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THE MYTH OF CHEMICAL SUPERWEAPONS

By MATTHEW MESELSON

Although the threat of poison gas may instill fear, it is a waste of time and effort to use chemical weapons against troops or civilians with proper training and protective gear.

Not since World War I has the topic of chemical weapons evoked such widespread interest and alarm as it does today. Just as negotiators in Geneva appear to be on the brink of banning the whole range of toxic weapons, the specter of chemical warfare was raised in the Persian Gulf. But despite the concern, a great deal of misinformation and even disinformation dominates the public discussion and perception of these weapons. It seems appropriate, therefore, to review what chemical weapons are and what they can—and cannot—do.

The armed forces of the United States and the Soviet Union stockpile only three types of chemical warfare agents, none of them new: blister agents, mainly mustard gas, extensively used in World War I; highly lethal organophosphorus nerve agents, first produced but not used during World War II; and the irritant agent CS, introduced in the 1950s and used in the Vietnam War. Even the newest U.S. chemical weapons, the binary chemical artillery projectiles which were in production until recently cancelled, release a nerve agent (GB) first made for warfare almost 50 years ago. Since 1915, military and civilian chemists in several countries have screened hundreds of thousands of substances for weapons potential, but nothing has proved superior to the nerve and blister agents now stockpiled.

Mustard is primarily effective as an incapacitating agent, not a lethal one, although high dosages can kill. A drop of liquid mustard on the skin causes a severe chemical burn that can take weeks to heal. Exposure to mustard vapor, if prolonged, can cause eye and respiratory damage and skin burns, particularly on moist skin. A site heavily contaminated with liquid mustard can remain hazardous to unprotected persons for hours or even days, depending on the surface and the weather. Nevertheless, only 2–3 percent of hospitalized American and British mustard casualties in World War I were fatal, and a similar low death rate is reported for Iranian mustard casualties in the Iran-Iraq War.

Nerve agents are more deadly and can act more rapidly than mustard.

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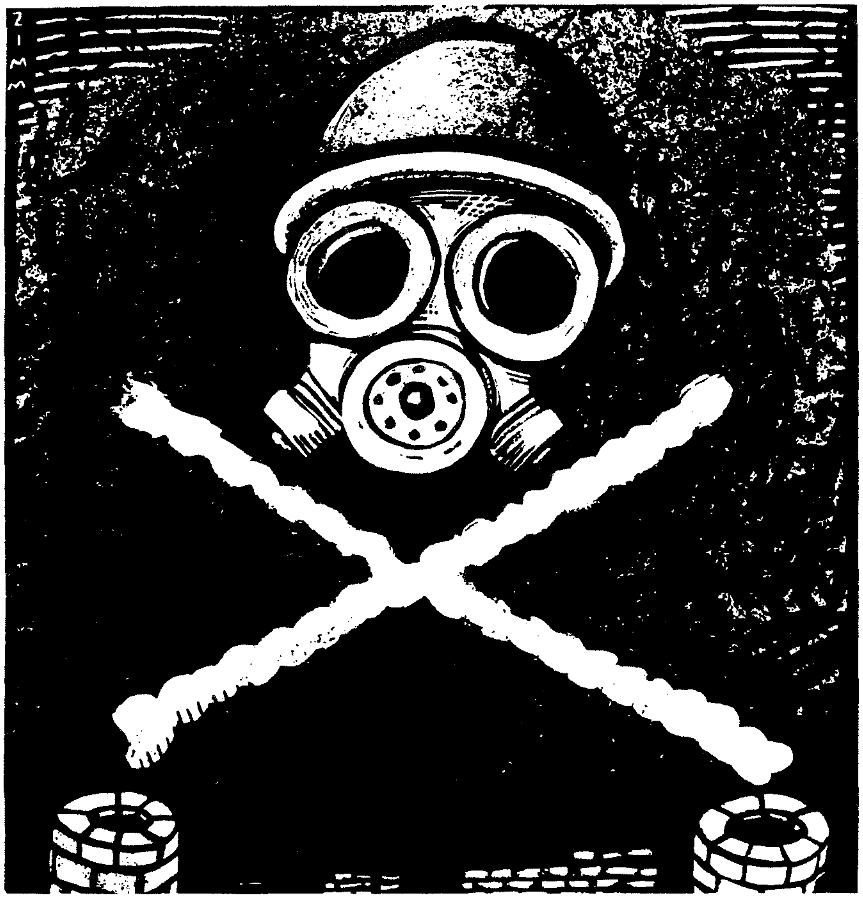

