertheless occur, chemical defence renders them much less dangerous.

It follows from these considerations that if the Chemical Weapons Convention (CWC) is to be maximally effective, measures of antichemical protection must be accessible to all its members. This argues for a considerable degree of openness and even cooperation among the states parties to the Convention in matters of chemical defence.

The conclusion is clear. Antichemical protection is essential while the possession of chemical weapons is not prohibited by international law and while states possess stocks of chemical weapons. Moreover, chemical defence will remain essential after the entry into force of the CWC.

Chemical defence in World War I

The first German cloud attacks with chlorine gas in Belgium in April 1915 caused some British and French scientists to become deeply pessimistic, arguing that the preponderance of Germany in industrial chemistry would give that nation a major advantage. Others argued that the gas threat would be largely offset by antichemical protection, based on knowledge of human physiology and other sciences in which the Allies were proficient.

¹ Adapted from the Keynote Address to the Sixth Annual Scientific Conference on Chemical Defense Research, US Army Chemical Research, Development and Engineering Center, Edgewood Area, Aberdeen Proving Ground, Maryland, 13-16 November 1990.

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The latter view proved correct. Chemical weapons caused about three percent of an estimated 15 million casualties on the Western Front.³ Although much effort was expended in the provision and use of chemical munitions and although gas caused much misery to troops on both sides, it was not a very important weapon in World War I, owing largely to the effectiveness of the defences that even then could be provided against it, chiefly the gas mask.

Nearly all of the innovations that first saw widespread use in World War I subsequently became standard in military establishments around the world: machine guns, barbed wire, tanks, motorized transport vehicles, radios, aircraft, submarines – but not gas. Without doubt, the effectiveness and availability of antichemical protection has been a major factor in limiting the spread and use of chemical weapons.

Some authors writing between the world wars, using unrepresentative and inaccurate data, argued that chemical weapons were much more effective than conventional weapons in producing casualties in World War I. But records of German ammunition production and of British casualties in Europe in 1918, the year of the war in which chemical warfare reached its highest stage of development, show that chemicals produced no more casualties, shell for shell, than did high explosive munitions.⁴ About one-fifth of German artillery shell production was chemical and about the same proportion of admissions to British medical units attributable to artillery were chemical. Nor does this include battle fatalities that never reached aid stations or hospitals, nearly all of which resulted from bullet and shrapnel wounds, not from chemicals. American records show a higher proportion of hospitalized chemical casualties than do British and French records, but must be interpreted with care in view of a 1926 Army Medical Department report that attributed a majority of the recorded US chemical casualties

to malingering,⁵ presumably associated with the American practice of hospitalizing essentially all men reporting with mustard burns, even when self inflicted.

Even against mustard – the ‘king of battle gases’ – the gas mask kept casualties far below what they would otherwise have been. Mustard was the principal agent used in the war capable of injuring the skin. Nevertheless, and even though most men had no protective clothing, the majority of mustard casualties were caused by burns of the eyes and lungs. Most of these casualties resulted from failure to wear the mask. Without adequate training, without detectors and with masks far less comfortable than those of today, troops frequently failed to mask or unmasked too soon. Also, inadequate training and the lack of detectors caused men to remain in contaminated trenches and dugouts for prolonged periods without realizing the hazard, when relocation could have prevented mustard casualties. Relatively few men were injured by passing through contaminated areas, and fewer still by direct exposure to liquid mustard from exploding munitions.⁶

Because of difficulties in Allied production efforts, Germany had a monopoly on mustard from its introduction in July 1917 until nearly a year later, in June 1918, when French supplies first became available. Nevertheless, even the limited defensive capabilities then available kept the massive and one-sided use of mustard by Germany from having any important effect on the course of the war.

The official British history of World War I states that ‘gas achieved but local success, nothing decisive; it made war uncomfortable, to no purpose’.⁷ In his history *The Real War 1914-18*, British military historian Basil Liddell Hart wrote that gas had a chance to accomplish something when it was first used but not later, because of the introduction of chemical defences.⁸ The detailed

³ L F Haber, *The Poisonous Cloud*, Oxford: Clarendon Press, 1986; Dorothy Kneeland Clark, “Effectiveness of Chemical Weapons in WWI”, staff paper ORO-SP-88, Operations Research Office, Tactics Division, the Johns Hopkins University, November 1959 (AD 233 081).

⁴ Clark, *op cit*.

⁵ M W Ireland (ed.), *Medical Aspects of Gas Warfare*, vol 14 in the series *The Medical Department of the United States Army in the World War*, Washington DC: Government Printing Office, 1926.

⁶ Clark, *op cit*.

⁷ J E Edmonds and R Maxwell-Hyslop, *History of the Great War: Military Operations: France and Belgium, 1918*, vol 5, London: Macmillan, 1947.

