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Chemical and Biological Weapons

Can they be eliminated or controlled?

The Syrian government's use of nerve gas on rebel-controlled Damascus neighborhoods this summer focused renewed attention on the threat posed by chemical and biological weapons. The attacks, which killed up to about 1,400, led President Obama to threaten military retaliation. Syrian President Bashar al-Assad responded by agreeing to destroy his chemical arsenal. Chemical weapons have been outlawed since 1928, after the world saw the horrors of their effect in World War I. After Iraq used chemical weapons to kill tens of thousands of Iranians and Iraqi Kurds in the 1980s, a 1993 international accord strengthened enforcement of the ban. The Syrian gas attacks have spurred debate over whether chemical weapons are worse than conventional arms. Meanwhile, biological weapons also are outlawed, but some experts fear they could be used by terrorists.

A student practices handling simulated waste at the Chemical Demilitarization Training Facility at the Army's Aberdeen Proving Ground in Maryland. Most of the world's chemical weapons have been destroyed under a 1993 treaty. However, several non-participants in the treaty, including North Korea, maintain chemical weapons stockpiles.

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Chemical and Biological Weapons

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Managing Editor: Thomas J. Billitteri
tjb@sagepub.com

Assistant Managing Editor: Kathy Koch,
kathy.koch@sagepub.com

Senior Contributing Editor:
Thomas J. Colin
tom.colin@sagepub.com

Contributing Writers: Marcia Clemmitt, Sarah Glazer, Kenneth Jost, Peter Katel, Reed Karaim, Barbara Mantel, Tom Price, Jennifer Weeks

Senior Project Editor: Olu B. Davis

Fact Checkers: Michelle Harris, Nancie Majkowski

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Chemical and Biological Weapons

BY REED KARAIM

THE ISSUES

As soon as the first rockets exploded around 2:45 a.m. on Aug. 21 in the Damascus suburb of Ghouta, in Syria, residents began experiencing horrific suffering: frothing at the mouth, fluid coming out of the eyes, convulsions and suffocation. [1]

Two hours later another round of rockets landed in the nearby neighborhood of Moadamiya. "We were praying in the mosque near the Turbi area, 400 meters away," an eyewitness later told the international advocacy group Human Rights Watch. "We heard the strike and went to the site to help the wounded . . . when we got there someone was screaming, 'Chemical! Chemical!' People covered their faces with shirts dunked in water. We didn't smell anything, but . . . if anyone entered the building where the rocket fell, they would faint." [2]

AP Photo/Shaam News Network

Civilians lie in a makeshift mortuary after being killed in a sarin gas attack on Damascus, Syria, on Aug. 21, 2013. Syrian forces under President Bashar al-Assad launched the attack against rebel forces in the city, according to Human Rights Watch and the U.S. and French governments. More than 1,400 people were killed, including hundreds of women and children, according to the U.S. government.

Human Rights Watch and United Nations inspectors later said the rockets carried sarin nerve gas. One drop of sarin fluid can make a person ill. [3] Estimates of the number of Syrians who died in the attacks range from the U.S. government's figure of more than 1,400 — including 426 children and other civilians — to 355, reported by Médicins Sans Frontièrs (Doctors Without Borders), the international humanitarian organization. [4]

Global outrage over the attacks sparked a renewed debate about how the world community should respond to chemical and biological weapons, and whether they are really any worse — morally or in their lethal effect — than conventional wartime arms. Both types of weapons kill people, some observers say, so making a distinction is meaningless. But others say chemical weapons are unique, in that they target defenseless civilians.

The rockets fired on Damascus had almost certainly been fired by the government of President Bashar al-Assad against rebel forces in Syria's ongoing civil war, according to Human Rights Watch and the U.S. and French governments. Although chemical weapons such as sarin long have been prohibited by international treaty, at the time of the attacks Syria was one of five nations that hadn't signed the 1993 Convention on the Prohibition of Chemical Weapons, known simply as the Chemical Weapons Convention (CWC), which went into effect in 1997.

Although some evidence indicated that Syria had used chemicals weapons on a smaller scale earlier in the war, the Ghouta attack represented the first time a nation had launched a significant chemical weapons attack since Iraqi leader Saddam Hussein used them against Iran and Iraqi Kurds in the 1980s.

The United States and much of the global community quickly condemned Syria's action. "This attack is an assault on human dignity," said President Obama, adding that he would ask Congress to support a limited military strike against Syrian forces in response. "Here's my question for every member of Congress and every member of the global community: What message will we send if a dictator can gas hundreds of children to death in plain sight and pay no price?" [5]

Obama's comments were intended to reinforce a "red line" he had drawn earlier insisting that chemical weapons were outside of the acceptable international norms of behavior, even in war. But some critics of Obama's comment questioned the wisdom of taking a position that could require a military response.

"The lesson learned is: Never anchor yourself by drawing red lines because then you take away other options," says Gary Guertner, a professor at the University of Arizona in Tucson and former chairman of the Policy and Strategy Department at the U.S. Army War College.

Most Chemical Weapons Have Been Destroyed

Nearly 82 percent of the world's declared chemical weapons have been destroyed since the Chemical Weapons Convention went into effect in 1997. Russia has the world's largest remaining stockpile of chemical weapons, about three times more than the United States. At least six countries are thought to have had or to still have undeclared chemical weapons.

Amount of Chemical Weapons Declared, Destroyed and Remaining, by Country (as of October, 2013)

Country	Metric Tons** Declared	Percent Destroyed (as of)	Metric Tons** Remaining
Albania	16	100% (2007)	0
South Korea	undisclosed	100% (2008)	0
India	1,000+	100% (2009)	0
United States	31,500	90% (intends by 2023)	3,150
Russia	40,000	76% (pledged by 2015-20)	9,600
Libya	26.3	85% (planning by end of 2016)	3.95
Iraq	unknown*	0%	NA
Syria	1,300	In process (first half of 2014)	NA

Note: Japan left 350,000 chemical munitions on Chinese soil during World War II. It is working with China to dispose of those weapons.

** When Iraq joined the Chemical Weapons Convention in 2009, it said an unknown quantity of chemical agents remained in bunkers that were bombed in 2003.*

*** A metric ton is 2,204.6 pounds.*

Sources: Organisation for the Prohibition of Chemical Weapons; "Chemical and Biological Weapons Status at a Glance," Arms Control Association, October 2013, www.armscontrol.org/factsheets/cbwprolif, and telephone conversations with Arms Control Association personnel

Others observers, however, suggested Obama should have acted even more forcefully. "When it comes to saying this is horrible, we need to contain it. We need to draw the line," says Michael Rubin, a resident scholar at the conservative American Enterprise Institute and a former Pentagon official. "The president could have acted symbolically by immediately targeting the units that used the weapons."

Obama asked Congress to approve limited strikes on Syria in retaliation, but lawmakers from both parties indicated that Congress might not approve more military action in the Middle East. Nevertheless, facing even the possibility of a U.S. military strike, Syria agreed to sign the 1993 convention and open its chemical weapons arsenal for immediate inspection and dismantling. (*See "Current Situation," p. 1068.*)

Although the deal, largely brokered by Syria's key ally, Russia, meant the U.S. Congress never had to vote on whether to authorize the use of force, the debate over the threat represented by chemical and biological weapons — and how the world should respond to their use — has continued.

Chemical weapons have been considered unacceptable by the global community since the widespread use of poison gases in World War I killed or wounded thousands of soldiers. (*See "Background," p. 1065.*) The Geneva Protocol banned them in 1928, and although scattered exceptions have occurred, the convention and the even stronger 1993 accord have largely kept chemical weapons off the world's battlefields.

"It's a real robust taboo that has developed over time," says Richard Price, a professor of political science at the University of British Columbia in Vancouver and the author of *The Chemical Weapons Taboo*. "What you saw in Syria, it's the first time they've been used in 25 years. That's a remarkable record for a weapon of warfare."

Biological weapons, which use disease microbes or toxins to attack their victims, have received less attention but also are outlawed by an international treaty, the 1972 Biological Weapons Convention, which went into force in 1975. Although biological agents rarely have been used in warfare, some analysts consider them a greater potential threat, especially as a terrorist weapon.

