# A Century of Innovation

## THE ARMY'S CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM

AT ABERDEEN PROVING GROUND, MARYLAND

# 1917-2017

U.S.ARMY

U.S. ARMY RDECOM TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

EDGEWOOD CHEMICAL BIOLOGICAL CENTER 100th Anniversary 1917 2017 A U.S. Army RDECOM Laboratory

## DISCLAIMER



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# PREFACE

Since 1917, a peninsula in Maryland formed by the Bush and Gunpowder rivers has played a major role in the United States' chemical and biological defense program. Previously named Edgewood Arsenal and today called Aberdeen Proving Ground (APG)—South, the U.S. Army organizations that have been located on the peninsula either researched, designed, developed, engineered, produced, tested, or worked on almost every chemical and biological defense piece of equipment, smoke/obscuration system, medical-related tool, flame and incendiary weapon, riot-control device, retaliatory chemical weapon, and demilitarization device that was standardized or approved for fielding or use by the U.S. Armed Forces.

Edgewood Chemical Biological Center (ECBC), the primary Defense Department technical organization for non-medical chemical and biological defense, traces its history back to World War I when, as Edgewood Arsenal, it produced chemical weapons for the war effort. After the war, it expanded its mission to include designing equipment that would help detect, protect, and decontaminate. After World War II, it eventually ended its chemical weapons production program and focused on the chemical defense program.

Several organizations outside of ECBC also trace their history back to the original Edgewood Arsenal. Those organizations include the Chemical Materials Activity (CMA), which manages the nation's stockpile of chemical weapons and assesses and destroys chemical warfare material, and the Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA), responsible for the safe and environmentally sound destruction of the United States' last remaining chemical weapons stockpiles stored at U.S. Army Blue Grass Army Depot in Kentucky and the U.S. Army Pueblo Chemical Depot in Colorado. Another organization that traces its lineage back to Edgewood Arsenal is the Medical Research Institute of Chemical Defense (MRICD), a science and technology laboratory for the development, testing and evaluation of medical chemical warfare countermeasures including therapies and materials to treat casualties of chemical warfare agents.

These, and the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) and the 20th Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Command, which are also located at Edgewood, are the organizations that the country calls upon whenever there is an emergency or threat to the Warfighter in the field or to the citizen at home. To help understand the many accomplishments of these organizations, one must also study the history of the events that created the requirements and needs for the accomplishments. Although not a complete listing of every accomplishment, this publication is hopefully a reference source for those asking: "What innovative solutions to chemical and biological challenges have Edgewood Chemical Biological Center and the organizations that sprung from it provided for the Warfighter since 1917?"

# CHAPTER 1 | WORLD WAR I

### Start of World War I

The U.S. Army Edgewood Chemical Biological Center (ECBC), located at Aberdeen Proving Ground, Md., a key component of the U.S. Army Research, Development and Engineering Command (RDECOM), traces its lineage back to 1917 and the creation of the Army's first chemical warfare research and development facility. While Europe was caught up in the crises of 1914 that led to World War I, the United States remained neutral under the policy of President Woodrow Wilson. Although monitoring the events of the war, the United States failed to prepare to fight in it. Thus, when World War I saw the first large-scale chemical warfare attack by the Germans at Ypres, Belgium, in 1915, the U.S. Army did not start an emergency chemical warfare program. Likewise, the U.S. Army was unaware of the covert use of biological weapons by German agents to sicken horses and cattle in the United States awaiting shipment to Europe and the Middle East.

The production and use of offensive chemical weapons in the European war, however, did not go completely unnoticed. In the fall of 1915, the War Department initiated planning to provide American troops with a gas mask. This mask project was assigned to the Medical Department, which sent several officers to Europe to act as observers. Since the United States was not at war, however, no particular emphasis was placed on the project and no mask was completed.

### Creation of the War Gas Investigations, Bureau of Mines

Two years after the initiation of chemical warfare in Europe, the continued use of chemical weapons attracted the attention of another U.S. Government agency. Van H. Manning, Director of Bureau of Mines, Department of the Interior, realized his organization, created in 1908, had a unique knowledge about toxic gases and fumes often found in mineshafts and the devices required to protect against them. On Feb. 7, 1917, he held his first staff meeting to discuss how they could assist the government if the country was drawn into World War I. The next day, Manning sent a letter to Dr. C. D. Walcott, Chairman of the Military Committee of the National Research Council (NRC), created the year before, offering the Bureau's services in creating a chemical warfare program for the Army. On Feb. 12, 1917, Dr. Walcott replied to Manning's letter stating that he would bring the matter to the attention of the Military Committee.

National events, however, moved quicker than the NRC. After repeated neutrality violations, on April 2, 1917, President Woodrow Wilson addressed Congress and called for a declaration of war against Germany. The next day, the NRC established the Subcommittee on Noxious Gases and assigned Manning as chairman. This new organization included Ordnance and Medical officers from the Army and Navy as well as two members of the Chemical Committee of the NRC. Their mission was to investigate noxious gases, the generation of chemical warfare agents, and the discovery of antidotes for war purposes. Three days later, the United States declared war on Germany when Congress approved the President's request. Within a short time, the new subcommittee began organizing chemical warfare research at several prominent chemical laboratories at universities and industries across the nation.

*The American University campus became the site of American University Experiment Station and the War Gas Investigations.*

On April 30, 1917, American University near Washington, D.C., offered its campus for government use. The Army quickly accepted the offer and selected the site for a central chemical warfare research facility called American University Experiment Station. In September, Bureau of Mines personnel began moving onto the campus to establish the new War Gas Investigations, under the direction of Dr. G. A. Burrell, an expert on toxic mine gases.

### The Creation of Edgewood Arsenal

After the declaration of war, the War Department also made additional plans to prepare for chemical warfare. The initial approach was to assign the various tasks to the military department with the appropriate expertise. Thus, the Medical Department was assigned responsibility for chemical defensive aspects. The Ordnance Department was assigned responsibility for the production of chemical weapons and chemical warfare agents. The Signal Department was asked to produce chemical alarms. The Corps of Engineers was tasked with providing training and special gas troops. This diversified arrangement lasted for almost a year.

In June 1917, Major General William Crozier, Chief of the Ordnance Department, verbally approved the proposal to build a chemical shell filling plant. Initially, Kent Island on the eastern shore of the Chesapeake Bay was mentioned as a possible site for the shell filling plant. On Oct. 16, 1917, President Woodrow Wilson issued a proclamation under the Urgency Efficiency Act of 1917 that designated Gunpowder Neck in Harford County, Md., adjacent to

*Chemical Shell Filling Plant No. 1 at Edgewood Arsenal.*

the Ordnance Department's new Aberdeen Proving Ground, for the plant. He issued a second proclamation on Dec. 14, 1917, that superseded the first and clarified the takeover date.

Actual work began on Oct. 25, 1917, when workers started construction of the plant, initially called Gunpowder Reservation. In December 1917, the Ordnance Department also authorized construction of chemical agent production plants to support the shell filling plant.

Prior to March 6, 1918, the Trench Warfare Section of the Ordnance Department supervised the work on Gunpowder Neck. On that date, Gunpowder Reservation was transferred from the Trench Warfare Section of the Ordnance Department to the newly created Chemical Service Section, Ordnance Department. The War Department assigned Colonel William H. Walker to command Gunpowder Reservation.

Until April 1918, the installation had unofficially been referred to as Gunpowder Reservation, Gunpowder Neck Reservation, or U.S. Filling Station, Edgewood, Md. On April 20, 1918, Brigadier General William S. Pierce, Acting Chief of Ordnance, recommended to the Secretary of War that Gunpowder Reservation be designated an arsenal and be renamed "Edgewood Arsenal" after the town of Edgewood. Mr. Benedict Crowell, Assistant Secretary of War, approved this recommendation on April 23, 1918. On April 30, 1918, the Ordnance Department designated the new command Edgewood Arsenal. On May 4, 1918, the Ordnance Department officially changed the name of the installation from Gunpowder Reservation to Edgewood Arsenal.

Among the chemical shell filling plants and chemical warfare agent production facilities, Edgewood Arsenal established the first research laboratory. Not officially authorized to have research laboratories because that mission was at American University during the war, the Arsenal had to get special permission to establish a laboratory to verify the quality of the chemical agents the plants were producing.

### The Creation of the Chemical Warfare Service

In 1918, the War Department centralized chemical warfare functions under a senior Corps of Engineers officer, Major General William L. Sibert. The first step toward centralization occurred June 25 when President Wilson transferred the American University Experiment Station from the Bureau of Mines to the War Department. The next step occurred on June 28 when the War Department established the Chemical Warfare Service (CWS) under Sibert as part of the National Army (the temporary wartime army, as distinguished from the Regular Army), with full responsibility for all facilities and functions relating to toxic chemicals. This responsibility included Edgewood Arsenal in Maryland.

The CWS was organized into seven main divisions. The Bureau of Mines' War Gas Investigations at American University Experiment Station became the Research Division, under now Colonel Burrell. Personnel at Edgewood Arsenal and other production sites became the Gas Offense Production Division, under Colonel Walker. The large gas mask factory in Long Island City, N.Y., became part of the Gas Defense Division. The Development Division in Cleveland, Ohio, was responsible for studying production processes, particularly for gas mask canister charcoal and mustard agent. The Proving Division at Lakehurst Proving Ground, N.J., was adjacent to the Training Division at Camp Kendrick. The Medical Division, also located at American University, was responsible for toxicological aspects of chemical defense.

The U.S. Army finally had an organization that controlled all the various aspects needed to successfully fight on a chemical battlefield. For the next four and a half months, the CWS helped provide the research and equipment that contributed to the Allied victory in 1918.

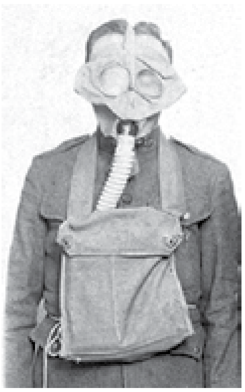

*Chemical Laboratory No. 1 at Edgewood Arsenal.*

### The End of World War I

The Armistice of November 1918 ended the world's first chemical and biological war. With the help of the CWS and Edgewood Arsenal, the Army successfully recovered from its early poor performance and survived repeated toxic chemical attacks against its troops. By the end of the war, the CWS had designed some of the best protective equipment for U.S. troops.