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About a milligram of the vapor of the volatile nerve agent GB, or Sarin, is lethal almost immediately if inhaled, but nerve agent vapor is much less toxic to the skin. In contrast to GB, the relatively nonvolatile liquid nerve agent VX presents mainly a contact hazard: approximately 200 milligrams (about five drops) can kill if left on bare skin for an hour.

This is not to say that milligram quantities of these agents are militarily significant. About one ton of nerve gas, or five tons of mustard gas, is required to produce heavy casualties among unprotected people in an open target area one kilometer square. This is under meteorological conditions of light wind and a moderately stable atmosphere, as might occur on an overcast day. For the nerve agent GB this means about 300 heavy (155 millimeter) chemical artillery projectiles or about seven 500-pound chemical bombs. The actual requirements vary greatly depending on weather and terrain.

Comparing the effect of chemical weapons with that of conventional high-explosive munitions requires consideration of weather conditions, whether people in the target area are protected, and how effectively the attack is delivered. For causing casualties to soldiers lacking antichemical protection, munitions containing nerve agent or mustard could often be competitive with, or superior to, an equivalent weight of conventional high-explosive fragmentation munitions.

The situation is dramatically reversed if people in the target area are wearing gas masks and protective clothing, or if they are in combat vehicles or shelters with filtered air. A well-fitting gas mask is by far the most important item of protective equipment against chemical attack, because the eyes and lungs are the most vulnerable parts of the body. Absorptive clothing, widely deployed by modern armies, protects against liquids and vapors that threaten the skin, while still allowing considerable passage of water vapor from perspiration. A complete ensemble such as that provided to U.S. ground forces, including gloves and boots, gives essentially total protection against all known chemical warfare agents. No such effective defense exists against weapons based on kinetic energy, blast, or flame.

The effectiveness of defenses against chemical weapons goes far toward explaining why chemical weapons, although massively employed during World War I, have been seldom used since—and then only against soldiers or civilians initially lacking gas masks. It also helps to explain why most modern military establishments deploy gas masks, while only a few have troubled to acquire chemical weapons.

Because well-protected personnel are far less vulnerable to chemicals than they are to the effects of an equal weight of conventional high-explosive weapons, using chemicals in combat is generally not an efficient way to cause casualties. And, of course, chemical weapons cannot destroy combat vehicles, artillery, or other equipment or installations.

If antichemical defense is so effective, why have the United States and Soviet Union produced and maintained large chemical stockpiles—tens of thousands of tons on each side? Although institutional factors have also played a role in procurement decisions, a number of military arguments have been made for these weapons over the years.

Chemical warfare specialists writing between the world wars, sometimes using inaccurate data biased in favor of chemicals, argued that chemical weapons were more effective than conventional weapons in producing casualties in World War I. An additional argument for mustard gas was that chemical casualties were less often fatal than bullet and shrapnel casualties, making them more humane and, at the same time, burdening the medical services of the defender.

After World War II, these two arguments lost most of their cogency. The humanity argument did not apply for nerve agents: the small difference between an incapacitating dose of nerve agent and a lethal dose meant that a high proportion of casualties could be fatal. And for relatively nonlethal agents such as tear gases, the humanity argument, although still raised, was largely specious. In war, these gases have almost never been used instead of lethal weapons but rather are used in conjunction with them, to increase casualties. The most recent example was the extensive U.S. use of CS in combination with conventional bombs and artillery in the Vietnam War.

More important, it came to be realized that chemicals are generally much less effective than conventional weapons in causing casualties when personnel are protected with modern gear and antichemical training. This was the conclusion of influential studies done under the auspices of the U.S. Army in the 1960s, and it necessitated a changed rationale for chemical weapons.

