ETHICS OF CHEMICAL WEAPONS RESEARCH (1)

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Abstract

Throughout history the use of chemical weapons in warfare has been controversial. The morality of chemical weapons research is similarly controversial because several potentially conflicting obligations and codes of ethics impact the decision of the individual chemist as to whether to participate in such research. In this article I will discuss the complex ethical questions surrounding chemical weapons research. All chemists are members of a national community with the obligations of citizenship, but they are also professionals subject to a code of ethics. Of course, they are also members of the human community and consequently subject to the more or less universal common morality. Membership in a religious community might also add moral restraints. A key question for chemists is whether the current professional codes of ethics can provide adequate guidance in trying to deal with this complex issue.

Introduction

In the usual telling, the history of chemical warfare begins on April 22, 1915, near Ypres, Belgium, when the Germans under the command of the future Nobel Laureate Fritz Haber opened the stopcocks on 5,370 buried cylinders releasing 168 metric tons of chlorine gas. The attack had been delayed for several days because of unfavorable winds, but on that day the wind carried a large elongated cloud of toxic gas about 50 feet high across no-man's land and into the Allied trenches. The gas seared eyes and lungs, and hundreds of French and Algerian troops were left blinded and dying in the wake of the cloud.

The attack was militarily ineffective because the German generals, skeptical of this new weapon, were not prepared to follow-up with sufficient ground troops, but the psychological effects were enormous. In the bitter words of Wilfred Owen,

> But someone still was yelling out and stumbling,
> And flound'ring like a man in fire or lime . . .
> Dim, through the misty panes and thick green light,
> As under a green sea, I saw him drowning.
> In all my dreams, before my helpless sight,
> He plunges at me, gutting, choking, drowning.
> . . .
> The old Lie; Dulce et Decorum est
> Pro patria mori.

The Latin is from Horace: "It is sweet and right to die for one's country" (2).

Like many stories, the standard account of the beginning of chemical warfare is not quite correct. Earlier in World War I the Germans, and perhaps the French, had used grenades and artillery shells filled with various poisons, but with little effect. In fact, the use of chemical weapons, such as poisoned arrows and Greek fire, goes

back to antiquity (3). The word toxic derives from the Greek word for an arrow: *toxon*.

The Hague Declaration of 1899 had specifically outlawed "the use of projectiles, the sole object of which is the diffusion of asphyxiating or deleterious gases." The Hague Declaration of 1907 had gone further and had prohibited "poison and poisoned arms." Disingenuously, the German High Command had focused on the 1899 Declaration and argued that their artillery shells also produced shrapnel and the release of chlorine from cylinders did not use projectiles (4). These are distinctions that a logician or lawyer might love, but they were little comfort to soldiers whose lungs were filled with hydrochloric acid.

It is not my purpose to recount the history of chemical warfare. That story is well told elsewhere (5), although I will refer to parts of that history as necessary. Instead, I want to examine the moral questions related to chemical weapons, particularly the question of whether scientists, especially chemists, may engage in chemical weapons research. The ethics of chemical weapons research is part of a larger question: the ethics of war-related research in general, about which I have written previously (6), but chemical weapons raise some specific issues which will be the focus of this article. These ethical questions involve the professional ethics of science, the relationship of science and society, the ethics of warfare, and in the end, our view of how we should treat our fellow humans, even when they are temporarily our enemies.

Science and engineering and the military have had a long, and often productive, mutual relationship. Beginning with World War II the U.S. Government has made huge investments in military-related research through the Department of Defense, the Department of Energy and other agencies. Many scientists and engineers are employed in industries that manufacture weapons and other war-related products. The scope of war-related research is broad, ranging from research on weapons, for example nuclear warheads, to improvements in radar, which have both civilian and military applications. In this article I leave aside these broader questions and concentrate on the ethical issues peculiar to chemical weapons development. Therefore, it is important to specify what I mean by the term chemical weapon.