## INDIVIDUAL PROTECTION

### FIRST U.S. PRODUCED GAS MASK



**Bureau of Mines Mask.** The Bureau of Mines produced the first large batch of U.S. gas masks during the war. These were a copy of the British Small Box Respirator (SBR). The Bureau produced about 25,000 of them in June 1917, but determined the masks were not as good as the original British masks. These masks were never issued to the soldiers. Instead, U.S. soldiers landing in Europe were issued British and French masks. A second production in July 1917 resulted in the Training Mask, also a copy of the SBR. As named, it was for training only and not adequate for frontline use.

### FIRST IMPROVED GAS MASK FOR FIELD USE

**Corrected English (CE) Mask.** The first U.S. mask produced for frontline use was the Corrected English Mask. Developed in October 1917, the mask added significant improvements to the Training Mask, increasing the comfort factor, and making the charcoal canister effective against the toxic smokes that Germany was using. Approximately 1.6 million of these masks were produced for the American Expeditionary Forces (AEF) during the war.

### THE PRIMARY WORLD WAR I GAS MASK FOR U.S. TROOPS

**Richardson, Flory, and Kops (RFK) Mask.** In the spring of 1918, the CWS issued the RFK mask that was an improved version of the British SBR. The CWS was able to improve on the comfort of the mask while also decreasing the size and breathing resistance of the mask's charcoal canister. Over three million were produced for U.S. troops.

### COMBINED FRENCH AND BRITISH TECHNOLOGY FOR A COMFORTABLE GAS MASK

**Akron Tissot (AT) Mask.** Utilizing both British and French designs, the CWS merged the technologies in 1918 to create the AT Mask. The mask eliminated the necessity for a mouthpiece and nose clip, making it much more comfortable for a soldier to wear. It also directed the incoming clean air over the mask's lenses to decrease fogging. Manufacturing problems limited production to less than 200,000.

### ANOTHER MORE COMFORTABLE GAS MASK

**Kops Tissot (KT) Mask.** The KT Mask was similar to the AT Mask and included the comfort improvements to the British Small Box Respirator design. Again, manufacturing problems limited production to 337,000.

### THE BEST U.S. GAS MASK DURING WORLD WAR I

**Kops Tissot Monro (KTM).** In October 1918, the CWS merged the best aspects of all the previous masks to develop the KTM mask. Although considered the best mask developed during the war, only 2,000 were produced before the end of the war.

## PROTECTIVE CLOTHING

### THE FIRST U.S. CLOTHING FOR MUSTARD AGENT PROTECTION

**Impermeable Protective Outfit.** Following the German use of mustard agent on the battlefield, the necessity for a special protective outfit instead of the standard wool uniform became critical. The CWS examined several versions of impermeable materials that would protect the soldier from head to toe, as well as treatments for the regular uniform that would neutralize the agent. By the end of the war, the CWS was just beginning field trials with the new outfits and did not have any large numbers available yet.

## ANIMAL PROTECTION

### PROTECTION FOR MILITARY WORKING DOGS

**Dog Mask.** Humans were not the only creatures requiring protection on the battlefield against chemical agents. The CWS developed protective masks for dogs used for sending communications.

### PROTECTION FOR HORSES AND MULES

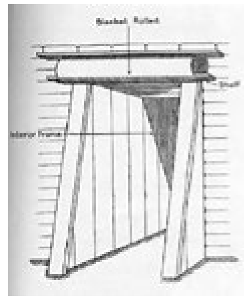
**Horse Mask.** Horses and mules were still an important means of transportation and required protective equipment.

### PROTECTION FOR THE BIRDS

**Carrier Pigeon Protectors.** Pigeons were used for aerial messaging and required a collective protected carrier when at the front lines.

## COLLECTIVE PROTECTION

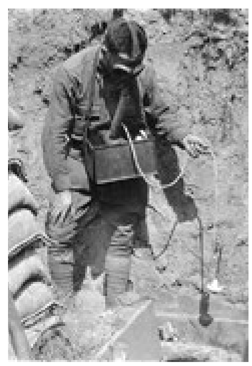
### PROTECTIVE DOORWAYS FOR TRENCH WARFARE



**Gas Proof Dugout Blankets.** The early concerns with collective protection primarily concentrated on providing a group of soldiers a place in the trenches that was gas proof and where they could remove the uncomfortable early gas masks. To accomplish this objective, the CWS treated blankets with various coatings or impregnates for agent resistance and hung them over dugout doorways. The best version was a regular cotton blanket treated with dugout-blanket oil. Over 35,000 such blankets were shipped to the AEF.

## DETECTION AND ALARMS

### NOSE BEST DETECTOR



**Early Chemical Agent Detectors.** The CWS continuously studied the critical need for chemical agent detectors. Initially, World War I soldiers relied on smell and throat and nose irritation to detect chemicals. Work on field detectors came close, but never could perfect a chemical detector during the war. The CWS also examined various dyestuffs that changed color when contaminated with mustard agent, but most of the formulas were British and the CWS had trouble duplicating their work.

### EARLY RESEARCH ON ALERTING THE TROOPS OF A CHEMICAL ATTACK

**Chemical Agent Alarms.** Once chemical agents were detected, soldiers needed a capability to alert everyone in the vicinity. For most of the war, the alarm was sounded by using truck horns, police rattles, church bells, or whatever loud noise was available. These alarms created problems of their own as the rattles often sounded like machine gun fire and it was difficult to distinguish between other non-chemical alarms. The CWS investigated many different types of alarms, but by the end of the war, the ability to detect chemical agents and alert the troops was still in a very primitive state.

# DECONTAMINATION

## ELIMINATING CHEMICAL AGENT ON THE BATTLEFIELD

**Bleaching Powder.** After a gas attack, there was a significant challenge of removing the chemical agents left on the battlefield to avoid further casualties. Mustard agent, a persistent danger, required extensive decontamination of the ground. The Germans were the first to use chloride of lime to decontaminate the ground after an explosion at Germany's mustard agent factory in Adlershof. For the AEF, bleaching powder (also known as chloride of lime or calcium hypochlorite) was the primary decontaminant during the war. Obtained from the bleaching industry, it was a white powder that proved effective in neutralizing mustard agent on the ground. Almost 2,000 tons of bleaching powder was sent to the AEF during the war.

## ELIMINATING CHEMICAL AGENT ON SOLDIERS

**Degassing Trucks.** The need to decontaminate soldiers after a chemical attack led to the development of degassing units. Each unit had two trucks. The first, a water truck, provided showers to remove the physical contamination. The second provided clean uniforms to replace the contaminated ones.

# RETALIATORY CHEMICAL WEAPONS

## CHEMICAL AGENT DELIVERY SYSTEM

**M1 Portable Chemical Cylinder.** The initial mode for large-scale dissemination of chemical agents was the chemical cylinder, designed to hold 30 to 70 pounds of agent. Soldiers simply opened a valve and hoped the wind continued to blow toward the enemy. The resulting cloud could drift many miles behind enemy lines, striking not only the front troops but also the headquarters, communications, and support elements. However, if the wind reversed its direction, the gas cloud would inflict the same damage on friendly troops. The early cylinders were heavy, bulky, and made a loud noise when releasing the gas. The CWS Research Division modified the design to create what eventually was designated the M1 Portable Chemical Cylinder. It was lighter weight and the nozzle made much less noise when in use than the earlier versions. Cylinders were improved after the war but only used for training.

## IMPROVED CHEMICAL AGENT DELIVERY SYSTEM

**M1 Livens Projector.** The British first developed the Livens projector, an 8-inch mortar-like tube that shot or projected a gas cylinder into the enemy's lines. The range was a respect able 1,700 yards with a flight time of 25 seconds. Special CWS gas troops used Livens Projectors during the war. After the war, the CWS made improvements primarily to the barrel, but only used the Livens for training.

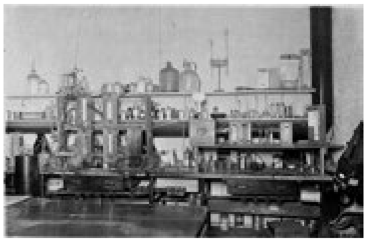
## LIGHTWEIGHT CHEMICAL MORTAR

**M1 4-inch Chemical Mortar.** British 4-inch trench mortars, called Stokes mortars, provided a solution to some of the problems with cylinders and Livens Projectors. The Stokes mortar did not require extensive preparation and could be moved as needed. Since it was not rifled, the range was only 1,200 yards, which meant about a 14-second time of flight. The small shell only held about 6 to 9 pounds of agent, but experienced gunners could fire 25 rounds per minute. Special CWS gas troops used Stokes mortars during the war. After the war, the CWS made improvements to the barrel using a higher grade steel, but only used the Stokes mortar for training.

## HEAVY WEAPONS

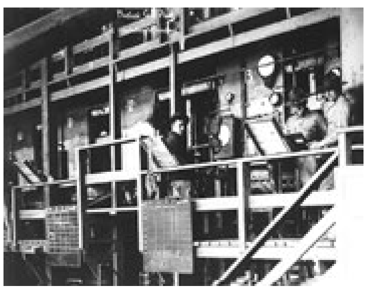
**Chemical Artillery Shells.** In addition to the special chemical weapons, the U.S. Army fired chemical rounds from 75-millimeter, 4.7-inch, 155- millimeter, and larger-caliber guns. Many of these had ranges of five to 10 miles, with pay loads as much as 50 pounds of agent. Owing to a shortage of shell parts and the late completion of U.S. shell-filling plants, U.S. troops primarily fired French phosgene and mustard agent rounds.

## NEW CHEMICAL AGENTS



**Chemical Agent Research.** The Research Division of the CWS at American University conducted extensive research on chemical warfare agents in their laboratories. They examined German, French, and British agents for potency and weaponization potential. Utilizing both American University and Catholic University chemical laboratories, they were able to develop new warfare agents not yet used on the battlefield. One such chemical was Lewisite, attributed to Captain W. Lee Lewis. Captain Roger Adams likewise gave his name to the toxic smoke Adamsite. The Research Division's knowledge of toxic gases contributed significantly to the war effort and the safety of U.S. soldiers.