The additional burden that wearing antichemical protective equipment and taking other antichemical measures impose on military units had long been recognized, even in World War I. In a modern war of maneuver, this could slow the tempo of operations—and this became and still remains the accepted U.S. rationale for maintaining an arsenal of chemical weapons for possible retaliation in kind. The tactical utility of chemicals then depends on whether the effect on enemy tempo outweighs their disadvantages: the added complications to one's own logistic and battlefield operations and the reduction of conventional firepower and maneuver necessitated by maintaining and using chemical weapons.

Antichemical gear can slow troops down for two reasons. First, masks, gloves, and other equipment can interfere with vision, speech intelligibility, and dexterity. But in most situations these problems are minimal, and improved design can reduce them still further. The other effect, which can be more serious, is that the overgarments reduce body cooling. Adding the complete U.S. Army personal protective ensemble to the regular battle uniform is approximately equivalent to raising the ambient temperature by 10 degrees Fahrenheit. Even if worn directly over underwear, the protective clothing interferes with normal cooling. In cool and temperate weather this is of little consequence, but in hot weather soldiers must avoid prolonged strenuous activity, or they must partly open or remove the protective clothing in order to avoid heat exhaustion. If attack with agents that threaten the skin appears likely, commanders will try to confine the most strenuous operations, such as dismounted assault, to the cooler hours of the day and to nighttime.

Although antichemical defenses clearly hamper military operations to some degree, determining whether this makes it worthwhile to acquire, deploy, and use chemical weapons is another question. There are three ways to assess the tactical effects of chemical weapons. One is to build mathematical models—but these have proved of dubious value. A large study done by the BDM Corporation for the U.S. Defense Department in 1975 stated: "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."

The official British history of World War I concludes, "Gas achieved but local success, nothing decisive; it made wars uncomfortable, to no purpose."

Field exercises are another way to assess the impact of chemical weapons. These have shown, not surprisingly, that wearing protective gear seriously degrades the performance of dismounted units engaged in prolonged, strenuous effort in hot weather. The same is true of units poorly trained and motivated to operate with chemical defenses. In contrast, trained combined-arms units exercising in temperate weather up to about 80 degrees Fahrenheit have been hampered little by the gear, even in sustained operations. In the hot desert sunlight, well-trained troops in protective gear have conducted dismounted assault exercises for up to two hours. Under common European weather conditions, military units have routinely exercised at or near full antichemical protection for several days continuously.

Another way to evaluate chemical weapons is to examine their use in World War I. About 120,000 tons of various chemical agents were used in that war, from the first tentative use of irritants in 1914 and the famous German cloud-gas attack with chlorine at Ypres in 1915, through phosgene and the arsenicals, to the German introduction of mustard in 1917. Chemical weapons caused about 3 percent of the estimated 15 million casualties on the Western Front. They caused much misery and contributed to the attrition of static trench warfare. Records of British casualties and of German ammunition production for 1918 indicate that chemical and conventional artillery projectiles were about equally effective in producing casualties.

But gas was used mainly against troops in fixed positions, as noted in a detailed study done for the army by the Operations Research Office at Johns Hopkins University and published in 1959. When men were ordered out of the trenches and into attack, concentrated fire from machine guns and artillery, not gas, was used to stop them. And attrition in trench warfare contributed little to military success. Producing casualties, never an adequate measure of military effectiveness, becomes even less relevant if the casualties are largely confined to static forces or if they are delayed.

Mustard, "the king of battle gases," was by far the most effective chemical in World War I. The persistence of liquid mustard meant that heavily contaminated sites could remain hazardous hours after the shells stopped falling. Most British and American mustard casualties resulted from failure to put on the gas mask or removing it too soon. Substantial numbers suffered skin burns from mustard vapor by remaining for prolonged periods in contaminated trenches. Relatively few were injured by passing through contaminated areas, and fewer still from direct exposure to liquid mustard from exploding munitions. Although masks protected against eye and respiratory injury, the protective clothing then available was not very effective or widely deployed, and there were no detectors to tell men when to mask or unmask or when to leave a contaminated site.