The term chemical weapon usually refers to a lethal or toxic agent such as the nerve agent sarin, that is designed to kill or incapacitate. There are, however, other forms of chemical weapons. I will consider four classes:

1. Lethal or toxic agents such as chlorine, mustard, and sarin
2. Non-lethal or incapacitating agents such as tear gas and malodorants
3. Herbicides such as Agent Orange used in the Vietnam War
4. Incendiary agents such as napalm

The distinction between a lethal and a non-lethal agent is a bit arbitrary because toxicity depends both on dose and on individual reactions to the agent. A large dose of a so-called non-lethal agent might kill and a small dose of a lethal agent might only act as an incapacitating agent. Herbicides generally do not kill outright, but can inflict serious environmental damage and sometimes can cause chronic human diseases. Incendiary weapons can be used in ways that do not take lives directly, say by starting fires to slow troop movement, but when used on humans can cause terrible injury and death. In a strict sense one might also consider gunpowder and other explosives as chemical weapons, but since these agents generally do not kill in and of themselves, the discussion will be restricted to the four categories listed above.

The moral decision as to whether to engage in research on chemical weapons is complicated by the fact that all scientists are members of at least three distinct moral communities. Each of us is a citizen of a national society with a history, goals and ideals. With citizenship comes obligations. For example, Kenneth Kemp has argued that conducting scientific research for the military is a civic duty (7). On the other hand, Jonathan Glover has warned against a "nationalization of morality" in which questions of war and weapons, among others, are seen only through a narrow patriotic lens (8). Every scientist belongs to a professional community of scientists, and more specifically to the community of chemists or biologists or some other discipline, and is subject to the professional code of ethics of science in general and of the particular discipline. Chemists are subject to the Chemical Professional's Code of Conduct of the American Chemical Society (9) and similar codes adopted by other chemical societies. In addition, as members of the human community, scientists have the same moral obligations as all other people. Finally, the moral landscape might be further complicated by the scientist's religious beliefs and practices. Because science is a secular community, the influence of religious beliefs will not be considered explicitly, although such beliefs might play a large role in an individual scientist's thinking.

These moral communities are not independent, however. A profession makes a tacit agreement with

society. In return for a monopoly on certain specialized knowledge and skills not easily attainable by the general population, the profession agrees to use that knowledge and those skills to serve society. In professions such as medicine, law and engineering, this agreement is part of the licensing procedure. In science, the agreement is less formal but it does imply that scientists have special obligations. For example, all U.S. federal grant applications require the principal investigator to discuss the broader impacts of the research for society. Guston and Kenniston characterize the bargain that has governed science in the U.S. since World War II as follows: "Government promises to fund the basic science that peer reviewers find most worthy of support, and scientists promise in return that the research will be performed well and honestly and will provide a steady stream of discoveries that can be translated into new products, medicines or weapons (10)." Historically, the emphasis on weapons resulted from the success of the Manhattan project and other wartime efforts, but military funding of research has continued unabated since World War II even after the end of the Cold War.

A second important consideration is the scientist's view of the morality of war (11). There are three general positions on this question. The first is realism. Realists express a strong suspicion about applying moral concepts, like justice, to international affairs. They view war as an inevitable part of an anarchical world system that should be resorted to when it is in a nation's self interest. When war begins, nations should do whatever is needed to win—no holds barred. In this view moral questions about any kind of weapons research are beside the point.

The second position, which is widely held, is based on just war theory which has a long and complex history. Just war theory does not suggest that wars themselves are just, but rather considers when a war is justified (*jus ad bellum)*, puts restraints on the conduct of the war (*jus in bello)*, and then outlines the components of a just peace after the war has ended (*jus post bellum*) (11). Those aspects of the just war theory particularly relevant to chemical weapons will be described in detail below.

The final position is pacifism. Pacifists object to killing, particularly mass killing for political reasons. They believe that there are no moral grounds that can justify war, so war is always wrong. As a result, for the pacifist, engaging in weapons research is always morally problematic and something to be avoided.