## HOW TO PRODUCE CHEMICAL WEAPONS



**Chemical Agent Production.** The Research Division conducted pilot plant studies on how to produce chemical agents. Large-scale agent production plants were primarily located at Edgewood Arsenal. There, the CWS constructed four chemical agent production plants for chlorine, chloropicrin, phosgene, and mustard agent. The four agent production plants produced the highest priority agents thought to be required for the western front in 1917. By 1918, however, the first two were no longer critical agents due to the improvement of gas masks, although chlorine was still used in the production of phosgene. Edgewood Arsenal produced over 935 tons of phosgene and 711 tons of mustard agent by the end of the war. Government contractors at several sites around the country also produced these four agents and small amounts of Lewisite. Lewisite, however, never reached the front. After the end of the war, most of it was disposed in the Atlantic Ocean off the East Coast.

## HOW TO FILL CHEMICAL WEAPONS

**Chemical Weapons Filling Plants.** Edgewood Arsenal was designed to have four shell-filling plants. Only two of the shell-filling plants were completed before the end of the war. Shell Filling Plant No. 1 loaded a mixture of stannic chloride and chloropicrin (designated by the code "NC") in 75-millimeter shells and phosgene in Livens projectiles. Filling Plant No. 2 filled mustard agent in 75-millimeter shells.

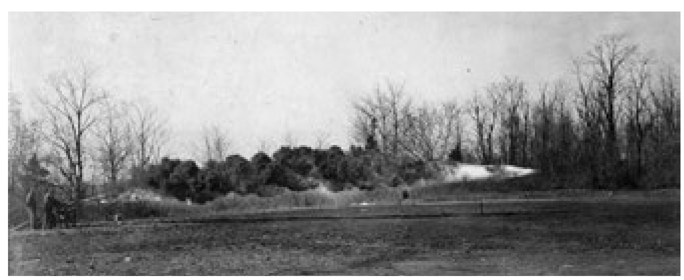
# RETALIATORY BIOLOGICAL WEAPONS

## U.S. FIRST TOXIN WEAPON

**Ricin Weaponization.** By 1918, the United States was aware of the active German biological warfare program, but the only agent the Research Division seriously examined was ricin, a toxin, for retaliatory purposes. The CWS examined disseminating ricin, derived from castor beans, in two ways. The first involved adhering ricin to shrapnel bullets for containment in an artillery shell.
The second involved the production of a ricin dust cloud created by depositing ricin on a dusty road. Although both approaches were tested, only small amounts of ricin were produced before the end of the war and none was used on the battlefield.

# FLAME WEAPONS

## EARLY FLAMETHROWERS



**Portable Flamethrower.** During the war, the CWS investigated several designs for a portable backpack-style flamethrower. The primary technical challenge was to have a safe system that could fire the greatest distance. They also looked at various other flame weapons, include a flaming bayonet. Although several versions were in design, the war ended before they could field a reliable flamethrower unit with an adequate range and duration of fire.

## INCENDIARY WEAPONS

### EARLY INCENDIARY WEAPONS

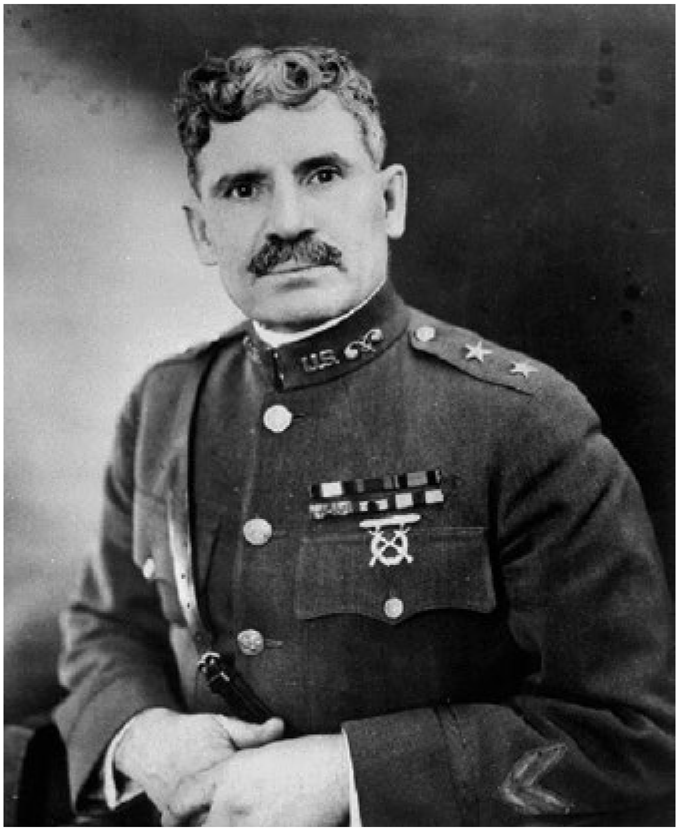
**Bombs, Grenades, and Projectiles.** The CWS conducted extensive work on developing incendiary bombs, grenades, and projectiles and designing the best incendiary mixture for them. One of the first incendiary bomb filling plants was completed at Edgewood Arsenal.

## SMOKE SCREENING

### EARLY SMOKE SCREENING

**Projectiles, Candles, and Grenades.** The need for an effective smoke-screening capability grew throughout the war. The CWS researched and developed several types of smoke agents to include White Phosphorus (WP), Bureau of Mines Smoke Mixture, and Titanium Tetrachloride (FM). To disseminate the smoke agent, the CWS developed smoke pots, smoke grenades, Stokes and Livens projectiles, and an experimental smoke generator for tanks.

# CHAPTER 2 | THE 1920s



*Major General Amos A. Fries was one of the strongest supporters of the Chemical Warfare Service.*

### CWS Made Permanent

Following the successful conclusion of World War I, the CWS's first major concern was to ensure its chemical research and development program survived demobilization. The Army had organized the CWS as a temporary war measure, a part of the National Army only, and that temporary existence was due to expire within six months after the end of the war. The deadline was later extended to June 30, 1920. During Congressional hearings, Secretary of War Newton D. Baker testified, "We ought to defend our army against a gas attack if somebody else uses it, but we ought not to initiate gas." He and Chief of Staff General Peyton C. March both used this philosophy to recommend abolishing the CWS and outlawing chemical warfare by a treaty.

To persuade Congress to keep the CWS, several prominent civilian and military leaders lobbied to include a permanent chemical warfare organization. Lieutenant Colonel Amos A. Fries, a CWS officer and one of the strongest proponents of a permanent organization, stressed the need for a central organization, one that covered all aspects of chemical warfare. He drew on the lessons learned from the previous war:

> *Had there been a Chemical Warfare Service in 1915 when the first gas attack was made, we would have been fully prepared with gases and masks, and the Army would have been trained in its use. This would have saved thousands of gas cases, the war might easily have been shortened six months or even a year, and untold misery and wasted wealth might have been saved.*

He also stressed that both retaliatory and defensive research must be conducted in parallel.

The chemical warfare specialists won the argument. On July 1, 1920, the CWS became a permanent part of the Regular Army. Its mission included development, procurement, and supply of all offensive and defensive chemical warfare material, together with similar functions in the fields of smoke and incendiary weapons. In addition, the CWS was made responsible for training the Army in chemical warfare and for organizing, equipping, training, and employing special chemical troops.

*Headquarters of Edgewood Arsenal.*

### Edgewood Arsenal as Chemical Research Center

After the end of World War I, almost all aspects of the CWS moved to Edgewood Arsenal—the exception being the Headquarters, which remained in the Washington D.C. area. This included all of the work at the American University Experiment Station, which was shut down. In addition, Edgewood received the Chemical School, the chemical testing mission, and the gas mask production plant. The original chemical warfare agent production work was placed on standby as leftover stocks of chemicals from World War I were deemed sufficient for the Army's stockpile. Only laboratory amounts of agent production were allowed for research and development.

Edgewood Arsenal took over the hospital administration building as its new headquarters. The research and development work was assigned to a new organization called the Technical Division, created in 1920. Initially there were two divisions, the Chemical Division and the Mechanical Division. Two years later, the Medical Research Division was added. In 1928, there was a major reorganization creating the following divisions: Research Division, Medical Research Division, Munitions Development Division, Protective Development Division, Engineering Division, and Information Division.

At Edgewood, the World War I chemical laboratory became Laboratory No. 1. Laboratory No. 2 used a former World War I guard barracks that had been used temporarily after the end of the war as the Chemical Museum. A new medical research facility was completed near Laboratory No. 1. Other research and development facilities were constructed around the post for testing, engineering, and experimental fabrication.

### Biological Warfare Research and Development

During the early 1920s, the CWS considered whether Edgewood Arsenal should also conduct biological weapons research. There were several suggestions from within the CWS that biological agents should receive more attention, but Fries, who had been promoted to major general and had replaced Sibert as the Chief Chemical Officer in 1920, decided it was not useful to do so. In 1926, he wrote in the annual report of the CWS:

> *The subject of bacteriological warfare is one which has received considerable notice recently. It should be pointed out in the first place that no method for the effective use of germs in warfare is known. It has never been tried to any extent so far as is known.*

International politics also discouraged biological research and development. The new League of Nations examined the topic and agreed with Fries:

> *[Biological] warfare would have little effect on the actual issue of a war because of protective methods available; that filtering and chlorinating drinking water, vaccination, inoculation, and other methods known to preventive medicine, would so circumscribe its effect as to make it practically ineffective.*

### New Mission: Non-Military Use of Chemical Warfare Technology

To improve its standing with the taxpayer and a growing pacifist movement that found all chemical research deplorable, the CWS expanded its research capabilities into non-military projects. These special civilian projects included researching ways to preserve wooden dock structures (1923) and pesticides for fighting boll weevils (1925–1927). For the latter program, the CWS recommended using airplane spray tanks to disseminate the chemicals.