Chemical and biological weapons often are discussed together, but weapons experts point out they require different resources to build and pose different challenges to find and neutralize. Building a chemical weapons arsenal requires a significant industrial capacity, the ability not only to manufacture large amounts of the chemical agents but also to load them in rockets or shells that can be fired at the enemy. The large-scale industrial plants, resources and personnel required mean

chemical weapons are harder to hide than biological weapons.

The 1993 Chemical Weapons Convention established an inspection procedure for chemical weapons sites and timetables for destruction of chemical arsenals. Nearly all nations with significant stockpiles of such weapons, including the United States and Russia, have been proceeding with their destruction. (*See chart, p. 1056.*) The Organisation for the Prohibition of Chemical Weapons, a Hague-based agency that oversees implementation of the convention, says 81.7 percent of the world's declared chemical weapons have been destroyed. [6]

Biological weapons, such as anthrax or smallpox, can be grown in a lab, so they have a smaller "footprint" than chemical weapons, making them easier to hide. But many of the deadliest pathogens exist only in a limited number of research laboratories around the world. Thus, they are less available than the basic materials of chemical weapons.

The United States and other nations have boosted efforts to secure supplies of dangerous pathogens in recent years. The 1972 Biological Weapons Convention, however, does not have the same strong inspection mechanisms as the Chemical Weapons Convention, leading to greater concerns that these deadly agents could be secretly grown and weaponized.

As the world weighs options for dealing with chemical and biological weapons, here are some of the questions under discussion:

Are chemical weapons worse than other weapons of war?

Chemical weapons are one of the few categories of weapons specifically banned through international treaty. [7] But even during World War I, when they were used widely by both sides, they accounted for a relatively small percentage of overall casualties.

Up to 100,000 soldiers were killed by gas attacks in World War I — less than 1 percent of the war's fatalities, and more than 1 million were wounded by gas, or about 2 percent of the total; many were blinded. [8] In the Syrian conflict, 70 to 100 times as many people have died from conventional weapons — 105,000 to 150,000 deaths — as died in the gas attacks. [9]

Such disparities lead some analysts to question whether chemical weapons should be considered worse than other weapons. "There's a sense people have that somehow chemical weapons are worse — more horrifying. But if you look at it coolly and rationally, it's not obvious that they are worse than shelling or guns, which have killed many more people," says Dominic Tierney, a political science professor at Swarthmore College in Pennsylvania.

Regardless of the casualty count, other analysts believe chemical weapons have characteristics that make them especially brutal.

North Korea Said to Have Large Stockpile

At least six countries are thought to have had or to still have undeclared chemical weapons, including North Korea, which is believed to have a large stockpile developed during a long-standing program.

Countries Suspected of Having Chemical Weapons

***China* —** The United States alleged in 2003 that China had an "advanced chemical weapons research and development program," but a 2010 State Department report said there was insufficient evidence to confirm China's previous or current activities.

***Egypt* —** Allegedly stockpiled chemical weapons and used them against Yemen in 1963-67; has never signed the Chemical Weapons Convention (CWC).

***Iran* —** Denounces possession of chemical weapons; recent State Department assessments said Iran is "capable of weaponizing" chemical agents in a variety of delivery systems.

***Israel* —** Believed to have had an offensive chemical weapons program in the past, but there is no conclusive evidence of an ongoing program; has not ratified the CWC.

***North Korea* —** Has a "long-standing CW program" and a large stockpile of weapons, according to a 2012 U.S. intelligence assessment.

***Sudan* —** Unconfirmed reports say that Sudan developed and used chemical weapons in the past; United States bombed what was alleged to be a chemical weapons factory in 1998. A 2005 State Department report questions whether Sudan was ever involved in chemical weapons manufacture.

Sources: Organisation for the Prohibition of Chemical Weapons; "Chemical and Biological Weapons Status at a Glance," Arms Control Association, October 2013, www.armscontrol.org/factsheets/cbwprolif, and telephone conversations with Arms Control Association personnel

From Anthrax to Mustard Gas

Chemical and biological weapons have a variety of characteristics.

A wide range of chemical and biological weapons have been developed in the past century, although only a limited number have been used on the battlefield. The earliest poison gases deployed in World War I were easily countered by simple gas masks, but before the war's end scientists had developed mustard gas, a blistering agent effective enough that it remained in chemical arsenals into the 21st century.

Chemical and biological weapons are outlawed today under international treaties. Much of the world's chemical arsenal has already been destroyed, and biological weapons are considered unlikely to be used by nations because of their unpredictable nature. Still, some countries, including the United States and Russia, are still in the process of destroying their chemical arsenals, and it is possible other hidden stockpiles exist. Both chemical and biological weapons are also considered attractive to terrorist groups because of the weapons' ability to cause widespread destruction and panic.

Here are some of the main chemical and biological agents that have been or could be used in weapons: [1]

• **Mustard gas —** Nearly odorless and hard to detect, sulfur mustard gas damages the skin and mucous membranes on contact. It is an organic chemical compound that derives its name from a faint smell of the mustard plant that sometimes accompanies it. Exposure can come through the skin, eyes, lungs or by drinking contaminated water. Death often occurs when the lungs fill up with fluid after their linings are destroyed. No antidote exists for mustard gas.

• **Sarin —** One of the first "nerve agent" chemical weapons, sarin is an oily liquid that evaporates quickly into a vaporous gas. It can cause convulsions, constriction of the chest and suffocation. It interrupts the operation of an enzyme that works as an "off switch" for muscles and glands, which then become constantly stimulated. Exposure by inhalation or touch can be deadly. Even a drop of sarin on the skin can cause serious injury. Antidotes exist, but must be administered quickly.

• **VX —** The most potent of all nerve agents, VX acts upon the body much like sarin does but more quickly. A miniscule drop can be fatal. An oily liquid that evaporates slowly, it lingers on surfaces for days and can kill within minutes. Early symptoms include blurred vision, chest tightness, drooling and excessive sweating, nausea and small, pinpoint pupils.

• **Anthrax —** An infectious disease caused by a bacteria found in soil, anthrax infects both domestic and wild animals around the world, often fatally, but rarely humans naturally. Anthrax is not contagious, but exposure to the miniscule spores, less than a thousandth of an inch in size, can lead to serious sickness or death. A person can become exposed by breathing in anthrax, ingesting contaminated food or liquids or through an open wound. Anthrax can be treated with antibiotics, if diagnosed quickly enough.

• **Smallpox —** A contagious and sometimes fatal disease that has killed tens of millions of civilians throughout history. Some historians believe the British used smallpox-contaminated blankets as a weapon against Native Americans in colonial America. Smallpox was eradicated in the 20th century through a worldwide vaccination program. But the smallpox virus still exists in laboratory samples and is considered a potential bioterrorism weapon today. Infection can come through face-to-face contact or by handling contaminated objects such as clothing, or breathing contaminated air in closed spaces. The United States maintains a large supply of smallpox vaccine in the event of an outbreak.

• **Pneumonic Plague —** A relative of the bubonic plague ("Black Death") that wiped out a third to a half of Europe's population in the Middle Ages, the pneumonic plague can be transmitted from person to person. Symptoms of the potentially fatal disease usually include fever, weakness and rapidly developing pneumonia. The United States has antibiotics that could be used to treat pneumonic plague. Like smallpox and other disease agents, it is considered most likely to be used as a weapon by terrorists or individuals rather than by a military force.

— Reed Karaim

[1] Most of the information in this sidebar on chemical and biological agents comes from the Centers for Disease Control and Prevention website. For more complete lists and further details, see "Chemical Weapons Information," www.cdc.gov/nceh/demil/chemical_agent.htm, and "General Fact Sheets on Specific Bioterrorism Agents," http://emergency.cdc.gov/bioterrorism/factsheets.asp.

"There is something unique about chemical weapons" because of "who they most effectively destroy: babies sleeping in their cribs and innocent civilians," says Greg Thielmann, a senior fellow at the Washington-based Arms Control Association, which supports effective arm control policies. "And the people they're least likely to destroy are prepared soldiers because soldiers can protect themselves against chemical weapons much more easily than they can against high explosives."

Rubin, the American Enterprise Institute scholar, notes that chemical weapons are less accurate than conventional weapons. "Conventional munitions have become more precise over time — more lethal while also more precise," he says. "The problem with chemical weapons is that they're notoriously imprecise — they're at the mercy of the wind, for example." That means they can only be counted on to sow terror or kill indiscriminately, he adds.