Chemical Weapons

To better specify the moral problem I will assume the general perspective of the just war theory, that there are times when warfare can be justified and that preparation for a national defense is a morally acceptable pursuit for a scientist or engineer although perhaps with limits. The moral questions arise because the just war theory places restrictions on the ways in which war can be conducted. The relevant provisions of *jus in bello* include (1) adhering to international conventions, (2) respecting noncombatant immunity, (3) using only proportionate force to achieve victory, and (4) not using methods or weapons that are "evil in themselves" (*mala in se*). These are restrictions on the decisions made by commanders and individual soldiers, but in my view, are also restrictions on those who develop weapons. Certainly, any tool, or weapon, can be misused, but I will argue that developing a weapon which is highly likely to break one of these restrictions is morally problematic.

The Chemical Weapons Convention (CWC), a multilateral treaty that bans chemical weapons and requires their destruction within a specified period of time, entered into force in 1997 (12). The CWC is far more comprehensive than the Geneva Protocol of 1925 that was developed after World War I. The Geneva Protocol had, in turn, strengthened the provisions of the Hague agreements that had been established in 1899 and 1907. One might conclude that because of the CWC and the restriction in the just war theory that all international agreements should be followed, that the issue of chemical weapons research would be simply resolved. This is not the case for several reasons.

First, the CWC prohibits the production and use of toxic agents which are defined a chemicals that "cause death, temporary incapacitation, or permanent harm to humans or animals." There is an exception, however. Toxic agents can be used for "law enforcement including domestic riot control." The United States has argued that the CWC does allow for the use of riot control agents, even in warfare, because these chemicals, such as tear gas, which produce sensory irritation or disabling physical effects, because these effects are not a form of temporary incapacitation and continues to pursue research on these non-lethal agents (13). Such research can raise moral questions for several reasons. First, these substances may not be as benign as advertised. As noted above, toxicity is a matter of dose and response, and incapacitating riot control agents do cause deaths, although at a much lower level than nerve agents, for example.

Second, even though the CWC only allows the use of these chemical agents for domestic reasons, once the weapon exists, there is the possibility of using it in war.

Although the CWC does not address the use of herbicides or incendiaries, Protocol III of the Convention on Certain Conventional Weapons of the United Nations, which came into force in 1983 and was finally ratified by the United States in 2008, states that incendiary attacks against concentrations of civilians should be considered as war crimes, which places a restriction on the use of agents such as napalm (14).

The just war theory makes a clear distinction between combatants and non-combatants. A combatant is someone, usually a soldier, who is engaged in harming. Soldiers are liable to attack, but those not engaged in harming, non-combatants, are not. But, the just war theory does provide a way to avoid this restriction, what is called the law of the double effect. Some kind of attacks, such as bombing, will inevitably harm some non-combatants who happen to be in the way. The current euphemism for this is collateral damage. Some harm to non-combatants can be morally justified from a consequentialist perspective if the ultimate result of an attack is to increase the chance of winning a just war.

Michael Walzer's doctrine of supreme emergency is a recent addition to the just war theory (15). Walzer argues that a nation can set aside the provisions of both *jus ad bellum* and *jus in bello* in cases where defeat is imminent and the aggressor will crush that nation's sovereignty and massacre and enslave its inhabitants. Walzer's only example of such an emergency is Nazi Germany, but there are recent examples of genocide and use of weapons of mass destruction that might also qualify. This exemption is quite controversial because, if accepted, it allows a nation to unilaterally declare a state of supreme emergency and then ignore all the restraints of the just war theory.

One of the strongest ethical arguments against the use of lethal, and non-lethal, agents is that they do not discriminate between combatants and non-combatants. Once a chemical weapon is released anyone in its path is likely to be harmed. A similar argument can be made against the widespread use of herbicides to "defoliate" the countryside. Whatever immediate or long term health effects there are will be shared by combatants and non-combatants alike (16). Another argument against the use of herbicides is that they can interrupt food production, which is a basic human need. A traditional law of warfare is that one may attack the soldier but not the human. Actions such as poisoning the water supply have always been regarded as unfair.