In response to the often violent labor conflicts and civil unrest during the 1920s, the CWS also developed riot control weapons. These included tear gas smoke pots, grenades, sprayers, bombs, and projectiles.

*During the 1920s, Edgewood Arsenal helped fight the boll weevils infesting cotton crops.*

### The Chemical Biological Threat

Throughout the 1920s, rumors of chemical warfare attacks plagued the world. Besides the United States and the major World War I powers, several other countries began to develop a growing chemical warfare capability. Some of the countries with chemical weapons used them in their military operations. During the Russian Civil War and Allied intervention in the early 1920s, both sides had chemical weapons, and there were reports of isolated chemical attacks. Later accounts accused the British, French, and Spanish of using chemical warfare at various times during the 1920s.

Two events related to biological warfare apparently went unnoticed by the U.S. Army. In 1928, a Japanese officer, Shiro Ishii, began promoting biological warfare research and took a two-year tour of foreign military research establishments, including some in the United States. His conclusion was that all the major powers were secretly researching biological warfare. Although his conclusion was erroneous for the United States, it was probably accurate for the Soviet Union. In 1929, the Soviets reportedly established a biological warfare facility north of the Caspian Sea.

### International Attempts to Ban Chemical and Biological Warfare

While the CWS and Edgewood Arsenal struggled to keep the Army ready for a chemical war, international attempts were made to prohibit chemical warfare. The Treaty of Versailles, completed in 1919, prohibited Germany from producing, storing, importing, or using poisons, chemicals, and other chemical weapons. The treaty was not ratified by the United States. A separate treaty with Germany did not mention chemical warfare, but the United States agreed to comply with the provisions of the Treaty of Versailles related to poisonous gases.

Although the new League of Nations concluded in 1920 that chemical warfare was no crueler than any other method of warfare used by combatants, the Limitation of Arms Conference, held in Washington, D.C., in 1922, banned the use of poisonous gases except in retaliation. The United States ratified the limitation, but France declined to ratify the treaty and therefore it was never implemented.

This unsuccessful attempt was followed by the 1925 Geneva Protocol, which was signed by 28 countries, including the United States. This agreement condemned the use of gas and bacteriological warfare. The U.S. Senate refused to ratify the Protocol and remained uncommitted by it. The Senate had apparently decided that chemical warfare was no crueler than any other weapon and therefore should not be banned. The general policy of the U.S. Government, however, still tended toward the discouragement of all aspects of chemical warfare, but was tempered by a policy of preparedness should chemical warfare occur again. Edgewood Arsenal remained the CWS's primary facility to ensure that the United States was prepared should it find itself in another chemical war.

## INDIVIDUAL PROTECTION

### FIRST U.S. POST-WORLD WAR I MASK

**M1 Gas Mask.** After the war, the CWS continued working on the World War I Kops Tissot Monroe (KTM) mask, which became known as the Model 1919. In 1921, the mask officially became the M1 Gas Mask. It had a stockinette-covered rubber facepiece, non-replaceable eyepieces, and came in five sizes. The M1 Mask continued to be improved over the years with better charcoal canisters until replaced by the next field mask.

### FIRST U.S. MASK WITH A SPEAKING CAPABILITY

**M1 Diaphragm Mask.** Communication problems while using the M1 Mask resulted in the design of a special Diaphragm Mask. This mask was designed to allow officers and non-commissioned officers to communicate while still wearing masks. The mask was standardized in 1925 and came in four sizes. Additional improvements such as replaceable eyepieces eventually led to a newer version designated the M1A1 Diaphragm Mask.

### IMPROVED MASK

**M1A1 Gas Mask.** Problems with the eyepieces in the original M1 Gas Mask led to the development of replaceable eye lenses. The new and improved mask, designated the M1A1 Gas Mask, was standardized in 1928.

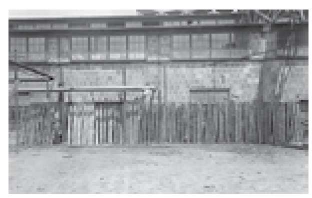
## PROTECTIVE CLOTHING

### FIRST U.S. PROTECTIVE OUTFIT

**M1 Impermeable Protective Suit.** In 1923, the CWS standardized the World War I impermeable protective suit. Referred to as the oilskin-type suit, this protective suit was used until it was replaced in 1937.

## CIVILIAN PROJECTS

### PROTECTING WHARFS AND PIERS



**Wooden Pier Pilings Treatment.** The CWS researched and tested chemical treatments to preserve wooden pier pilings from sea creatures.

### PROTECTING COTTON CROPS

**Boll Weevil Pesticides.** The CWS researched and tested chemical agents to kill boll weevils attacking cotton crops in the south.

## RETALIATORY CHEMICAL WARFARE

### FIRST U.S. CHEMICAL BOMB

**M1 30-pound Chemical Bomb.** During World War I, chemical weapons were not delivered by airplanes. After the war, the CWS developed the M1 30-pound Chemical Bomb in the 1920s. It could hold chemical warfare agents, riot control agents, or smoke agents. Additional work on this first U.S. chemical bomb led to more designs that increased their capacity and reliability.

### FIRST U.S. RIFLED CHEMICAL MORTAR

**M1 4.2-inch Chemical Mortar.** In the early 1920s, Captain Lewis M. McBride experimented with rifling the barrel of the 4-inch Stokes Mortar. In truing the inside of the barrel preparatory to rifling, the bore became 4.2 inches in diameter. This work increased the range of the mortar from 1,100 yards to 2,400 yards (1.3 miles). In 1928, the improved mortar was standardized as the M1 4.2-inch Chemical Mortar and became the CWS's prized ground weapon for the delivery of toxic chemical agents as well as smoke and high explosives. Continued work increased the range to 3,200 yards (1.8 miles) before World War II.

## RIOT CONTROL

### FIRST U.S. RIOT CONTROL SMOKE POT


**M1 Adamsite (DM) Irritant Candle.** For riot control, the Portable Chemical Cylinder was too large and bulky and took too long to employ. To replace it, in 1924, the CWS standardized a toxic smoke pot that was only 7 inches in diameter, 2-7/8-inches tall, and weighed only 9-1/4 pounds. The candle burned for about two minutes and produced a smoke that could drive most rioters away, yet was nonlethal.

## SMOKE SCREENING

### IMPROVED SMOKE AGENT


**Hexachloroethane Smoke Mixture (HC).** Many of the World War I smoke agents used a liquid base that evaporated rapidly in storage. To solve this problem, the CWS replaced the liquid with HC, a dry powder, in 1920. This created a significant improvement and resulted in a mixture that was still being used in new smoke items well into the 1970s.

### RECYCLED GAS MASK CANISTERS

**M1 Smoke Candle.** After the end of World War I, the Army had over 600,000 surplus gas mask canisters. Instead of scrapping them, in 1920, the CWS filled them with HC smoke mixture and created a small smoke pot (called a candle). These candles produced white smoke for about two to four minutes.

# CHAPTER 3 | THE 1930s

## Change in U.S. Chemical Warfare Policy

During the 1930s, international attempts to ban not only the use of chemical weapons but also all research, production, and training caused a response that developed into a new U.S. policy on chemical warfare that impacted Edgewood Arsenal. The Army Chief of Staff, General Douglas MacArthur, stated the policy in a letter to Secretary of State Henry L. Stimson in 1932:

> *In the matter of chemical warfare, the War Department opposes any restrictions whereby the United States would refrain from all peacetime preparation or manufacture of gases, means of launching gases, or defensive gas material. No provision that would require the disposal or destruction of any existing installation of our Chemical Warfare Service or of any stocks of chemical warfare material should be incorporated in an agreement. Furthermore, the existence of a War Department agency engaged in experimentation and manufacture of chemical warfare materials, and in training for unforeseen contingencies is deemed essential to our national defense.*

There were no other major attempts to ban chemical and biological warfare during the 1930s. Despite the Depression and severe economic restraints, Edgewood Arsenal remained the Army's premier chemical research and development center.

## Use of Riot Control Technology

In response to the often violent labor conflicts and civil unrest during the 1930s, the Army occasionally was called upon to use riot control devices against rioters. The intent was to use less-than-lethal chemicals that would eliminate the need for lethal weapons during domestic riots. Edgewood Arsenal scientists spent a large portion of their research time working on riot control devices.

One such incident occurred during the Bonus March when World War I soldiers seeking promised financial support marched on the U.S. Capitol in 1932. The Army used tear gas to drive them away. The assessment by Major Alexander Wilson was: "This operation showed without a doubt that tear gas should always be used against infuriated mobs of fellow citizens."

## Italian-Ethiopian War

Most chemical warfare experts during the 1930s expected the next world war to again include the use of chemical weapons. Conflicts in Africa and Asia provided examples. The first major use of chemical weapons after World War I came in 1935 during the Italian-Ethiopian War. Marshal Pietro Badoglio resorted to chemical weapons to defeat the Ethiopian troops led by Emperor Haile Selassie. Despite the Geneva Protocol of 1925, which Italy had ratified in 1928 (and Ethiopia in 1935), the Italians dropped mustard bombs and occasionally sprayed it from airplane tanks. There were also rumors of phosgene and chloropicrin attacks, but these were never verified. The Italians attempted to justify their use of chemical weapons by citing the exception to the Geneva Protocol restrictions that referenced acceptable use for reprisal against illegal acts of war. They stated that the Ethiopians had tortured or killed their prisoners and wounded soldiers. The CWS sent military observers to both sides and their conclusion was that chemical agents were very effective against unprepared soldiers. This lesson learned from the war was added to the Chemical School classes' curriculum to ensure that officers were ready for the next chemical war.

*Edgewood tests of protective clothing against mustard agent in 1936-1937.*

## Japanese Chemical and Biological Warfare in China

Japan had an extensive chemical weapons program and was producing agent and munitions in large numbers by the late 1930s. During the war with China, Japanese forces reportedly began using chemical shells, tear gas grenades, and lachrymatory candles, often mixed with smoke screens. By 1939, the Japanese reportedly escalated to mustard agent. Against the untrained and unequipped Chinese troops, the weapons proved effective. The Chinese reported that their troops retreated whenever the Japanese used just smoke, thinking it was a chemical attack.