⁸ B H Liddell Hart, *The Real War 1914-1918*, Boston: Little Brown, 1930.

study done for the US Army by Dorothy Kneeland Clark at the Johns Hopkins Operations Research Office, published in 1959, reached the same conclusion.⁹

Chemical defence in World War II

Poison gas was used by Japan against Chinese forces in Manchuria but it was not used in Europe, even though both sides produced large stockpiles of mustard and other agents including, in Germany, the nerve agent tabun. It is commonly said that chemicals were not used because of the threat of retaliation in kind. However, available documents also show that a different reason was operative at military staff level; military staffs on both sides were sceptical about the utility of chemical weapons and did not recommend their use. For example, in 1944 Winston Churchill instructed his Joint Planning Staff to examine whether chemical weapons might be useful against the launching of the German missiles then bombarding England. The report sent back to him concluded, 'Gas attacks are unlikely to be any more effective than bombing with high explosives'.¹⁰ German military opinion regarding the utility of gas was similar. At the end of the war the commander of the German chemical troops, Generalleutnant Hermann Ochsner, told British interrogators, 'Gas was not considered a useful weapon compared to other munitions'.¹¹ Of course, each side knew that the other had good antichemical protection.

By the start of World War II, tens of millions of gas masks had been distributed to civilians throughout Britain. As a result, both British and German chemical warfare experts concluded that poison gas attacks on British cities would cause fewer casualties than an equal weight of conventional weapons. Regarding the possible effects of gas delivered by German V-1 and V-2 missiles, General Ochsner wrote in a 1949 report for the US Army, 'There was no room for hope that if

the V weapons had been given a gas charge, the effect would have been any greater than that of an explosive charge. Under existing circumstances (with the British population protected), gas casualties undoubtedly would have been less than those caused by explosive bombs'.¹² Similarly, the British scientist and wartime civil-defence adviser J B S Haldane advised a US military representative in 1940 that the Germans were unlikely to replace high explosives with gas in the London bombing because 'people would soon learn to protect themselves, since they have been educated to do it, and all have gas masks'.¹³

Without chemical defence, there is no doubt that gas would have been considered a highly effective weapon at the time of World War II. As it was, chemical defence on both sides precluded any concerted military advocacy for initiating chemical warfare. While other factors, including political ones, also enforced restraint, the prior restraint of military scepticism regarding the utility of gas kept recommendations for initiation from being made to national command authorities.

Lesser wars

Poison gas has been used in only a few of the more than 200 wars fought since World War I. In every case it was initiated against forces entirely lacking or highly deficient in protective equipment and antigas training. This was so, for example, in Ethiopia (1935-36), Manchuria (1938-42), Yemen (1966-67), and in the recent Iran-Iraq war. Iraqi gas attacks caused only a small proportion of total Iranian battle casualties. Nevertheless, the use of gas against poorly prepared Iranian military units and against completely unprotected civilians in Iranian towns, combined with intense apprehension that Iraq would use gas against Teheran in the War of the Cities were certainly among the factors contributing to the collapse of Iranian morale in 1988. However Iranian units engaged in major

⁹ Clark, *op cit*.

¹⁰ "Chemical warfare in connection with Crossbow", report by the Joint Planning Staff, War Cabinet, 5 July 1944. In Public Record Office, London, file PREM 3/89 5119.

¹¹ "Interrogation of Gen. Lt. Ochsner", British Intelligence Objectives Sub-Committee, Final Report no 187, Item no 8, 5 and 6, December 1945.

¹² H Ochsner, "History of German chemical warfare in World War II; part I: The military aspect", *Chemical Corps Historical Studies*, no 2, US Army Historical Division, 1949.

¹³ "Interview with Professor J B S Haldane", Military Intelligence Division, US War Department General Staff, Military Attache Report number 41639, 1 October 1940.

action under chemical attack never achieved even a marginally adequate level of antichemical protectedness and training, and civilians were totally unprotected and unprepared.

In short, history provides no example of the initiation of chemical warfare against well protected forces, nor any evidence that chemicals can be more than marginally effective against forces with good protective equipment and training.

Military rationale for chemical weapons

If antichemical protection is so effective, why did the United States and the former Soviet Union, possessing good antichemical protection for their armed forces, produce and maintain large stockpiles of chemical weapons – tens of thousands of agent tons on each side?

Influential studies done for the US Army in the 1950s and 1960s showed that chemicals were generally not competitive with high explosive weapons for direct casualty production against protected forces. Instead of casualty production, the effect of antichemical protective posture in slowing enemy tempo then became the principal US rationale for maintaining an arsenal of chemical weapons for possible retaliation in kind.

The additional burden that wearing antichemical protective equipment and taking other antichemical measures imposes on military units has been recognized ever since World War I. In a modern war of manoeuvre, antichemical protective posture will slow the tempo of combat and logistical operations. The tactical effect of chemicals on a target force then depends mainly on their effect in slowing its tempo and disrupting its timetable, and on the effect on troop morale. While the morale factor is hard to study, British and US experience in World War I and in modern exercises, including training with live agents, indicates that well trained, well protected troops with otherwise good morale will continue to function well in a chemical environment.