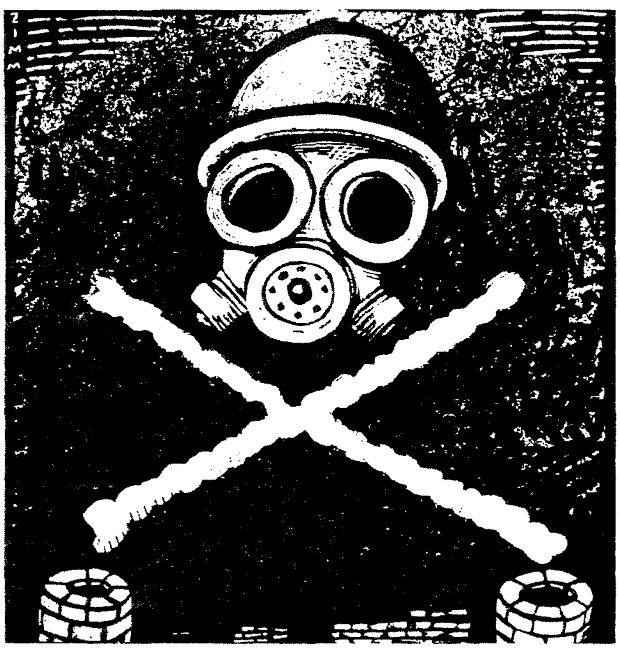
Because of difficulties in Allied production efforts, Germany had a monopoly on mustard from its introduction in July 1917 until nearly a year later, in June 1918, when French supplies first became available. But Germany's massive and one-sided use of mustard had no evident effect on the course of the war.

The official British history of the war states that "gas achieved but local success, nothing decisive; it made war uncomfortable, to no purpose." The Operations Research Office study reached the same conclusion. In his history *The Real War*, 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 antichemical defenses. Despite its extensive use, gas was a military failure in World War I.

Poison gas was used on a limited scale by Japan against China in World War II but it was not used in Europe, even though both sides produced large stockpiles of mustard and other agents. It is commonly said that they were not used because of the threat of retaliation in kind. While this may have been a factor, available documents also show that military staffs were skeptical 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." German military leaders concurred. 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." Of course, each side knew that the other's military forces had good antichemical protection.

Poison gas has been used in only a few of the more than 200 wars fought since World War I, and in every case it was against forces entirely lacking or highly deficient in protective equipment. This was so in Ethiopia (1935–36), China (1938–42), Yemen (1966–67), and in the Iran-Iraq War.

Iraqi gas attacks caused only a very small proportion of total Iranian battle casualties. Nevertheless, the use of gas against poorly prepared Iranian units, and apprehension that Iraq would use gas in the War of the Cities, were certainly among the factors contributing to the collapse of Iranian morale in 1988. But the point remains that the Iran-Iraq War provides no examples of gas attack with major tactical impact on well-prepared troops.



In short, there is no historical evidence that gas can be more than marginally effective against forces with good protective equipment and training.

While chemical weapons may have little utility against well-trained and equipped forces, they can be devastating against unprotected civilian populations, as the Iraqi attacks on Kurdish towns and villages demonstrated in 1988. But here, too, protection can make an immense difference. Civilians provided with gas masks, shelters, and antichemical training, as Israelis and Saudis have been, have much less to fear from chemical attack than from conventional explosives.

Early in World War II, tens of millions of gas masks were distributed to civilians in major British cities. As a result, both British and German chemical warfare experts concluded that poison gas attacks on 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, German chemical commander Ochsner wrote in a 1949 report for the U.S. 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."

J.B.S. Haldane, the British biologist and wartime civil defense adviser, reached the same conclusion. He advised U.S. military representatives 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 it, and all have gas masks."

Against civilian populations as well as military forces, the principal threat of gas is to those without protection, as in the poorer nations of the Third World, where defenses are least likely to be available. The 1991 Gulf war apparently ended without the use of chemicals. If Iraq had used its chemical arsenal, the high state of antichemical preparedness of U.S. and other coalition forces would have provided a high degree of protection. Perhaps these weapons did their greatest harm by instilling fear in civilians and soldiers, a dread perpetuated by ill-informed reports that ignored or underestimated the effectiveness of modern antichemical protection. ■