In 1933, Japan set up an offensive biological warfare laboratory, later designated Detachment 731, in occupied Manchuria that developed and tested a biological bomb within three years and also tested biological agents on Chinese prisoners. By the beginning of World War II, Japan had developed and tested in the field nine different kinds of biological bombs and had produced over 1,600 bombs, although some had been expended in research.

Despite the Chinese reporting the use of chemical and biological weapons, Edgewood Arsenal did not initiate a biological weapons program in response to this conflict. The Army monitored the reports, but took little action to either establish a retaliatory capability or develop specialized defense equipment for a biological attack.

### German Chemical Weapons Development

In 1936, German chemist Dr. Gerhart Schrader of I.G. Farben Company discovered an organophosphorus insecticide which was reported to the Chemical Weapons Section of the Germany military prior to patenting. The military was impressed with the effects of the compound on the nervous system and classified the project for further research. The military assigned various names to the new substance, including Trilon-83 and Le 100, but Tabun was the one that stuck. The CWS after World War II gave it the code designation GA, for German Agent A.

About two years later, Schrader developed a similar agent, designated T-144 or Trilon-46 and eventually Sarin, which was reportedly five times as toxic as Tabun. The United States would later call this agent GB. The Germans assigned a large number of chemists to work on these new nerve agents and began building a pilot plant for production in 1939, the year World War II started in Europe. The CWS and Edgewood Arsenal were unaware of this development at the time. In fact, U.S. Army chemists went so far as to insist that there would be no further new chemical warfare agents discovered because they would have discovered them. Only during the closing months of World War II did the United States become aware of nerve agents.

*The renovated World War I Mustard Agent Plant used to produce mustard agent in 1937 and 1939.*

### Preparing for the Next War

The possibility of war in Europe during the late 1930s became the primary concern of the U.S. Army and the CWS. Official policy, however, was against the employment of chemical warfare, and initially, the CWS met with much resistance in gearing up for a future war. President Franklin D. Roosevelt detested chemical warfare and in 1937 refused to permit the redesignation of the CWS as a corps. The same year, however, Edgewood Arsenal rehabilitated their World War I mustard agent plant and restarted limited production of that agent and phosgene to enlarge their retaliatory stockpile.

The start of World War II in Europe in 1939 led President Roosevelt to declare a limited national emergency that resulted in a major increase in the rate of American rearmament. Edgewood Arsenal began a major construction program, increased production of both defensive equipment and retaliatory weapons, and expanded the Chemical School program to prepare for another possible chemical war. Although no major use of chemical or biological agents occurred in Europe, continued rumors and reports of incidents in both Europe and during the Japanese-China conflict attracted the attention of U.S. intelligence officers during the early part of the war. Their conclusion was that both Germany and Japan had the potential to make a devastating surprise chemical or biological attack and that the United States should be prepared to defend against such an attack and have the capability to retaliate in kind.

## INDIVIDUAL PROTECTION

### FIRST U.S. MASK IN ONE UNIVERSAL SIZE

**M1A2 Gas Mask.** In 1934, the first major modification to the original M1 Mask design resulted in the M1A2 mask. The new design allowed the mask to be issued in one universal size that fit 95 percent of soldiers. This mask became the standard mask for the Army up to the beginning of World War II. By 1937, Edgewood Arsenal was producing over 50,000 masks per year. The mask was eventually obsoleted during World War II.

### FIRST U.S. MASK WITH SPECIAL VISION

**M1 Optical Mask.** The Navy originally requested a special mask for personnel operating gun sights, range finders, and other optical equipment that also had a diaphragm for speaking. After designing the Mk 1 Navy Diaphragm Optical Mask, the Army liked the design and standardized it as the M1 Optical Mask in 1935. The mask was used throughout World War II and was finally obsoleted in 1945.

### IMPROVED SPEAKING MASK

**M2 Diaphragm Mask.** Improvements to the first Diaphragm Mask in 1935 resulted in the M2 Diaphragm Mask. This mask was more comfortable to wear, had better speaking capability, and came in one universal size. The mask was obsoleted during World War II.

### FIRST U.S. MASK WITH FULLY MOLDED RUBBER FACEPIECE

**M1 Training Mask.** In 1939, the CWS developed the M1 Training Mask that used a small lightweight filter connected directly to the facepiece. The facepiece was the first to use a fully molded rubber faceblank. The original concept of a training mask was that complete protection from all chemical agents was not required, therefore, there was no need for state-of-the-art canisters.

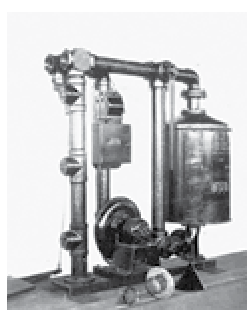
## PROTECTIVE CLOTHING

### IMPROVED ONE-PIECE OUTFIT

**Impermeable Protective One-Piece Suit.** Improvements to the M1 Impermeable Protective Suit led to the Quartermaster Department replacing it with a new version in 1937. The CWS conducted the research and testing of the new outfit. This new version was used primarily in production plants and during testing throughout World War II until replaced after the war.

## COLLECTIVE PROTECTION

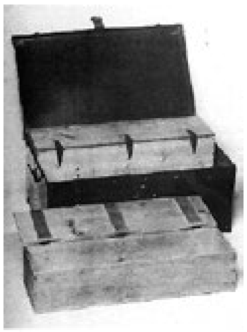
### FIRST LARGE COLLECTIVE PROTECTION UNIT



**M1 Collective Protector.** A significant technical challenge during the 1930s was a collective protection capability for troops in the field. The CWS standardized its first collective protective unit in 1932. The M1 Collective Protector, a giant 1,210-pound fixed installation unit providing 200 cubic feet of air per minute, was designed primarily for coastal defense fortifications. The level of protection was the same as provided by the standard gas mask canister.

## DETECTION AND ALARMS

### FIRST MOBILE LABORATORY



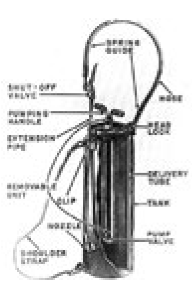
**M1 Field Laboratory.** The World War I establishment of a field chemical laboratory in France led to the development of the first mobile chemical laboratory in 1936. The laboratory was intended to provide onsite analysis and identification of foreign chemical warfare agents while operating near the frontlines. It consisted of 123 foot lockers, boxes, and crates, totaling 21,000 pounds and required seven trucks to move the collection. Eleven of the laboratories were assembled during World War II, but excessive equipment breakage during transport led to improved versions.

## DECONTAMINATION

### PRIMARY DECONTAMINATING AGENT DURING WORLD WAR II


**M4 Decontaminating Agent.** In 1938, the CWS made the important discovery of the decontaminating capability of the compound RH-195, developed by the DuPont Company, when mixed with acetylene tetrachloride. This combination was later designated Decontaminating Agent Non-Corrosive (DANC). DANC, redesignated M4 Decontaminating Agent in 1942, was the primary decontaminant during World War II. Over one million of the 3- and 4-gallon containers were produced during the war.

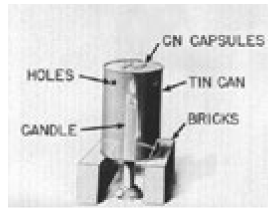
### FIRST POST WORLD WAR I DECONTAMINATION DEVICE




**M1 Decontaminating Apparatus.** The first standardized handheld sprayer was the 3-gallon Demustardizing Apparatus, Commercial Type, standardized in 1938 and later designated the M1 Decontaminating Apparatus. It held enough decontaminant to clear about 50 square yards. This unit was one of the main decontaminating devices during World War II and was still in use during the 1960s.

## TRAINING

### TEAR GAS CAPSULE FOR TRAINING




**CN Capsule.** As early as 1922, the CWS developed a small gelatin capsule of concentrated chloroacetophenone (CN) for use in tear gas training. The capsule was heated in a closed room and produced tear gas. In 1931, the capsules were official standardized as a metal can holding 50 capsules. During World War II, over 4.3 million capsules were produced.

## RETALIATORY CHEMICAL WARFARE

### FIRST U.S. CHEMICAL LANDMINE


**M1 Chemical Landmine.** During World War I, chemical landmines were not used. The CWS developed and standardized the first chemical landmine for mustard agent in 1939. Intended primarily for defensive use, this 1-gallon gasoline was set off by an igniter and sprayed mustard agent around for terrain denial.

## RIOT CONTROL

### FIRST U.S. RIOT CONTROL GRENADE


**M6 Tear Gas (CN/DM) Grenade.** In 1933, the CWS approved a burning-type tear gas grenade that disseminated a mixture of the quick-acting tear gas chloroacetophenone (CN) and the nauseating toxic smoke Adamsite (DM) for about one minute. Over 500,000 were procured during World War II. The grenades were also used for riot control during the Korean War and not obsoleted until 1970.

### FIRST U.S. TEAR GAS GRENADE


**M7 Tear Gas (CN) Grenade.** Similar to M6 CN/DM Grenade only with CN, the M7 was also standardized in 1933. It proved very effective for training and riot control. A later version during the Vietnam Conflict replaced the CN tear gas with CS tear gas.

## SMOKE SCREENING

### IMPROVED SMOKE GRENADE


**M8 Smoke Grenade.** The need for a smoke-screening and signaling grenade led to the development in 1931 of the M2 Smoke Candle containing hexachloroethane (HC) smoke agent in a cylindrical container. This grenade could produce white smoke for about two minutes. Eventually designated the M8 White (HC) Smoke Grenade, this grenade provided a significant signaling and screening capability to the Warfighter that continued to be used decades after its development.

### CHEAPER SMOKE AGENT

**Sulfur Trioxide Solution (FS).** Although the World War I development of FM smoke was important, FM was costly and slow to produce. To solve these problems, the CWS developed FS smoke during the 1930s. Originally intended only for airplane spray tanks, by World War II it was used in most chemical weapons.

### IMPROVED SMOKE PRODUCER


**M1 Smoke Pot.** Although the M1 Smoke Candle was useful, the Army wanted a much longer smoke producer. In 1935, the M1 Smoke Pot was standardized. It was filled with HC smoke mixture and produced smoke for about five to eight minutes.