Antichemical protective equipment can slow troops down for two kinds of reasons. First, the wearing of masks, gloves and other equipment can interfere with vision, speech intelligibility, personal recognition and dexterity. But with adequate practice and good antichemical gear, these effects can be reduced to the point of having little impact on overall mission performance. The second category of effect, which can be more serious, is the limitation of body cooling imposed by the wearing of full protective covering. Depending on temperature, sunlight and humidity, if the actual or expected threat of agents that threaten the skin causes units to don protective clothing, commanders may need to sharply reduce the duration of the most strenuous operations, confine such operations to the cooler hours of the day or to night time, or order partial opening of the protective ensemble.

Antichemical protection clearly hampers military operations to some degree, but the effects on overall combat outcome are difficult to quantify. There are three ways to approach the problem: history, model building and field exercises. Historical evidence from World War I has been cited above. Model building starts with various measured parameters and makes assumptions about their interactions and effects. Models can be useful for certain specialized purposes but are of dubious value for predicting overall effects on unit mission performance. The difficulty is illustrated in the summary of a large study done for the US Defense Department in 1975, which frankly states, 'The conclusion of this analysis is that the model predicts degradation in unit mission effectiveness that is quite severe and is not supported by any troop tests or field experiments currently available'.¹⁴

Largescale field exercises, if carefully designed, executed and evaluated, can provide more reliable information.¹⁵ In weather that is both hot and humid, the wearing of full protective gear can very seriously degrade the performance of military

¹⁴ "Techniques for war games assessments of chemical operations", Final Report, vol 1, BDM Services Company, September 1975 (AD B021 809L).

¹⁵ "ROAD battalion operations in a toxic environment", vol 1, US Army Combat Developments Command, Experimentation Center, Fort Ord, CA, December 1963 (AD 371 766); "METOXE II: Final Report, Troop Test Mission Effectiveness in a Toxic Environment", 5th Mechanized Infantry Division, Fort Carson, CO, October 1969 (AD 505 384); "Combined Arms in a Nuclear/Chemical Environment", Phase IIB (Battalion Level) Force Development Test and Experimentation, report no 88-FD-TCAT-0101B, TEXCOM Combined Arms Test Center, Fort Hood, TX, October 1988 (AD C045 814).

units and can cause casualties from heat stress. Even in more clement weather, chemical protective posture seriously degrades the performance of units that are poorly trained or poorly motivated to operate with chemical defences. Under common European weather conditions, however, regular military units have routinely exercised at or near full antichemical protection for several days continuously. In recent largescale field exercises conducted in dry cool-to-warm weather, combined-arms units with only several hours of prior experience in wearing respirators and protective clothing conducted offensive, defensive and maintenance operations in full protective gear with little degradation in mission performance scores.¹⁶ Even in hot weather, if the humidity is low, well trained infantry have successfully engaged in strenuous dismounted assault exercises for several hours, as viewed by this Workshop in a videotape of training exercises conducted in full sunlight in a Middle Eastern desert.

The net utility of using chemicals depends not only on their effects on the target force but also on the costs that using chemicals imposes on the user. There is a trade off between the effect of chemicals in slowing enemy tempo and disrupting his timing versus the increased logistic burden, the diversion and attrition of firepower and other assets, and the operational complications and uncertainties incurred by the user. Ochsner, in his 1949 report, cited such costs as the reason for not even considering the use of chemicals either in the German drive through France and Belgium in 1940 or the offensive against the Soviet Union later.¹⁷ It is noteworthy in this connection that, at least in the Western literature, there have been many studies of the burden of chemical defence but few studies and little appreciation of the opportunity costs and other costs to the user of chemical weapons.

Chemical defence and chemical disarmament

The CWC prohibits the development, production, possession, transfer and use of chemical weapons, but places no constraint on measures of antichemical protection. On the contrary, Article X of the Convention, entitled 'Assistance and

Protection Against Chemical Weapons', ensures the right of states parties to maintain antichemical protective programmes and provides mechanisms whereby states parties attacked with chemical weapons or threatened by actions prohibited by the Convention may request and receive from other states parties and from the treaty-oversight organization itself such assistance as 'detection equipment and alarm systems; protective equipment; decontamination equipment and decontaminants; medical antidotes and treatments; and advice on any of these protective measures'.

The provisions of Article X make access to antichemical protection an incentive for certain less developed countries to join the Convention, enhancing its universality and likelihood of success. Conversely, making the provision of chemical protective assistance a commitment under the treaty and fostering its general diffusion and availability among states parties helps to sustain interest and support for antichemical protection, again contributing to the stability of chemical disarmament.

In summary, modern antichemical protection can have unique effectiveness against chemical weapons. It can greatly reduce the damage of chemical attack in war; it provides a disincentive to the acquisition, proliferation and use of chemical weapons. Without it, chemical disarmament would not be possible, and it enhances the effectiveness of verification.

¹⁶ TEXCOM Combined Arms Test Center, *op cit.*

¹⁷ Ochsner, *op cit.*

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