Just war theory requires that the amount of harm not be unnecessary or otherwise disproportionate to what can be achieved by the resort to violent force. This restriction bans weapons that are indiscriminate and whose destructiveness goes well beyond the rational military objective of neutralizing the enemy (17). There are two kinds of proportionality, horizontal and vertical. Horizontal proportionality involves the amount of harm and the number of people harmed. This aspect of proportionality overlaps with the principle of non-combatant immunity but also addresses the wholesale massacre of enemy soldiers. Vertical proportionality involves the severity of that harm.

Although some might argue to the contrary, a clear example of a weapon that violates the principle of horizontal proportionality is the thermonuclear warhead which indiscriminately kills combatants and non-combatants, destroys property and leaves behind radioactive wastes that contaminate the area. Many would argue that chemical weapons are similarly disproportionate. Toxic agents kill indiscriminately but do not ordinarily destroy property. Herbicides do not usually cause many immediate deaths but can cause serious long-term damage to the environment as well as chronic health problems among those humans and animals who have been exposed. Incendiaries kill indiscriminately particularly when used on cities.

On the other hand, one might argue that it is inappropriate to classify particular weapons as disproportionate for two reasons. First, it is possible to use these weapons in a way that is not indiscriminate. Second, conventional weapons can also be used indiscriminately. These are reasonable arguments, but some weapons are more likely to be used indiscriminately than others. Weapons that increase the physical and emotional distance between the attacker and the victim are more likely to be used indiscriminately. A rifle shoots bullets which are directed at particular targets, targets that shooters can see through their sights—one bullet, one victim. A bomb usually kills most if not all the people near where it lands whether they are combatants or non-combatants. I think there is a reasonable moral distinction between the two.

Vertical proportionality overlaps with the fourth restriction, that it is impermissible to use weapons that are evil in themselves (*mala in se*). Are there weapons that should be banned because they are just too horrible to use? Are there limits to harm, even in warfare? To

approach this question we need to realize that the enemy soldier is also a human being and is part of the broader human community. This fact is something that wartime propaganda does its best to persuade us to forget. The enemy is portrayed as the "other." The goal is moral exclusion: increasing the psychological distance, viewing the enemy as non-entities undeserving of fairness, and destroying any sense of moral obligation. This allows one to approve of actions that would be unacceptable if performed on those who are within the sphere of justice. During World War II, as the Japanese became increasingly vilified in the American press, there were calls for the use of chemical weapons. Headlines appeared saying, "We should gas Japan" (18). Weapons that are evil in themselves are weapons that cause unnecessary suffering, not justified by military necessity. They are weapons that attack the human rather than the soldier.

What kinds of weapons should be considered evil in themselves? Based on the completely indiscriminate nature of their impact and the horrible deaths that result, nuclear weapons are certainly a prime candidate. Another candidate is incendiary weapons such as napalm. Death by fire is exceptionally cruel and fire is similarly indiscriminate. Nick Ut's iconic photo of Vietnamese children fleeing a napalm attack shows the horror (19). During World War II flame throwers loaded with napalm were used to attack and immolate Japanese soldiers hiding in caves. Napalm bombs dropped on Japanese cities during World War II killed more people than the two atomic bombs (14). Some other weapons that are considered exceptionally cruel are land mines, which are placed before a battle and are indiscriminate, harming combatants and non-combatants alike and causing horrible injury, and cluster bombs that send out hundreds, or thousands, of small bomblets or grenades over a large area. Another candidate is shells filled with glass. Once imbedded in the body, the glass shards are undetectable by X-rays, so they remain, causing long-term suffering.

There are those who argue that the category of weapons that are evil in themselves is meaningless in the context of war. Instruments are neutral; they can be used either for good or evil. A scalpel can be used to commit murder and a saber can be used to perform surgery. Conventional weapons, bullets and grenades, can also cause horrible injuries. For the soldiers going over the top during World War I, was there a qualitative difference in the horror between being mowed down by machine gun fire and being gassed? It is certainly true that as weapons become more familiar, the degree of revulsion decreases. For example, long ago the introduction of firearms was opposed by both practical and moral arguments. Some said that they must have issued from the devil himself, but eventually guns and cannons were accepted and even glorified (20).