# CHAPTER 4 | THE 1940s

## World War II and the Growth of the CWS

When the United States entered World War II after the Japanese attack on Dec. 7, 1941, the transition to wartime conditions was much less sudden than in 1917. Major General William Porter, who served as the Chief of the CWS throughout the war, commanded a large and rapidly growing organization whose personnel numbered in the thousands, whose physical facilities were scattered throughout the eastern half of the country, and whose products were in urgent demand by a rapidly growing Army.

The primary facility for both chemical defense and retaliatory capabilities remained Edgewood Arsenal. In 1942, there was a major reorganization at Edgewood Arsenal. The overall organization was designated the Chemical Warfare Center at Edgewood Arsenal. Administratively underneath this headquarters but also under the direct command of the CWS Headquarters in Washington, D.C., was the Technical Command, formerly the Technical Division, and a separate Medical Research Division. The Technical Command was the primary chemical research and development organization for the CWS and was responsible for not only chemical items but also flame, incendiary, and smoke.

*New construction at the Chemical Warfare Center included a laboratory and administration building for the Technical Command.*

Along with the reorganization and new name, Edgewood saw a massive construction program. The primary focus was on new production and filling plants but also included a new two-story laboratory/administration building for the Technical Command, a similar two-story complex for the Medical Research Division, test facilities, experimental fabrication, a new chemical agent storage yard, and numerous support buildings to include a hospital, barracks, a paved airfield, and expanded Chemical School facilities.

Even with this expansion, the chemical weapons production and storage needs could not be met by Edgewood Arsenal alone, so the CWS quickly constructed new chemical arsenals at Huntsville, Ala., Denver, Colo. (called Rocky Mountain Arsenal), and Pine Bluff, Ark., and a chemical/biological test facility at Dugway Proving Ground, Utah. The research and development mission, however, primarily remained at Edgewood.

## New Mission: Guard and Security Division

Because of the hazardous nature of chemical weapons, moving them required personnel who were knowledgeable about the effects and dangers of the agents and what to do in case of an accident. Initially, the soldiers assigned to move chemical munitions belonged to the arsenal or depot that supplied the weapons. This arrangement put administrative and logistical burdens on the arsenals and depots, many of which were controlled by the Ordnance Department and did not have chemical weapon handlers.

To solve this problem, the Chief of the CWS made an agreement with the Chief of Ordnance to establish a special unit to handle chemical weapon transfers. In 1943, the CWS created the Guard and Security Division at Camp Sibert, Ala., the CWS's primary chemical training site. The unit transferred to the Chemical Warfare Center in early 1944.

By the end of World War II, the unit had accomplished 1,151 missions and had escorted over 848,000 tons of material. On some of the missions, guard teams had covered over 300,000 miles and had circled the world. After the war, the unit received a Meritorious Unit Commendation for performing 847 missions without serious injury during the period May 31, 1944, to Dec. 31, 1945.

## The Chemical and Biological Warfare Threat

The primary threat for the CWS during World War II was that Germany or Japan would initiate chemical warfare against both military and civilian targets. During the war, Germany produced approximately 78,000 tons of chemical warfare agents. This total included a new type of chemical agent called nerve agents that were unfamiliar to the United States. Germany produced approximately 12,000 tons of the nerve agent Tabun (GA) between 1942 and 1945 and about 1,000 pounds of Sarin (GB) by 1945. Mustard agent, however, was still considered the most important chemical warfare agent, and the Germans filled artillery shells, bombs, rockets, and spray tanks with the agent. Phosgene, of somewhat lesser importance, was loaded in 250- and 500-kilogram bombs.
The Germans were the greatest producers of nitrogen mustards and produced about 2,000 tons. This was filled in artillery shells and rockets. They also had a large number of captured chemical munitions from France, Poland, Soviet Union, Hungary, and other occupied countries. The German biological warfare program was much less extensive than their chemical program. Most of their work was with antipersonnel agents such as plague, cholera, typhus, and

*A training exercise at the Chemical Warfare Center during World War II.*

yellow fever. They also investigated the use of insects to spread disease to animals and crops.

Japan produced about 8,000 tons of chemical agents during the war. They loaded mustard agent, a mustard/lewisite mixture, and phosgene in shells and bombs and had experience in their use during their attacks on China. They also filled hydrogen cyanide in mortar and artillery shells and in glass grenades. Japan's biological warfare program was also in full swing by the time the United States entered World War II, and they had tested biological weapons on humans in the laboratory and on the battlefield.

### U.S. Biological Defense Program

This reported use of cholera, dysentery, typhoid, plague, anthrax, and paratyphoid by the Japanese against the Chinese led to an American decision to also conduct biological warfare research and establish a retaliatory biological warfare capability. Initially, the Army's biological warfare program was centered at Edgewood. In April 1943, an airfield near Frederick, Md., was acquired by the CWS and eventually designated Fort Detrick. Fort Detrick became the Army's center for biological warfare research. Edgewood provided technical support primarily in the defensive aspects.

### U.S. Chemical and Biological Warfare Policy

Early in the war, President Roosevelt established a no first-use policy for chemical weapons. In 1943, this was reiterated in an official statement: "We shall under no circumstances resort to the use of such [chemical] weapons unless they are first used by our enemies." Neither Germany nor Japan chose to initiate chemical or biological warfare with the United States. Thus, the CWS and Edgewood spent the war training troops, researching and developing chemical, incendiary, smoke, and flame weapons, protective equipment, and planning for a chemical war that never occurred.

Toward the end of the war with Japan, the combination of President Roosevelt's death, the extremely costly battles of Iwo Jima and Okinawa, and the start of planning for the invasion of the Japanese homeland led the Army to consider the possibility of initiating chemical warfare to save American lives. The senior military staff, however, concluded that chemical warfare would only complicate the invasion of Japan and would not be a decisive weapon. In addition, coordinating and preparing America's allies for chemical warfare was also perceived as a major problem. The use of the atomic bomb in 1945 effectively ended the discussion.

### Creation of the Chemical Corps

The Army began demobilization activities almost immediately upon the President's proclamation of the end of hostilities. By early 1946, the CWS and Edgewood Arsenal were effectively demobilized and military strength approached pre-war levels.

To preserve the CWS from total demobilization, the Army determined that the CWS should continue its existence as a distinct entity in the peacetime Army. On Aug. 2, 1946, Public Law 607 changed the name of the CWS to the Chemical Corps.
The Chemical Warfare Center at Edgewood Arsenal was redesignated the Army Chemical Center (ACC). The Technical Command remained the main research and development organization at the ACC.

### New Mission: Chemical Weapons Demilitarization

In 1946, the Guard and Security Division took on a new mission at the ACC. The testing ranges were littered with old U.S., German, and other foreign chemical weapons. The ACC was also designated to receive additional captured German chemical munitions from Europe. In response, the Division took over the new mission of

*Cleaning up former chemical weapons disposal sites became a new mission of the Technical Escort Detachment after World War II.*

chemical munitions demilitarization and disposal. One of their first major projects was the cleanup of the S.S. Francis L. Lee, a Liberty ship loaded with captured German chemical munitions that arrived at ACC that year.

To better reflect the Division's new missions, its name was changed in 1947 to the Technical Escort Detachment. The unit continued with the basic mission of transporting chemical weapons but added emergency response to chemical accidents and incidents, chemical weapons disposal, and environmental remediation of previous disposal sites.

### New Mission: Radiological Division

After the end of the war, U.S. national defense became increasingly based upon the threatened use of nuclear weapons. This led to the Chemical Corps' mission being expanded to include radiological protection. The Chemical Corps' new Radiological Division was established at the ACC in 1948 to investigate radiological defense and radioactive weapons (non-nuclear).

### Nerve Agent Retaliatory Capability

The primary focus of the Chemical Corps after the end of World War II was finding a way to produce its own nerve agents after discovering the German agents. In addition to developing a retaliatory capability, the Chemical Corps also had to make significant improvements to detectors and alarms, protective equipment, and decontamination.

### The Beginning of the Cold War

The declining relations with the Soviet Union after the war caused that country to become the number one intelligence target for chemical and biological warfare preparations. Reports noted with alarm that the Soviets had captured a German nerve agent production facility toward the end of the war and had moved it back to their country. Both the Soviets and the Chemical Corps also researched Japan's biological warfare program.

One of the first Cold War actions that involved the Chemical Corps did not include chemical or biological warfare. During the Berlin Blockade in 1949, cold weather caused frost to build up on the airplanes flying to Berlin with supplies. The accepted method of ice removal was to use brooms to sweep it off. The Chemical Corps provided a simple solution to this slow and dangerous work. They sent decontamination trucks to spray isopropyl alcohol as a deicer. This allowed a large plane to be deiced in about five minutes. Thus, the Chemical Corps was credited with helping win one of the early battles of the Cold War by keeping the supply airplanes from being delayed by frost.

*The Berlin Airlift in 1949 used Chemical Corps decontamination trucks to spray a deicer on the planes to keep the planes flying.*

## INDIVIDUAL PROTECTION

### FIRST U.S. CIVILIAN MASK

**M1 Noncombatant Mask.** With the potential threat of an aerial attack against American cities, the CWS initiated a major civil defense program to protect civilian populations against both chemical and biological weapons. This program developed protective masks and equipment for adults, children, and infants. The M1 Noncombatant Mask was the first standard civilian mask approved in 1940. Later versions during the war improved the facepiece, making it more comfortable. Approximately 6 million of the various versions were produced during the war. The latest version was not obsoleted until 1954.

### IMPROVED GAS MASK

**M2 Service Mask.** Because soldiers liked the 1939 M1 Training Mask's facepiece, the CWS standardized the M1 Training Mask as the M2 Service Mask in 1941. Later versions improved the outlet valves. Over 8.4 million of the M2 series masks were procured during the war but were only used for training.

### IMPROVED SPEAKING MASK

**M3 Diaphragm Mask.** The CWS made significant improvements to the earlier Diaphragm Mask, which resulted in the new M3 version in 1941. This mask provided improved eye lenses and utilized the fully molded rubber facepiece with a better diaphragm for the communications capability.