But other analysts say the relative military ineffectiveness of chemical weapons argues against the idea they are worse than other weapons. "Because they are hard to use in most battlefield situations, chemical weapons are usually less lethal than non-taboo weapons like high explosives," wrote Stephen M. Walt, a professor of international affairs at Harvard University in Cambridge, Mass. [10]

And in a civil war such as the Syrian conflict, where President Assad has regularly targeted civilian neighborhoods held by the opposition, Walt asked, "Does it really matter whether Assad is killing his opponents using 500-pound bombs, mortar shells, cluster munitions, machine guns, icepicks or sarin gas? Dead is dead, no matter how it is done." [11]

Rubin counters that chemical weapons can cause particularly brutal injuries, and that victims can suffer permanently scarred lungs, nerve damage and other lingering disabilities. "The more relevant issue is not how painful the death is, but what happens to the walking wounded. You have a much greater chance of recovering from a bullet or shrapnel wound than you do recovering from mustard gas or sarin," Rubin says. "Once the hostilities end, you can really suffer the effects of this much more acutely than the effects of a bullet wound, often for the rest of your life."

But Tierney believes drawing a line around chemical weapons can have an unintended negative consequence. "If you say chemical weapons are unacceptable in Syria, you're implicitly saying that conventional weapons are acceptable," he says. "You have to be careful about drawing these lines because there's a way in which you legitimize war on the other side of the line."

Making the kind of weapon used the determining factor in one's response to a conflict, he says, misses a larger point. "What I'd like to see is less focus on the means by which leaders kill and more on the ends: How many people killed? Focus more on the amount of human suffering and the overall situation and less on the specific means."

The University of British Columbia's Price, however, says ruling chemical weapons out of bounds has limited the potential for mass destruction in war. When chemical weapons first came on the scene, they were seen as potential weapons of mass destruction, he says. "People thought, 'Oh my God, you're going to wipe out whole cities.' And that's why there were efforts to curtail them. Chemical weapons have never lived up to that, . . . in part because of the restraints we've imposed."

Anything that gets the world to say someone has gone too far when it comes to making war should be considered a positive, he adds. "We ought to be grateful that we have some of these thresholds, at least, that galvanize humanitarian attention and response around the world," he says.

But for others, lumping chemical and biological weapons together with nuclear arms as "weapons of mass destruction," as some U.S. policymakers have done, overstates their capacity for destruction. "I've always had trouble with that trilogy," says the University of Arizona's Guertner. "Nuclear weapons are in a category all by themselves. Neither chemical nor biological weapons are going to cause mass casualties in the sense that nuclear weapons are."

Although chemical weapons are not as destructive as nuclear weapons, Rubin says that doesn't mean they're not unusually cruel weapons.

"The real question is, do we say chemical weapons should become normal in war? Ultimately, I would say no. You risk opening a Pandora's box if you do," he says. "You're erasing a line that was drawn almost 100 years ago, and then you have to debate about where you draw the new line."

AFP/Getty Images/Ali Al-Saadi

Photographs of Iraqi Kurds gassed by Iraqi President Saddam Hussein are displayed at a memorial in the Kurdish town of Halabja, in northern Iraq. By some estimates 50,000-60,000 Iranians and Kurds were killed or wounded in Iraqi gas attacks during the Iran-Iraq War in the 1980s, which led in part to the 1993 Chemical Weapons Convention.

Are biological weapons a serious threat to the United States?

A week after the Sept. 11, 2001, terrorist attacks on the United States, letters

World War I Saw Deadliest Chemical Attacks

Toxic gas dispersed first by Germany and then by both sides killed 100,000 people. It is unknown how many Chinese were killed by Japan's 2,000 chemical weapons attacks in 1937-42 because Japan was dropping non-chemical bombs at the same time. In the 1980s, Iraq's use of chemical weapons during the Iran-Iraq War killed or wounded up to 60,000 people, prompting a worldwide ban on the use of such weapons in 1993.

Casualties from Chemical Weapons Attacks

Year	Event	What happened	Estimated Deaths/ Casualties
1915-18	WWI	Poison gas used, first by Germany against the Allies and then by both sides.	100,000 deaths
1935-36	Second Italo-Ethiopian War	Italy used mustard gas against the Ethiopians.	15,000 casualties
1937-42	Japanese Invasion of China	Japan used variety of chemical agents in 2,000 attacks against the Chinese.	unknown
1962-67	Vietnam War	U.S. used herbicides against the North Vietnamese.	unknown
1980-88	Iran-Iraq War	Iraq used various gases against Iran and the Kurds.	Up to 60,000 casualties
1995	Terrorist Attack	Aum Shinrikyo cult releases sarin gas in Tokyo metro.	13 deaths
2013	Syrian Civil War	Government uses sarin gas against rebel forces.	Up to around 1,400 deaths

Sources: Javed Ali, "Chemical Weapons and the Iran-Iraq War: A Case Study in Noncompliance," The Nonproliferation Review, *Spring 2001, pp. 43-58; Lina Grip and John Hart, "The use of chemical weapons in the 1935-36 Italo-Ethiopian War, SIPRI Arms Control and Non-proliferation Programme, October 2009; "Chemical Weapons: Frequently Asked Questions," Arms Control Association, October 2013; "The Shadow of Ypres: The history of chemical weapons,"* The Economist, *Aug. 31, 2013*

containing anthrax spores were mailed to offices of two U.S. senators and several news media outlets. [12] The Centers for Disease Control and Prevention (CDC) considers anthrax, an infectious disease that can cause sickness or death, "one of the most likely agents to be used in a biological attack." [13]

Five people died and 17 became seriously ill from the anthrax-contaminated letters. The FBI eventually concluded they were the work of one man, Bruce Ivins, an army scientist with access to anthrax in a government lab. Ivins, who committed suicide before he could be charged, had a history of psychological problems, and his alleged motives remain obscure. [14]

Still, coming on the heels of the 9/11 attacks, the letters raised fears the nation was vulnerable to a major biological attack by terrorists. [15] Since 2001, the government has spent more than $71 billion to beef up its defenses against biological weapons by creating better detection systems and increasing stockpiles of vaccines and other treatments. [16] But there has not been a significant biological attack in the United States in the 12 years since 9/11, leading to a debate over the likelihood of such an event.

A 2012 study by the Aspen Institute, a Washington think tank, concluded that "the threat of bio-terrorism remains undiminished," in part because the bacteria and viruses that could be used in a bioweapon are found around the world. "Any nation with a developed pharmaceutical industry has the capability to produce potent 'military-grade' bioweapons," the study said. [17]

While terrorists probably cannot build a weapon as sophisticated as a weapon of mass destruction, the report said, there is "considerable evidence" they could produce bioweapons approaching the standard of such a weapon. The study noted that al Qaeda is now headed by Ayman al Zawahiri, a former Egyptian surgeon who earlier led the terrorist group's efforts to develop a biological weapon, and al Qaeda still appears intent on developing such a weapon. [18]

A bioweapon attack is "a serious potential threat," says Leonard Cole, an editor of the study and director of the University of New Jersey's Program on Terror Medicine and Security. Noting that smallpox killed an estimated 300 million people in the 20th century before it was eradicated, he says, "Anybody who fails to understand or acknowledge the potential for catastrophic consequences of a biological release is not facing reality."

But while they agree the consequences of an attack would be severe, other experts doubt the capability of terrorist groups to build a bioweapon capable of mass death. For example,

JSSGallery.org/John Singer Sargent

Soldiers wounded in a mustard gas attack walk toward an aid station in this large-scale 1919 oil painting by the American artist John Singer Sargent, now at Britain's Imperial War Museum in London. During the "Great War," some 100,000 troops were killed — and more than a million injured, many of them blinded — by poison gas, used first by Germany and then by the Allies.

they point to the failure of the Japanese cult Aum Shinrikyo, which managed to obtain a nonlethal version of anthrax and another disease agent, but was unable to create biological weapons from them despite having a member who had done Ph.D. work in virology. The group later released sarin gas in the Tokyo metro. [19]

"Biological weapons are extremely hard to develop. Even though lots of ingredients are available, it still takes a lot of skill and knowledge to convert a sample of anthrax into a bomb capable of causing widespread casualties," says George Koblentz, deputy director of the biodefense graduate program at George Mason University in Fairfax, Va. "So far, we've not seen a terrorist group capable of doing that."