But certain kinds of weapons continue to seem more repugnant than others, and chemical weapons certainly fit into this category. There are several reasons for this. First, in traditional warfare, poison was considered not to be honorable. War was a battle between men, essentially a duel, and poison was "sneaky." It subverted the traditional hierarchy of war between men of stature. It was a weapon resorted to by barbarians and others who could not win in a fair fight. Margaret Hallissy has argued that the negative image of poison results from men's fear that it could be used to upset the dominance of men. A "weaker" woman could use secret knowledge to compensate for her physical inferiority (21). Another reason is that chemical weapons fuse the roles of the doctor and the warrior and disrupt the normal social order (22). The warrior injures by deadly force while the doctor heals by providing medicines which we ingest. Chemical weapons use the methods of the doctor to injure or kill.

The experiences of World War I certainly contributed to the perceived horror of chemical weapons. At the 1921 Washington Conference on arms limitations, a report signed by General John J. Pershing, the U.S. commander during World War I, stated that "chemical warfare should be abolished among nations as abhorrent to civilization. It is a cruel, unfair and improper use of science. It is fraught with the gravest danger to noncombatants and demoralizes the better instincts of humanity" (23). An emotionally powerful literature, exemplified by the poem by Wilfred Owen quoted earlier, made a huge psychological impact and has contributed to a taboo on the use of these weapons (24). Chemical weapons were not used during World War II, although the Germans had developed and manufactured the nerve agents tabun and sarin. The history is complex, but moral considerations were important. Neither side was willing to introduce a controversial weapon, partly in fear of retaliation but also because of the moral opprobrium that would accompany the use of lethal chemical agents.

During the Vietnam War, the widespread use of napalm gained enormous public attention largely due to widely circulated photographs of victims, particularly children, but napalm, invented during World War II by the Harvard organic chemist Louis Fieser, had been used to devastating effect in both World War II and Korea. Napalm burns at a high temperature and because it is a gel it adheres to the skin causing horrible burns. Na-

palm bombs dropped on Tokyo caused conflagrations that killed approximately 100,000 people and destroyed fifteen square miles of the city. People were burned alive and those who sought refuge in pools or streams were boiled to death.

In deciding whether a weapon is evil in itself, the moral perspective that seems most relevant is that of Kant (25) who argued that the essence of morality was that human beings needed to be treated as ends in themselves and not as means. In the context of war, this means that even extremely hostile behavior towards others must be compatible with treating them as persons. Inside the enemy uniform is a human being. A weapon that is evil in itself is one that degrades the essential humanity of the person being attacked.

Making a Decision

Should a scientist, usually a chemist, engage in chemical weapons research? What are the moral considerations that should go into such a decision? This is a question that must be answered by individuals based on their own values but I will try to outline the issues that should be considered.

As noted earlier, I assume that it is morally permissible, and perhaps also an obligation for scientists who do not have personal philosophical or religious objections to participating in war to contribute to research related to the national defense, which might include weapons research.

Chemical weapons research, however, is morally problematic for several reasons. First, many chemical weapons are prohibited by the CWC, which represents an international consensus on the use of lethal agents. Arguments have been made that certain kinds of chemical agent such as riot control agents are permitted under this treaty, but there is good evidence that these so-called non-lethal agents are not as benign as hoped and, if used in war, can be quite destructive. If developed, such weapons are available for use by governments, insurgents and terrorist organizations that are not parties to the CWC. Recent history has shown that there are those who will use even banned chemical weapons (5). It has also shown that the use of non-lethal riot control agents can be deadly (13).

One might argue that it is morally permissible to develop chemical weapons as a deterrent. Similar arguments were made during the Cold War regarding nuclear weapons. This argument is easily countered. First, the CWC bans lethal chemical weapons independent of their proposed use. Second, once the weapon is developed it is available for use in a future war.

Second, although there are dangers associated with the manufacture of all weapons, chemical weapons pose more dangers than most. For example, in the manufacture of nerve agents, any leaks in the production system or in the filling of shells can be fatal. There are also serious problems in disposing of the toxic wastes from the manufacturing process.