### FIRST U.S. MASK DESIGNED FOR AMPHIBIOUS LANDINGS

**M3 Lightweight Mask.** The M3 mask, standardized in August 1942, made several improvements to the M2 design. In the facepiece, a nosecup covering the nose and mouth was added to prevent lens fogging. The canister was much lighter, and this decreased the overall weight of the mask. In addition, the hose from the canister to the facepiece was shortened to allow for wearing of the canister higher on the body, especially during amphibious landings. Eventually, over 13 million M3 series masks were procured during the war.

### IMPROVED MASK TO MEET TEMPORARY NEED

**M4 Lightweight Mask.** Production problems with the M3 mask molds led to the CWS issuing the M4 series mask in 1942. This mask used a modified M2 series facepiece with a nosecup to prevent lens fogging. Only about 250,000 of the masks were produced.

### IMPROVED VISION MASK

**M2 Optical Mask.** The CWS made improvements to the M1 Optical Mask that included better eye lenses, a better speaking diaphragm, and simplified air track from the canister. The new mask was designated the M2 Optical Mask in 1942.

## FIRST CHILDREN'S MASK BASED UPON A CARTOON CHARACTER

**Mickey Mouse Mask.** One particular challenge was to develop a mask that children would be willing to wear. With the help of Walt Disney, who came to Edgewood, the CWS designed a non-frightening Mickey Mouse gas mask in 1942. Only about 1,000 of the masks were produced during the war.

## FIRST U.S. BABY PROTECTOR

**M1 Infant Protector.** The requirement to have a protective device for babies led to the development of the M1 Infant Protector in 1942. It consisted of an impermeable cloth bag that used a hand bellow to pump air into the bag. Over 300,000 of these were made during the war.

## FIRST U.S. MASK WITH THE CANISTER ON THE CHEEK

**M5 Combat Mask**. By 1944, with a major invasion of Europe by U.S. forces pending, the Army requested a better amphibious assault mask that was even lighter and less bulky that the M3 series. To meet this requirement, the CWS put the canister directly on the facepiece. The result was the M5 Combat Mask standardized in May 1944. Due to the rubber shortage, the M5 mask was the first to use synthetic rubber (neoprene) for the facepiece. The new canister used ASC whetlerite charcoal, which proved a better protection against hydrocyanic acid, a chemical agent discovered in a Japanese grenade shortly after Pearl Harbor. Over 500,000 were procured during the war. The soldiers who landed at Normandy carried this mask with them.

## FIRST U.S. MASK DESIGNED FOR WOUNDED SOLDIERS

**M7 Headwound Mask.** One problem with most protective masks was that a soldier with a head wound could not wear them. To solve this problem, the CWS developed the M7 Headwound Mask in 1944. The mask was basically a hood of vinyl resin sheeting with an outlet valve and canister sealed by adhesive tape. Over 13,000 were procured during the war.

## FIRST U.S. SYNTHETIC RUBBER MASK

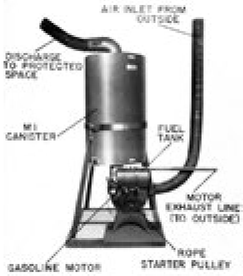
**M9 Protective Mask.** The Chemical Corps developed a new gas mask in 1947. Designated the M9 series, it was an improved version of the M5 mask. This mask utilized a superior synthetic rubber composition that worked better in cold weather than the neoprene of the earlier mask. Over 3 million M9 series masks were procured by the Army. Considered one of the most useful and comfortable masks, it was used for special purposes until the M9 series was finally obsoleted in 1997.

## ANIMAL PROTECTION

**Dog and Horse Masks, Pigeon Protector**. Although animals were being used less frequently on the battlefield by World War II, there was still a need to provided protective equipment for working dogs, horses, mules, and pigeons. The CWS standardized the M6 Dog Mask in 1944. This mask continued to be used decades after the war. In 1941, the CWS standardized the M4 and M5 Horse Gas Masks for pack horses and cavalry horses. Each had a different canister arrangement depending upon the horse's load. For pigeons, the CWS developed several versions of bags that provided collective protection for a portable pigeon cage.

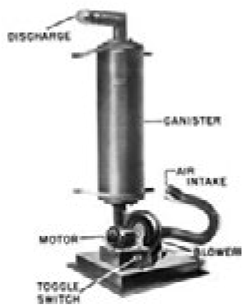
## COLLECTIVE PROTECTION

### IMPROVED COLLECTIVE PROTECTION UNIT



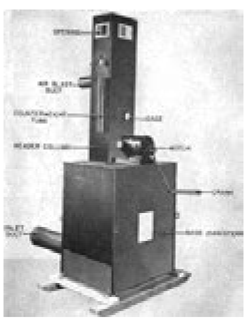

**M2 Collective Protector.** For collective protection, the CWS concentrated on improving the bulky M1 Collective Protector. A somewhat lighter version, the M2, was standardized in 1942. It provided the same amount of air but weighed just over 600 pounds.

### FIRST U.S. COLLECTIVE PROTECTION FOR THE FIELD



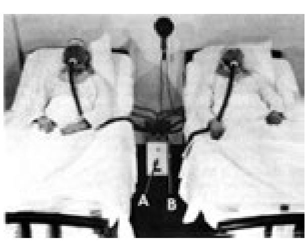

**M3 Collective Protector.** Still needing a lighter version of collective protectors for field use, the CWS standardized the M3 in 1942. It weighed only 225 pounds but provided less air per minute.

### COLLECTIVE PROTECTOR FOR CIVILIAN DEFENSE



**M4 Collective Protector.** In 1943, the CWS developed the M4 Collective Protector for civilian defense use. It was built from lightweight materials and used an electric motor to move the air. Although not very rugged, it could also be used in permanent military installations.

### COLLECTIVE PROTECTOR FOR HOSPITALS




**M5 Six-Man Hospital Collective Protector.** The M5 Collective Protector met the need for a central filter unit that could provide forced purified air to up to six patients in a hospital. Designed for patients in poor condition or with breathing problems, the unit used the M7 Headwound Mask without its canister. The M5 was standardized in 1946.

## DETECTION AND ALARMS

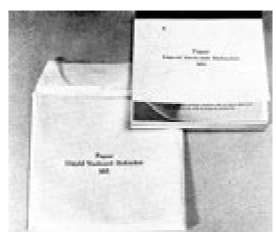
### FIRST EFFECTIVE U.S. MUSTARD AGENT DETECTOR


**M4 Vapor Detector Kit.** One of the prime objectives of the CWS was to improve the detection capability for toxic chemical agents, particularly blister agents such as mustard agent and lewisite. The early war efforts included the M4 Vapor Detector Kit, developed in 1942, which could detect even faint concentrations of mustard agent and other agents. Over 41,000 M4 kits were assembled during the war.

### FIRST U.S. DETECTOR PAINT


**M5 Liquid Detector Paint.** The concept of liquid detector paint was that the olive drab paint could be applied to a vehicle or other items and would change to red when in contact with mustard agent. The CWS standardized M5 Detector Paint in 1942. Over 7.8 million cans of the paint were procured during the war.

### FIRST U.S. DETECTOR PAPER



**M6 Liquid Detector Paper.** Utilizing the same concept as the liquid detector paint, the CWS put the detector paint on a thick paper backing that could then be dipped in water or touched to a contaminated surface, which would result in a color change. The CWS approved the design in 1942, and over 1 million of 25-sheet books were produced during the war.

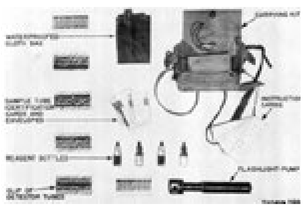
### FIRST U.S. DETECTOR CRAYON

**M7 Detector Crayon.** The M7 detector crayon was similar to a regular crayon except that, when rubbed or crumbled on a contaminated surface, the pink crayon material would change to blue when in contact with mustard agent. The CWS standardized the crayons in 1942 and procured over 600,000 packs of crayons during the war. After the war, the CWS found that the crayons could also detect nerve agents and procured an additional 300,000 packs.

## FIRST U.S. UNIQUE GAS ALARM

**M1 Gas Alarm.** The need for a unique sounding alarm during a chemical attack resulted in the CWS standardizing the M1 Gas Alarm in 1942. The alarm was basically a hollow, metal u-shape tube that was struck with a steel tube. Over 77,000 M1 Alarms were procured during the war.

## BEST U.S. DETECTOR KIT OF WORLD WAR II



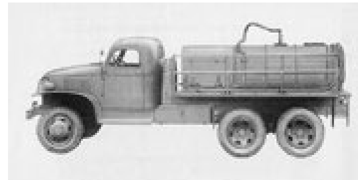
**M9 Chemical Agent Detector Kit.** The development of the M9 Chemical Agent Detector Kit in 1943 proved to be one of the most significant detection developments of the CWS during the war. The kit could detect small amounts of mustard agent, phosgene, and arsenicals by color changes. It was simple to use and did not require a chemist to make the tests. The CWS procured over 82,000 of the kits during the war.

# DECONTAMINATION

## SMALL DECONTAMINATION DEVICE

**M2 Decontaminating Apparatus.** The CWS first began testing commercial fire extinguishers as decontaminating devices in 1934. Continued testing eventually led to the standardization of the 1-1/2 quart Decontaminating Apparatus in 1940. It was small in size but could decontaminate approximately 12 square yards. The Army procured over 1.9 million of the devices during the war. After the war, it continued in use until the 1960s.

## LARGE DECONTAMINATION DEVICE



**M3 Decontaminating Apparatus.** The continued testing of commercial powered orchard sprayers for large-scale decontamination eventually led to the M3 series. These were basically water tank trucks that could spray decontaminate from a wooden tank and also heat water for decontamination or showers. The first of the series, the M3 had several issues when standardized in 1940. The M3A1, standardized in 1941, solved many of the problems of the first unit and was the primary version during World War II. Over 1,500 M3A1 units were procured during the war. Later versions after the war replaced the wooden tank with a metal tank. The series was finally obsoleted in 1972.