However, a bipartisan congressional commission looking at terrorist threats in 2008 concluded there was a high likelihood terrorists would use a weapon of mass destruction in the next five years, and "terrorists are more likely to be able to obtain and use a biological weapon than a nuclear weapon." [20] The commission painted a nightmare scenario: "A recent study from the intelligence community projected that a one- to two-kilogram [2.2- to 4.4-pound] release of anthrax spores from a crop duster plane could kill more Americans than died in World War II (over 400,000)." [21]

But two experts who examined the commission's scenario found several holes in their example. Lynn Klotz, a senior fellow at the Center for Arms Control and Non-Proliferation in Washington, and science journalist and Arizona State University journalism professor Edward J. Sylvester concluded it would take much more than four pounds to cause mass casualties, and there were significant challenges in getting the anthrax safely loaded into a spray plane and dispersed into the air.

"We decided this was very improbable," says Klotz. "These are sort of scare tactics. The way I look at these things is, you have a big biodefense effort underway and the more you scare Congress, the more likely you are to get funding."

Given the technical hurdles, Klotz says, "Any serious biological attack would have to be launched by a state program." But, any country doing so would likely face massive retaliation if discovered, he adds. "It would have to be a state willing to take a big risk. That's not to say that I don't think there is a risk [that bioweapons could be used], I just don't think it's as big as people think there is."

However, because biological programs are relatively easy to conceal, nations, including those with ties to international terrorism, could maintain them secretly, says Raymond Zilinskas, director of the Chemical & Biological Weapons Nonproliferation Program at the Monterey Institute of International Studies at Middlebury College in Vermont. "Does North Korea have a biological weapons program? Does Iran have a biological weapons program? Does Syria have a biological weapons program? All these are black boxes," he says. "We don't know what's going on inside them."

He adds that Russia has three military microbiological institutes "still active and closed to all foreigners. You have to assume they have weaponized agents waiting to go, if the decision was made."

But Klotz says the indiscriminate nature of biological weapons — they present a danger to anyone using them and can't be controlled once released — makes them unattractive as weapons of war. He notes the U.S.

government discontinued its biological weapons program in 1969, when President Richard M. Nixon became convinced "the United States would be safer without biological weapons."

Can the world rid itself of chemical and biological weapons?

The Convention on the Prohibition of Chemical Weapons is widely considered an example of a successful disarmament treaty. Now that Syria signed the convention in September, only four nations — Angola, Egypt, North Korea and South Sudan — have not signed it, and two others, Israel and Myanmar, have signed but not ratified it. [22]

The world's other 190 nations have ratified the convention, which stipulates they will never use, develop, produce, acquire, transfer or stockpile chemical weapons. Under the accord, nations that have chemical weapons also agree to destroy them and submit to international inspection and verification of their efforts. [23]

The Organisation for the Prohibition of Chemical Weapons says more than 80 percent of all existing weapons have been destroyed, including the bulk of the sizable U.S. and Soviet arsenals, where destruction is ongoing. Several analysts are optimistic the global community will eventually rid itself of these weapons.

"It's very realistic to believe it can be done. It is being done," says the University of Arizona's Guertner. Worldwide revulsion, combined with the fact "the military doesn't like them" because they are imprecise and ineffective against prepared soldiers provides momentum to continue disarmament, he says.

But Swarthmore's Tierney doubts the world will ever be free of the threat. "You're always going to find regimes that are going to try to use chemical weapons," he says. "They're not that difficult to produce, and they do have shock value. In fact, an unfortunate side effect of putting them in a special category is that it might make them more attractive to groups looking to have that shock effect."

Thielmann, the Arms Control Association fellow, says the world's reaction to Syria's chemical attacks increases the chances the holdouts to the convention could reconsider. "I don't think anyone could watch what is happening in Syria and say it would be safe to use chemical weapons," he says. "It creates a real threat that the international community will come down on them like a ton of bricks."

While some analysts can envision a world without chemical weapons, the situation surrounding biological weapons is more complex. Thielmann notes that the 1972 Biological Weapons Convention does not have the inspection and verification provisions found in the Chemical Weapons Convention, making it impossible to be sure what nations are doing.

Still, he says, "Diseases and plagues are very hard to control. It's just not the kind of weapon that military forces like to have. I think there is a possibility, even in our lifetimes, of seeing a time when both biological and chemical weapons won't be part of the arsenals of any nation."

Thielmann adds, however, that individuals or terrorist organizations are another matter. "There's a much longer time that we will worry about a small group of individuals using them as a terror weapon," he says.

The Aspen Institute's Cole believes the world will never be rid of the threat of biological weapons. "How can you? That would be the same as getting rid of all biological agents, all pathogens," he says. "It's like saying get rid of every micro-organism and you'll be rid of all biological weapons."

The University of British Columbia's Price worries more about the prospect of a terrorist group or other "non-state actor" acquiring a biological weapon than about the possibility of such a group building chemical weapons, because a biological weapon has a greater capacity to do widespread harm. But, he concedes, that very capability limits the attractiveness of such weapons.

"There's a much greater risk of falling prey to it yourself," he says. "If some group unleashed a deadly plague, it could just as well kill them. The extra bit of restraint that provides has always proven very powerful in the case of biological weapons."

However, the Monterey Institute's Zilinskas believes it is becoming increasingly likely that someone will use a biological weapon, as more people get their hands on deadly pathogens.

"The whole biological, technical workforce is growing all the time," he says. "Someone is going to get greedy. Without any doubt, that's going to happen." ■

BACKGROUND

Primitive Attempts

Chemical and biological weapons may seem like modern inventions, but primitive forms of both were used in some of the earliest recorded instances of warfare.

The ancient Scythians, fierce horsemen who came from an area around the Black Sea, were known for their use of poison arrows, according to the Greek historian Herodotus, which may have helped them defeat Darius, the king of Persia, in 513 B.C. [24]

About 750 years later, in 256 A.D., a Persian army attacking the Roman-controlled city of Dara-Europos apparently used a chemical gas attack. According to University of Leicester archaeologist Simon James, evidence from the site indicates the Persians added bitumen and sulfur to fires to create a toxic cloud in tunnels into the city that killed at least 20 Roman soldiers. [25]

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Chronology

1915-1925

Widespread use of poison gas during World War I leads to growing revulsion toward chemical weapons.

1915
Germans use chlorine gas against the French at Ypres, Belgium, in first major chemical weapons attack of World War I (April 22). . . . British use chlorine gas in battle of Loos, France (Sept. 25).

1918
Germans lob more than half a million gas shells at allied troops in final attempt to break through allied lines in France in the Second Battle of the Marne.

1925
Geneva Protocol outlawing chemical and biological warfare is signed by most nations, U.S. signs but doesn't ratify the treaty. Japan does not sign.

1940-1945

Major powers build up their chemical arsenals, but the prohibition against chemical weapons largely holds on World War II battlefields.

1940
Japanese drop rice and wheat mixed with plague-carrying fleas over China and Manchuria, a primitive use of biological weapons against the civilian population.

1940-1945
Germany, the United States, Britain and Japan accumulate stockpiles of deadly chemical agents but never use them against each other during the war, partly in fear of retaliation.

1947-1972

As the Cold War heats up, the United States and the Soviet Union build chemical and biological arsenals.

1947
Soviet Union begins building secret factory in Zagorsk to produce smallpox for biological weapons.

1950
United States begins building secret biological weapons facility in Pine Bluff, Ark.

1969
President Richard M. Nixon orders the unilateral end of the U.S. biological weapons program.

1972
Biological Weapons Convention, which prohibits the research, use or stockpiling of biological agents, is negotiated. U.S. is early signatory.

1983-1993

Iraq defies prohibition on chemical weapons without consequences. New international treaty seeks to eliminate chemical weapons.

1983-1988
Iraq uses lethal mustard, phosgene and hydrogen-cyanide gases in Iran-Iraq War. Some 50,000 Iranians die from the attacks. World community does not interfere.

1988
Iraq uses hydrogen-cyanide and mustard gases against Kurds.

1993
Chemical Weapons Convention, calling for the elimination of chemical weapons, is negotiated.

2001-Present

Concerns raised by 9/11 terrorist attacks on United States give new urgency to efforts to control and defend against chemical and biological weapons.