Herbicides present different issues because they have legitimate peacetime uses in agriculture. The agents used in Vietnam, including the now infamous "Agent Orange," were commercial products, mainly 2,4-D and 2,4,5-T (T (2,4,-Dichlorophenoxyacetic acid and 2,4,5-Trichlorophenoxyacetic acid respectively). All herbicides are toxic to some degree and must be handled carefully. The major fear with 2,4,5-T is that it is inevitably contaminated with the very toxic dioxin. The moral question with herbicides is in their use during warfare, so research in the development of better herbicides, particularly those that are less toxic to humans is a legitimate enterprise.

Incendiaries such as napalm are also morally problematic. Napalm burns are enormously painful. Although Kim Phúc, the Vietnamese girl in the iconic photo mentioned above, did recover from her burns, a physician in the hospital where she was treated "compared the experience to being flayed alive: suffering so severe that it constituted a 'wound to the soul'" (26). The firestorms created when napalm bombs are dropped in a city destroy essentially everyone and everything in their paths (27).

The chemist trying to decide whether to engage in research on chemical weapons will get no help from the American Chemical Society's Chemical Professional's Code of Conduct. The code lists the responsibilities of chemists to various groups beginning with the responsibilities of chemists to the public (9).

> Chemists have a professional responsibility to serve the public interest and welfare and to further knowledge of the science. Chemists should actively be concerned with the health and welfare of coworkers, consumers and the community. Public comments on scientific matters should be made with care and precision, without unsubstantiated, exaggerated, or premature statements.

These are fine words, but the code does not help the chemist decide how to prioritize the various responsibilities. What does "active concern with health and welfare" mean in practical situations? The code is silent on the ethics of

weapons research, leaving that decision to the individual. I have argued elsewhere that current codes of ethics for chemists should be revised to address contemporary ethical issues more fully (28).

In the end, I think the crucial question is not whether a weapon can be used in a way that is consistent with the restrictions of the just war theory and other moral considerations, but whether having a particular weapon, say napalm, in the arsenal makes it more likely that the conduct of the war will be escalated. Dwight Eisenhower observed that as war proceeds, both sides are pulled deeper and deeper into the business of killing. The history of war in the twentieth century is filled with examples of conflicts that violate the principles of the just war theory (8). The chemist needs to decide whether the particular chemical weapon being developed will make it easier to conduct war in an unjust manner, whether that weapon attacks the human rather than the soldier, whether it is evil in itself. No one can foresee all the possible uses of a discovery, but all chemists have a moral responsibility to consider the long-term negative consequences of their actions.

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References and Notes

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2016 HIST Award

The History of Chemistry Division of the American Chemical Society is pleased to announce that Professor Doctor Ursula Klein of the Max Planck Institute for the History of Science in Berlin is the winner of the 2016 HIST Award for Outstanding Lifetime Achievement in the History of Chemistry. This international award has been granted since 1956 under sequential sponsorships by the Dexter Chemical Company, the Edelstein Foundation, the Chemical Heritage Foundation, and the History of Chemistry Division.

The award includes presentation of a monetary prize and a plaque, a symposium honoring the work of Professor Klein, and a lecture by the awardee; it took place on August 23, 2016, at the American Chemical Society's annual Fall meeting in Philadelphia, Pennsylvania. The symposium program was:

- Wolfgang Lefevre, "Methode de nomenclature chimique (1787): A document of transition"
- Michael Gordin, "Periodic table as scaffold and foundation: paper tools and demarcation"
- Alan J. Rocke, "Erlenmeyer as capitalist and entrepreneur: A case study of chemical enterprise in mid-19th- century Germany"
- Mary Jo Nye, "Stability and change in chemical problems and methodologies from the 1890s to the 1930s"
- Stephen J. Weininger, "Delayed reaction: The tardy embrace of physical organic chemistry by the German Chemical Community"
- Evan Hepler-Smith, "Paper tools, paper things and a third-order science of organization"

The symposium culminated with Prof. Dr. Klein's address on "Chemists for the common good."