2001
Shortly after 9/11, letters containing anthrax are sent to news media offices and two U.S. senators, killing five people and infecting 17 others. FBI identifies Bruce Ivins, a government scientist, as the culprit, though some doubt his guilt; he commits suicide before being charged.

2003
Claiming Iraq still has chemical and biological weapons, President George W. Bush pushes the United States and its allies to invade. It is later determined Iraq had no such working weapons.

2012
President Obama warns Syria that use of chemical weapons in the country's civil war would cross an unacceptable "red line."

2013
Chemical weapons attacks in Damascus by Syrian military kill more than 1,400 people (Aug. 21). . . . President Obama says he will seek authorization from Congress for a limited military response to the Syrian chemical attacks (Aug. 31). . . . As part of a deal negotiated by Russia and the United States, Syria announces it will join the Chemical Weapons Convention and allow inspectors to enter the country to identify and dismantle its chemical weapons (September). . . . Organisation for the Prohibition of Chemical Weapons announces that Syria's most critical chemical weapons will be removed from the country by year's end (November).

Biological Weapons vs. Natural Occurrences

Sometimes it's difficult to tell the difference.

The use of biological weapons, which rely on disease agents, is not always easy to separate from natural occurrences. A sudden outbreak of plague, for example, could be caused by a weapon or a new, mutated version of the bacteria that causes the disease.

One of the strangest cases of confusion about a biological weapon and a natural occurrence may have occurred during the Cold War, when Secretary of State Alexander Haig publicly charged Soviet-backed forces in Laos and Cambodia with waging biological warfare.

In a 1981 speech in Berlin followed by a detailed report to Congress, Haig said Hmong fighters and others resisting the Soviet-backed forces in the two Southeast Asian countries told officials they had been sprayed from the air with a yellow substance, and that hundreds of casualties had resulted. [1]

U.S. investigators interviewed Hmong refugees and obtained small samples of the "yellow rain" to test. They concluded the samples included potentially deadly mycotoxins derived from fungi. If the samples were from a biological weapon released in the air, it would have violated the 1925 Geneva Protocol outlawing the use of chemical or biological weapons. It also would have been the first significant use of such a weapon during the Cold War. [2]

But Matthew S. Meselson and Julian Perry Robinson, scientific researchers from Harvard and the University of Sussex in England, respectively, wrote in 2008 that a scientist at the Chemical Defence Establishment at Porton Down had determined in 1982 that the principal component of the yellow rain was pollen. [3]

Repeated tests later confirmed that finding, and subsequent research indicated that bees in the region sometimes engaged in mass "cleansing flights" in which they released large amounts of yellow bee feces in the air. That was almost certainly what the Americans had publicly charged was a dangerous biological weapon.

Although the U.S. government never formally renounced the charges, the scientific evidence indicates the refugees either exaggerated their claims or confused the physical injuries caused by the effects of conventional arms — including from smoke inhalation and physical shock — with those caused by chemical weapons. The initial results indicating mycotoxins were also found to be suspect by later researchers, although it is possible that the bee droppings could have contained miniscule amounts of fungal material. [4]

"The lesson is, if you're going to investigate these type of allegations you need to lean on scientists, not political types. The other lesson is you need to be skeptical of refugee accounts until you get first-hand information," says Gary Guertner, a professor at the University of Arizona in Tucson who previously served as chairman of the Policy and Strategy Department at the U.S. Army War College.

AFP/Getty Images/Robert Atanasovski

Demonstrators at the Albanian Embassy in Skopje, Macedonia, hold a sign reading "Stop chemical weapons" on Nov. 14, 2013. They oppose possible plans to destroy Syrian chemical weapons in nearby Albania.

— Reed Karaim

[1] Jonathan B. Tucker, "The "Yellow Rain Controversy: Lessons for Arms Control Compliance," *The NonProliferation Review*, Spring 2001, http://cns.miis.edu/npr/pdfs/81tucker.pdf.

[2] *Ibid.*

[3] Matthew S. Meselson and Julian Perry Robinson, "The Yellow Rain Affair: Lessons from a Discredited Allegation," in *Terrorism, War or Disease?* (2008), p. 76, http://belfercenter.ksg.harvard.edu/publication/18277/yellow_rain_affair.html.

[4] Tucker, *op. cit.*

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An example of a primitive early attempt to use a biological weapon occurred in 1346, when Tartars besieging the city of Kaffa, in what is now Ukraine, catapulted plague-contaminated corpses into the city. [26]

Evidence also suggests that British forces in the French-Indian Wars in 1763 may have given blankets used by smallpox victims to hostile Native American tribes with the hope of infecting them. Smallpox did ravage Native Americans around the time. [27] There is also circumstantial evidence indicating the British may have used the same strategy during the Revolutionary War. [28]

By 1899, the potential of chemical weapons was well enough understood in Europe that most major world powers agreed, in the Hague Convention, not to use "poison or poisoned arms" in warfare. [29] The treaty was the first significant attempt to control chemical weapons, but less than two decades later it would be ignored in the first great war of the 20th century.

World War I

On April 22, 1915, French and French-Algerian soldiers in the allied trenches near Ypres, Belgium, saw a greenish-yellow cloud billow from the enemy lines and roll toward them. The first significant chemical attack of World War I had begun. [30]

German soldiers had opened the valves on 6,000 cylinders of liquid chlorine, which formed a poisonous gas when it hit the air. Chlorine gas strips the lining from the lungs and bronchial tubes, leading to a buildup of fluid in the lungs that causes the victim to drown in his own fluids. [31]

"The effect of the gas was devastating," wrote historian Martin Gilbert. [32] The French and Algerian troops had no gas masks, and as the gas reached them thousands fell dead in the trenches. Others fled. A four-mile gap was blown in the allied lines, but the Germans, advancing carefully through the cloud in crude masks of moistened cotton, were unable to exploit the advantage. They had launched the gas attack as an experiment but didn't have sufficient reserves in place to press on. [33]

The attack and others that followed, directed at British-held parts of the line, caused widespread outrage in England and other nations sympathetic to the allied cause. British military officers quickly asked for authority to respond in kind. [34] On Sept. 25, in the battle of Loos, France, the British unleashed their own chlorine gas attack on German lines. It ended up illustrating the dangerously unpredictable nature of chemical weapons.

As the gas was about to be released, the wind shifted along parts of the British lines. At least one officer in charge of a gas canister decided not to release his load of chlorine, but he was overridden by orders from headquarters far behind the lines. When the gas was released, some of it simply hung in no man's land between the trenches and some drifted back into British-held territory, gassing hundreds of British soldiers; confusion reigned on the battlefield. [35]

Gas would continue to cause similar problems for the rest of the war. As gas masks and other defensive measures improved, soldiers would become more used to dealing with it and holding their positions. In a deadly chemical weapons race, both sides tried to develop ever more deadly weapons to gain an advantage. In 1917, the Germans introduced mustard gas, a blistering agent that could disable a soldier simply by getting on his skin or into his eyes, where it could cause blindness. [36] It also lingered in the environment, presenting a danger long after an attack.

The effectiveness of chemical weapons in World War I is debated by historians and chemical weapons experts. Considering they caused only a small percentage of casualties and never led to a major shift in fortunes, some analysts have discounted their significance.

But Edward Spiers, a British historian and the author of *A History of Chemical and Biological Weapons*, says, "Contemporaries did not regard them as 'relatively ineffective.' In fact, their proportion of usage grew with each year of the war."

For the soldiers in the trenches, however, despite their having equipment and gaining experience that enabled them to survive chemical attacks, the psychological impact of the chemical weapons did not dissipate.

"In the ordinary soldier there was born a hatred of gas that steadily deepened as the war progressed," wrote Robert Harris and Jeremy Paxman in *A Higher Form of Killing*, a history of chemical and biological warfare. [37]

That revulsion only grew after the war, as the public learned more about conditions on the battlefield and the lingering health problems faced by gassing victims, according to Spiers. "The psychological fears of gas . . . magnified in some of the postwar imagery of temporarily blinded victims of mustard gas, coupled with fears of its future development — and especially aerial delivery over cities — all stoked the postwar reaction," he says.

In 1925 in Geneva, at a disarmament conference held under the auspices of the League of Nations, the leading military powers agreed to "the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare." [38]

Eventually, some 130 nations signed onto the so-called Geneva Protocol. But the strength of the prohibition soon was severely tested.

World War II

The prohibition against chemical weapons largely held on the battlefields during World War II, the largest and deadliest conflict in history. Before the war, Italy used chemical weapons, primarily mustard gas, in a campaign against the Ethiopian army in 1935-36, a precursor to the larger war. [39] Japan also used various forms of gas and other chemical and biological weapons during its invasion of China, but the actual death toll attributable to such weapons is undetermined because the Japanese were using conventional bombs simultaneously. [40] But the countries fighting in Europe, including Nazi Germany, refrained from battlefield gas attacks, and Japan and the United States never used chemical weapons against each other in the Pacific.

The major powers had built up significant chemical weapons arsenals between the world wars, but historians say the Geneva Protocol largely held, for several reasons. Revulsion stemming from the World War I experience partly explained the restraint. In addition, "President Roosevelt was staunchly against the use of gas," says the University of British Columbia's

Price. "He personally found it abhorrent and said we will not be the first to use these weapons."

In England, Prime Minister Winston Churchill pressed his military commanders to consider using gas if the Germans invaded. But the commanders, many of whom had first-hand experience with gas in World War I, rejected the idea. "Clearly, I cannot make head against the parsons and the warriors at the same time," a frustrated Churchill wrote. [41]

Nazi leader Adolf Hitler had been gased and temporarily blinded during the end of his World War I military service. Historians have speculated the experience may have contributed to his reluctance to use chemical weapons on the battlefield — although it did nothing to stop him from gassing to death millions in his concentration camps.

Experts suggest that fear of retaliation may explain why the most powerful combatants in the war never engaged in chemical warfare. "Neither side felt like they were ready to prevail if the conflict took that turn," says Price. Despite stockpiles of chemical weapons, he adds, "both sides felt they were under-prepared."

China, the only theater of war where chemical weapons were used during the Second World War, also suffered the only significant deployment of biological weapons in modern warfare. Jeanne Guillemin, a senior adviser at the Massachusetts Institute of Technology Security Studies Program, says the Japanese dropped disease agents from the air, contaminated water supplies and even introduced plague-infected fleas. They also conducted experiments on civilians and prisoners to measure the effectiveness of biological weapons. [42]

"The use of biological weapons in 1942 as the Japanese were retreating east from central China was likely quite extensive, although sorting out biological weapons casualties from victims of conventional weapons is difficult," Guillemin says. "Some have estimated the victims at 200,000 or so. Anthrax, glanders [an infectious disease], cholera, and typhoid were certainly used."

Japan's biological warfare and human experimentation have gotten little notice, Guillemin says, because after the war American officials suppressed information about the program in order to shield Japanese scientists and officials from prosecution in order to take advantage of Japan's germ warfare experiences for the U.S. bioweapons program. If the program and its consequences had come fully to light, Guillemin believes the future might have taken a different turn. "There was a critical juncture in late 1945 [and] early 1946 at which biological programs could have been legally eliminated," she says, "but that moment passed."

Instead, the United States and other nations continued to develop both biological and chemical agents. "Unfortunately, a real arms race developed between the Soviets and the U.S. over who could develop the most deadly chemical weapons. Further laboratory development went on for more than 25 years after World War II," says Paul Walker, a longtime arms control expert who runs the Washington office of Green Cross International, a global environmental organization headquartered in Geneva.

Despite the development and stockpiling of deadly chemical and biological agents, only a few cases of relatively small-scale use were reported in the next few decades. Egyptian forces involved in a civil war in Yemen used chemical weapons in the 1960s, and the Soviet Union may have supplied chemical weapons to fighters in Southeast Asia and Afghanistan in the 1970s. [43]

However, in the 1980s, during the eight-year Iraq-Iran War, Iraqi leader Saddam Hussein shattered the inter-

Getty Images/Photothek/Thomas Imo

A chemical company technician in Münster, Germany, demonstrates how to dispose of rocket-borne chemical warfare agents on Oct. 30, 2013. More than three-quarters of the world's declared chemical weapons have been destroyed since the 1993 Chemical Weapons Convention went into effect in 1997. At least six countries are thought to have had, or still have, undeclared chemical weapons.

And the Nobel Peace Prize Goes to. . . .

The Organisation for the Prohibition of Chemical Weapons won the 2013 award.

On Oct. 11, Thorbjorn Jagland, chairman of the Nobel Prize Committee, stepped to the podium in Oslo, Norway, to announce that, to the surprise of many, the Organisation for the Prohibition of Chemical Weapons (OPCW) had been awarded the 2013 Nobel Peace Prize.

The OPCW had not been considered a favorite to win the world's most prestigious humanitarian award, but Jagland noted that the organization has helped to define "the use of chemical weapons as a taboo under international law." [1]

Combined with the OPCW's recent investigation of Syria's chemical arsenal, the award brought international recognition to an agency that has largely worked behind the scenes during most of its existence. Secretary of State John Kerry joined those praising the organization, saying the OPCW "has taken extraordinary steps and worked with unprecedented speed" to respond to Syria's use of chemical weapons last summer. Kerry praised the "bravery and resolve" of OPCW inspectors who had traveled through the country during wartime to verify that Syria had used — and was shutting down — its chemical weapons operations. [2]

The OPCW was created in 1997 to serve as the watchdog for the Convention on the Prohibition of Chemical Weapons, an international accord outlawing the use, manufacture or possession of chemical weapons. Since then, the agency's 125 inspectors have conducted more than 5,000 inspections in 86 countries, often under difficult or dangerous circumstances.

Based in The Hague, Netherlands, the OPCW is a relatively small international agency, with an annual budget of about $100 million and a staff of 500. But it oversees one of the largest disarmament efforts in history. Only six nations — Angola, Egypt, North Korea, South Sudan, Israel and Myanmar — have either refused to sign or have not ratified the convention; 190 nations have joined.

To date, 64,124 tons of chemical agents — nearly 82 percent of the global declared stockpile of chemical weapons — have been destroyed in compliance with the convention, according to the OPCW. Individual nations are generally responsible for destroying their arsenals, although they sometimes receive outside assistance. OPCW inspectors monitor the progress to make sure nations are complying with the treaty. [3] Most of the remaining global arsenal is in the United States and Russia, which are behind schedule in destroying their large chemical weapons stockpiles.

Getty Images/Anadolu Agency/Irfan Cemiloglu

Turkish diplomat Ahmet Uzumcu, director-general of the Organisation for the Prohibition of Chemical Weapons, received the Nobel Peace Prize in Oslo, Norway, on Dec. 10, 2013.

The delays have been attributed to the unexpected complexity of destroying the dangerous chemical agents in the weapons, according to James Lewis, a spokesman for the Center for Arms Control and Non-Proliferation, a Washington-based research organization. But both countries hope to done within the next 10 years.

— Reed Karaim

[1] "The Nobel Peace Prize for 2013," The Nobel Prize, Oct. 11, 2013, www.nobelprize.org/nobel_prizes/peace/laureates/2013/press.html.

[2] John Kerry, "Statement on Awarding of the Nobel Peace Prize to the Organisation for the Prohibition of Chemical Weapons," U.S. Department of State, Oct. 11, 2013, www.state.gov/secretary/remarks/2013/10/215318.htm.

[3] "Demilitarisation: Latest facts and figures," Organisation for the Prohibition of Chemical Weapons, Oct. 30, 2013, www.opcw.org/our-work/demilitarisation/.

national prohibition against the use of chemical weapons when he made widespread use of them on the battlefield against the Iranians and against Kurdish communities inside Iraq, which were in a loose alliance with Iran. An estimated 50,000-60,000 Iranians were killed by a variety of chemical weapons, and up to 100,000 continue to suffer today from lingering health effects. [44]

Unlike the Obama administration's outrage at the gassing deaths of up to 1,400 Syrians earlier this year, the Ronald Reagan administration was mostly silent about the deaths of tens of thousands of Iranians and Kurds due to Saddam's chemical attacks. In fact, *The Washington Post* later found that the Reagan administration knew it was supplying materials to Iraq that were being used to make chemical weapons, but the administration considered stopping Iran's forces a priority. [45]

The initial response among other Western nations also was muted, although Iran protested to the United Nations and sent victims of the attacks to Europe in an effort to build international support for its cause. [46] "The world basically ignored the Iraqi use of chemical weapons against Iran," says Thielmann, the Arms Control Association fellow. "And the U.S., the most powerful nation in the world, decided to assist Saddam Hussein, the perpetrator of these attacks. . . . That was a terrible example of the world failing to enforce the [1925 Geneva] ban on chemical weapons."

However, the attacks against Kurdish civilians and growing concern about Iraq's behavior finally led the United States, the U.N. and other nations to speak out. [47] Iraq's chemical weapons use is thought to have spurred the global community to adopt the Convention on the Prohibition of Chemical Weapons in 1993, which contained stronger provisions than the Geneva Protocol had, allowing inspections and requiring the destruction of weapons stockpiles. [48]

Until the Syrian civil war, the only other use of chemical weapons since the convention was enacted occurred in 1994-1995, when Aum Shinrikyo, a Japanese cult that believed it was destined to rule the world, launched two sarin gas attacks in Tokyo. In the largest attack, Aum followers released sarin gas in three different trains in the Tokyo subway system. About 5,000 people were injured and a dozen died. [49]

The attacks raised concerns that similar groups could get access to chemical weapons — fears that only grew after the 9/11 attacks. Worried that terrorists or other rogue groups could get their hands on chemical weapons, governments around the world have been dismantling their chemical arsenals ever since. ■

CURRENT SITUATION

Syria Disarms

Change in Syria's chemical weapons status is occurring rapidly. In September the Assad regime announced it would submit to the Chemical Weapons Convention.

In mid-November, the Organisation for the Prohibition of Chemical Weapons (OPCW) announced that the most critical chemical weapons in Syria's arsenal will be removed from the country by the end of the year, while the rest will be removed by early February. [50] Once outside Syria, the country's declared arsenal of nearly 1,300 tons of chemical weapons will be destroyed in the "safest and soonest manner," no later than the end of June 2014, according to the OPCW Executive Council. [51]

Earlier in November, OPCW inspectors announced they had only one site left to check and had verified that Syria had destroyed 22 of the 23 sites the Syrian government said had been used to produce chemical weapons. [52] A week earlier, the OPCW announced that Syria said the equipment at all the sites had been rendered inoperable. [53]

"This is much quicker than any other state," says Green Cross's Walker. "Everything I've heard from negotiators and inspectors has been very positive. They've said the Syrian government and military seem very committed to following through on their obligations under the Chemical Weapons Convention."

James Lewis, a spokesman for the Center for Arms Control and Non-Proliferation, says the Syrians could be hiding some facilities or weapons, but OPCW has 27 people in the country, and the Syrian government has made no effort to impede their investigation. He adds, "Syria runs a major risk of getting caught if it tries to cheat."

Rubin, the American Enterprise Institute scholar, doubts the sincerity of the Syrian effort. But, he says, "What I find most troubling is that if you have chemical weapons, use them once to the greatest effect and then cry uncle, you can escape [serious sanctions]." Syria is facing no significant retribution, he says, even though "here you have a thousand people killed."

Other Efforts

Although the OPCW's efforts in Syria have captured the world's attention, chemical weapons also have been dismantled and destroyed recently in several other countries.

The Chemical Weapons Convention calls for nations to declare their arsenals within 30 days of joining the accord and have destruction facilities — usually special incinerators — ready for testing by the second year; destruction of the most dangerous chemical weapons should commence in the third year and be complete within 10 years after signing. [54]

Many nations that joined the accord never developed chemical weapons, while others certified they had previously disposed of their arsenals. Albania, India and South Korea have destroyed their chemical weapons stockpiles and facilities under the accord. Libya is very close to finishing its chemical disarmament effort. [55]

Russia and the United States have the world's two largest chemical arsenals and are significantly behind schedule in destroying their chemical weapons. But Lewis, of the Center for Arms Control and Non-Proliferation, says the delays are due to the difficulty of destroying such large amounts of chemical weapons.

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Does use of chemical weapons warrant military intervention?

PATRICK CHRISTY
SENIOR POLICY ANALYST, FOREIGN POLICY INITIATIVE

WRITTEN FOR *CQ RESEARCHER*, DECEMBER 2013

When the use of chemical weapons by foreign entities threatens America's national security interests, military intervention is warranted. President Obama said as much in August 2012, when he drew a "red line" against Syrian dictator Bashar al-Assad's use or transfer of chemical weapons in Syria. However, Obama's failure to respond to Assad's subsequent use of chemical weapons was a mistake that has undermined our values and harmed U.S. interests in the Middle East and beyond.

Assad's repeated use of chemical weapons in 2013 was an open challenge to America's moral values and national security interests. The regime has slaughtered more than 1,500 people using chemical weapons in a conflict that has claimed more than 115,000 lives. He has employed death squads, missile strikes and chemical weapon attacks in his effort to terrorize the Syrian people into submission. These barbaric acts have helped facilitate the emergence of Islamist extremists in opposition-held territory, while Assad relies on Hezbollah and Iranian Revolutionary Guard Quds Force fighters to transform an uprising into a regional conflict. This caldron of terror, regional instability and weapons of mass destruction directly threatens such U.S. allies as Jordan, Turkey and Israel.

Obama's failure to adequately enforce his own "red line" on Assad's use of chemical weapons undermines U.S. credibility and has created a crisis of confidence in Washington's ability to deter aggression. Secretary of State John Kerry was right when he warned, "we will have lost credibility in the world . . . if we turn our backs today."

Assad has gone unpunished for his crimes. The U.S.-Russian agreement on Assad's chemical weapons has not removed him from power and does not guarantee that he will surrender his chemical weapons. If anything, it gave him a green light to continue his indiscriminate violence against Syrian rebels and noncombatants, so long as he does not again use chemical weapons.

A U.S.-led military intervention in Syria would not have created Iraq 2.0. At a minimum, limited airstrikes to disable the Assad regime's chemical weapons delivery systems could have weakened its position. Indeed, since September 2007 Israel has launched various airborne campaigns against the regime's activities related to weapons of mass destruction or attempts to transfer advanced conventional weapons to Hezbollah. Without U.S. intervention, the killing continues, Assad remains in power and the growth of Islamist extremists is on the rise.

JOHN MUELLER
***POLITICAL SCIENTIST, OHIO STATE UNIVERSITY; SENIOR FELLOW, CATO INSTITUTE; AUTHOR,* ATOMIC OBSESSION: NUCLEAR ALARMISM FROM HIROSHIMA TO AL-QAEDA**

WRITTEN FOR *CQ RESEARCHER*, DECEMBER 2013

Those who began the movement to ban chemical weapons a century ago probably hoped it would eventually lead to elimination of all weapons and therefore the extinguishment of war.

But that hasn't happened, and the chemical weapon ban has been widely accepted, primarily because militaries generally have found them to be inferior weapons. After World War I, the largest armed conflict in which chemical weapons were used extensively, a British military history concluded that such weapons "made war uncomfortable . . . to no purpose."

A nuclear weapon certainly is a "weapon of mass destruction," because a single one can kill tens of thousands. But that does not hold for chemical weapons: Overall, chemical weapons were responsible for less than seven-tenths of 1 percent of World War I battle deaths and, on average, it took a ton of gas to register a single fatality. Moreover, soldiers incapacitated by gas usually returned to battle within a few days, while those wounded by bullets were frequently removed for much longer periods and were far more likely to die.

Those who insist it is morally reprehensible to kill people with gas in wars should be asked, "How would you prefer they be killed?"

Deaths inflicted by bullets generally appear quick and painless on television or in the movies because most viewers have an aversion to seeing blood spilled. Indeed, films that show lots of blood are officially categorized as "horror" movies and carry specific warnings for the viewer.

Admittedly, death by some gases can be painful. But it is difficult to see why dying from chemicals is worse than bleeding slowly to death after being punctured by a bullet, having an arm torn off by shrapnel or being repeatedly hacked by a machete — the weapon that has killed more people than any other in recent decades due to its extensive use in the 1994 Rwandan genocide.

Rather than leading to the end of war, the aversion to chemical weapons has helped trigger conflicts. Hostility to former Iraqi President Saddam Hussein — because he had used, and was presumed to possess, chemical weapons — was a key justification for the U.S. invasion of Iraq in 2003. The result was the violent deaths of well over 100,000 people. None of them by gas.

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The United States, which originally listed 30,000 tons of nerve gases and other chemical agents in its arsenal, has destroyed 90 percent of that stockpile at an estimated cost of $28 billion, according to the center. The United States still has two facilities with chemical weapons — in Pueblo, Colo., and Blue Grass, Ky. It plans to complete destruction of its remaining arsenal by 2023 — 13 years past its original deadline. [56]

AFP/Getty Images/Jim Lopez

Mohammad Zayed, a student at Syria's Aleppo University, teaches local citizens to use gas masks on Sept. 15, 2013. An estimated 1,400 Syrians were killed last summer when the forces of Syrian President Bashar al-Assad gassed rebel-controlled areas near Damascus. After President Obama threatened military retaliation, Assad agreed to destroy his chemical arsenal.

Russia has destroyed about 75 percent of its declared stockpile of 44,100 tons of chemical agents, according to the center. It hopes to complete its work between 2015 and 2020. [57]

"The sheer volume of these materials has been a problem, and [in the U.S.] there was a lot of backlash from the environmental community about how are you destroying this stuff," Lewis says. "We had a limited number of locations where we were burning it, and then the decision was made that we wouldn't do that anymore. We're using low-temperature destruction, which takes a long time."

The United States originally hoped to incinerate its stockpile at three sites, but concerns about moving the material safely across the country eventually led to creating nine disposal sites, according to Green Cross's Walker, who was involved in the early establishment of the program.

The process proved more time consuming and complicated than the Pentagon anticipated, he notes. As an alternative to high-temperature incineration, the United States turned to using chemical agents to neutralize the chemicals in the weapons and then incinerating the final product.

"Both countries are behind," Walker says. "But I must say that both countries have been fully committed."

Bioweapons Threats

America's effort to protect itself from a biological attack is proceeding along several fronts. Two key programs initiated after the 9/11 terror attacks are expanding the health care system's ability to respond to an attack and developing an early warning system to detect dangerous airborne biological elements.

The Biowatch detection system, established by President George W. Bush in 2003, now has sensors that analyze the air for dangerous microorganisms in 30 U.S. cities and is used during large spectator events. Plans also are underway to expand Biowatch and install new equipment, Biowatch Gen-3, but the program has been plagued by controversy, and some members of Congress have questioned the wisdom of continuing the effort. [58]

According to a *Los Angeles Times* investigation, Biowatch has signaled false attacks more than 100 times in various cities. At the same time, experts familiar with test results say the system isn't sensitive enough to reliably detect low, yet dangerous amounts of pathogens such as anthrax, smallpox or plague, according to *The Times*. [59]

In a 2012 statement, "The Truth about Biowatch," Department of Homeland Security Chief Medical Officer Alexander Garza wrote that the program had never reported a false positive. [60] But testifying before a congressional committee in the summer of 2013, Biowatch Program Manager Michael V. Walter acknowledged there have been false reports but said efforts to improve the program are underway. [61]

The United States also now has the personnel and supplies to deal with a biological attack. "We have huge national stockpiles of antibiotics against bacterial diseases, huge stockpiles of vaccines against smallpox and such diseases. These things are pretty up to date," says the Monterey Institute's Zilinskas.

While biodefense efforts under Bush were "tailored only to address the threat from biological terrorism and biological

weapons," says George Mason's Koblentz, the Obama administration has broadened the effort to include threats to public health "ranging from manmade outbreaks caused by terrorists to naturally occurring, emerging infectious diseases and pandemics."

The broader effort includes a focus on developing multi-use antibiotics and vaccines, says the Center for Arms Control and Non-Proliferation's Klotz. "That, I think, is the way to go. Anything you develop for natural disease would most naturally have an application for biological weapons as well."

Zilinskas believes the focus on versatile antibiotics reflects that the greatest public health threat still comes from a natural outbreak of a new, deadly disease strain. "What you've got to keep in the back of your mind all the time is that the biggest enemy we face in the biological area is nature," he says.

But experts point out that biological defense presents another challenge: The samples of pathogens needed to study dangerous diseases and prepare successful treatments and vaccines are the basic materials of the weapons. "Essentially, every country has culture collections that contain the pathogens that could be weaponized," says Zilinskas. "They're all dual use."

U.S. labs bolstered their security efforts after the 2001 anthrax letters. But Klotz says the expansion of biodefense research still has had a paradoxical effect. "Most of the knee-jerk response to the anthrax letters in 2001 was wrong," he says. "We started this huge biodefense program, most of it in secret. Before the anthrax attacks, there might have been a few hundred people working on anthrax. After 9/11, the biodefense sector blossomed to maybe up to 400 labs, with thousands of people working in them. If a terrorist wants to get into a lab, it's a lot easier. . . . We've increased the risk of theft, and the likelihood something will escape the lab by accident." ■

OUTLOOK

Complacency?

Looking 10 or 15 years down the road, many analysts profess optimism that the world's nations are largely ready to abandon chemical and biological weapons. They are less positive about the ability of the global community to keep such weapons out of the hands of smaller groups of people determined to do harm.

The University of British Columbia's Price says the idea that chemical weapons are "beyond the pale" has developed deep roots over the last century. "We're unmistakably at the point where we have what scholars would call a quite robust international norm. It's a combination of the legal restraints, the moral prohibition and just the sheer tradition of non-use," he says. "Do people want to go where even Hitler didn't go in World War II?"

Thielmann, at the Arms Control Association, believes Syria's agreement to sign the Chemical Weapons Convention could spur further movement among the remaining holdouts, particularly Egypt and Israel. "If we can pull this off with Syria, that's going to put a lot of pressure on other countries in the Middle East not to retain the option," he says. North Korea is likely to remain unyielding, he believes, "but if you can get to the point where the only country in the world that retains the option for chemical weapons is North Korea, you'll really have accomplished something."

Green Cross's Walker shares his optimism. However, he adds, even after the stockpiles have been destroyed, a significant number of chemical weapons sites contaminated by leaking weapons will remain, and cleaning those up could take many more years. The United States alone has more than 200 sites, he says.

"They were also dumped in every ocean," Walker says. "There is a long-time legacy issue about cleaning up old and abandoned chemical weapons."

Biological weapons are more troublesome, he says, "because of the potential for non-state actors to [use them to] gain a significant capability for destruction." Price also worries about "the pushing of genetic research, in particular. That's one area on the cutting edge of science [that] could produce different things with enormous capacity to do harm to humans."

The Aspen Institute's Cole worries someone will develop a hybrid pathogen, "an organism that is highly contagious, highly virulent or lethal and also highly durable. That would be a nightmare."

However, George Mason's Koblentz says, "There has been this shrinking list of countries that appear to be interested in biological weapons. I'm optimistic that we can eliminate these weapons and focus everyone's attention on how to use these technologies for beneficial purposes."

But, warns the American Enterprise Institute's Rubin, it's important to remember the damage caused by chemical weapons in World War I and other conflicts, and the lethal effects of diseases such as smallpox and anthrax.

"The danger is historical amnesia," Rubin says. The prohibitions have been successful "because of the memory of how horrific these weapons can be. However, the success of these organizations has meant that memory has faded with time. What the international community is facing is complacency." ■

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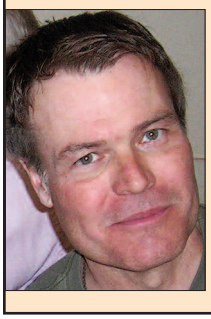
About the Author



Reed Karaim, a freelance writer in Tucson, Ariz., has written for *The Washington Post*, *U.S. News & World Report*, *Smithsonian*, *American Scholar*, *USA Weekend* and other publications. He is the author of the novel, *If Men Were Angels*, which was selected for the Barnes & Noble Discover Great New Writers series. He is also the winner of the Robin Goldstein Award for Outstanding Regional Reporting and other journalism honors. Karaim is a graduate of North Dakota State University in Fargo.

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FOR MORE INFORMATION

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The Center for Arms Control and Non-Proliferation, 322 4th St., N.E., Washington, DC 20002; 202-546-0795; www.armscontrolcenter.org. Seeks to enhance international peace and security in the 21st century.

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Office of Health Affairs, Department of Homeland Security, Washington, DC 20528; 202-254-6479; www.dhs.gov/office-health-affairs. Leads and coordinates the government's biological and chemical defense activities and provides medical and scientific expertise to support the department's preparedness and response efforts.

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