## PROTECTING THE SKIN


**Protective Ointments.** The Army needed a protective ointment for the skin that could be applied before a chemical attack or after an attack to decontaminate the skin. In 1944, the CWS standardized the M5 Protective Ointment Kit. This kit came in a small, waterproof container and held four tubes of M5 Protective Ointment and a tube of British Anti-Lewisite (BAL) Eye Ointment. The protective ointment was used to liberate chlorine to neutralize vesicant agents on the skin. The BAL ointment neutralized lewisite in and around the eye by changing it to a nontoxic compound. Over 26 million of the kits were procured for the Army during the war.

# DEMILITARIZATION

## ELIMINATING GERMAN CHEMICAL WEAPONS

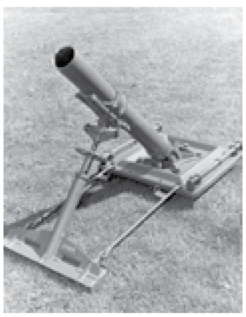
**The S.S. Francis L. Lee**. In 1946, the S.S. Francis L. Lee arrived in the United States filled with 8,000 tons of German mustard agent bombs. The bombs were leaking and the ship was contaminated with mustard agent. The ship was brought to Pooles Island in the Chesapeake and the mustard agent bombs unloaded. The mustard agent was transferred to ton containers for storage and some was reprocessed to U.S. standards. The S.S. Francis L. Lee was eventually cleaned up and placed in the U.S. mothball fleet.

# RETALIATORY CHEMICAL WEAPONS

## PROVIDING THE CHEMICAL AGENTS

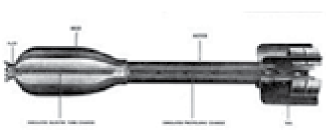
**Chemical Agent Research and Production.** During World War II, the CWS produced primarily phosgene (CG), mustard agent (HS), cyanogen chloride (CK), and hydrogen cyanide (AC) as its stockpiled retaliatory warfare agents. New agent research concentrated on nitrogen mustard (HN) after the discovery that the Germans were producing it. Nitrogen mustard was produced at Edgewood in a small pilot plant to develop the production process for a larger facility elsewhere. Edgewood also investigated ways to improve the purity of mustard agent. This work resulted in the discovery that washing the agent with water and then distilling it produced a much purer agent. The new agent was called Distilled Mustard Agent (HD). Edgewood used a pilot plant to produce small quantities of the agent in 1944, and a full-scale plant was completed at Rocky Mountain Arsenal the next year.

## BEST U.S. WORLD WAR II CHEMICAL MORTAR



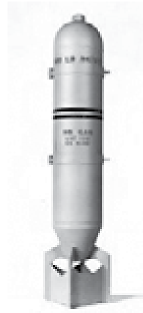
**M2 4.2-inch Chemical Mortar.** The 4.2-inch chemical mortar was the main ground delivery system for chemical agents. The continued need for greater range, accuracy, durability, and ease in manufacturing, resulted in the improved M2 4.2-inch mortar in 1943. The M2 had a maximum range of 4,400 yards, which was later increased to 5,600 yards by modifying the propellant in test firings at Edgewood in 1945. Although not used for chemical weapons, the M2 4.2-inch mortar rapidly became a key ground weapon for firing high explosive, smoke, and white phosphorus rounds.

## RETALIATORY CAPABILITY FOR THE INFANTRY



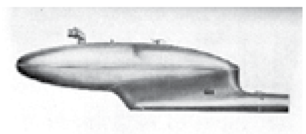
**Chemical Warheads for Rockets.** During the war, the CWS developed chemical rockets similar to German and Russian developments. In 1945, the CWS standardized chemical warheads for the 7.2-inch rocket (one filled with phosgene and one with cyanogen chloride) and the 2.36-inch bazooka (filled with cyanogen chloride).

## RETALIATORY CAPABILITY FOR THE ARMY AIR FORCE



**Chemical Bombs.** The CWS improved the M47 100-pound chemical bomb and developed the M78 500-pound and M79 1,000-pound chemical bombs for the Army Air Force. These heavier bombs provided a significant retaliatory capability, although they were never used.

## FIRST MULTIPURPOSE U.S. CHEMICAL SPRAY TANK



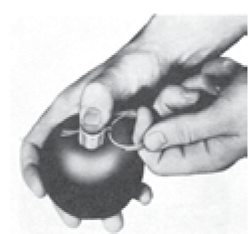
**M10 Airplane Spray Tank.** For aerial spraying, the CWS standardized the first multipurpose airplane spray tank, the M10, in 1940. This unit could disseminate up to 32 gallons of either chemical agents or smoke agents in four to six seconds. It was particularly useful for spraying riot control agents for training or crowd dispersion. Edgewood also developed additional multipurpose chemical spray tanks for most combat aircraft.
The M10 remained a useful spray tank for fixed-wing aircraft for decades after the war.

## NEW RETALIATORY CHEMICAL AGENT

**Nerve Agents.** After the discovery of the German nerve agents in 1945, the CWS chose Sarin (GB) in 1948 as the best retaliatory agent to produce and stockpile. The same year, the CWS also issued a new circular on nerve agents and a technical bulletin on the treatment of nerve agent poisoning that discussed detection, decontamination, and medical treatment.

# RIOT CONTROL

## FIRST BASEBALL TEAR GAS GRENADE



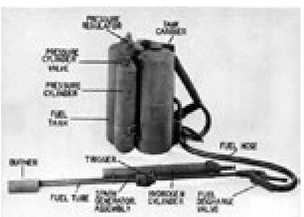
**M25 Riot Grenade.** The standard chemical and smoke grenade design was a circular tin can that was difficult to throw very far and required burning the fill several minutes. During that time, rioters could pick it up and throw it back at the users. To solve those problems, in 1945, the CWS designed a plastic baseball-size grenade filled with CN that burst to spread the tear gas. The average soldier could throw the grenade about 50 yards and the detonation did not produce significant fragmentation danger. After World War II, the grenades were used during the Korean and Vietnam conflicts, with later versions of the grenade changed to CS tear gas instead of the CN.

## FLAME WEAPONS

### FIRST FLAMETHROWER FOR FIELD USE

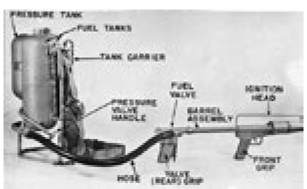
**M1 Portable Flamethrower.** Although the CWS had experimented with portable flamethrowers during World War I, the first standardized flamethrower was the M1 in 1941. It used unthickened gasoline as the fuel and nitrogen to expel the burning fuel approximately 25 yards for about 15 seconds. It was primarily used in the Pacific Theater until replaced by improved units by 1943.

### IMPROVED FLAMETHROWER



**M1A1 Portable Flamethrower.** To solve the short range of the M1 Portable Flamethrower, the CWS thickened the fuel, changed the trigger, barrel, and ignition design, thus creating the M1A1 Portable Flamethrower in 1942. The changes resulted in an effective range of 50 yards with an aiming ability to hit an opening in a pill box accurately.

### BEST U.S. WORLD WAR II FLAMETHROWER




**M2 Portable Flamethrower.** In 1944, the CWS redesigned the portable flamethrower based upon the demands of the soldiers using them. The improvements included a new gun with dual pistol grips, a new ignition system, a larger nitrogen tank, and redesigned shoulder straps for carrying the unit. The M2 had an effective range of 60 yards for about nine seconds. Over 24,000 M2 Portable Flamethrowers were produced during the war and used by both the Army and the Marines.

### FIRST U.S. STANDARD SECONDARY FLAMETHROWER FOR A TANK

**M3 Mechanized Flamethrower.** The portable flamethrowers required the operator to approach closely to the target, exposing them to hostile fire. To solve that problem, the CWS put flamethrowers in tanks. Designs included either having the flamethrower as the main armament or having it as the secondary armament in place of a machine gun. The M3 Flamethrower was designed to replace the machine gun in the M4 Sherman Tank. It was standardized in 1945, and over 1,700 were procured during the war.

### FIRST U.S. STANDARD PRIMARY FLAMETHROWER FOR A TANK

**M5 Mechanized Flamethrower.** The M5 Flamethrower replaced the main armament of a M4 Sherman tank. The M5 was standardized in 1945, and 151 procured during the war. It was primarily used during the Pacific Campaign for destroying pill boxes and cave defensive positions.

### FIRST AUXILIARY MOUNTED MECHANIZED FLAME THROWER

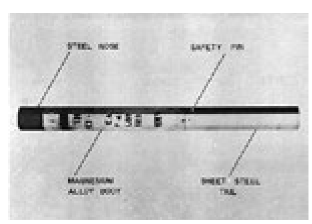
**M6 Mechanized Flamethrower.** Continuing to experiment with the placement of flamethrowers in tanks, the Chemical Corps designed an auxiliary mount that mounted in the turret by the periscope of a M4 Sherman Tank. This version was standardized as the M6 Flamethrower in 1947, and 192 units were procured before the M4 Sherman Tank was replaced by more modern versions.

## INCENDIARY WEAPONS

### NEW INCENDIARY WEAPON

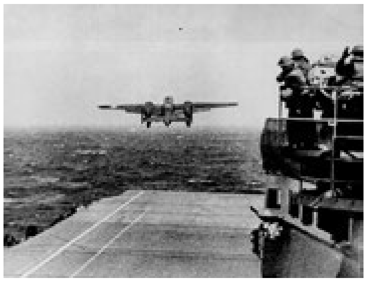
**Napalm.** Unthickened gasoline exploded into flame, but burned quickly. The solution to the problem was the development of thickened gasoline, a thick jelly mixture. The CWS tried many thickeners during the early part of the war, most of which included rubber and polymers, but both were high-priority war items. Instead, to thicken the gasoline, aluminum soap of naphthenic and palmitic acids was used, thus giving it the name “napalm.” Napalm production started in 1943 and over 20 million pounds was produced during the war. Napalm continued to be effectively used as an incendiary during both the Korean and Vietnam conflicts.

### PRIMARY U.S. INCENDIARY BOMB FOR GERMAN TARGETS



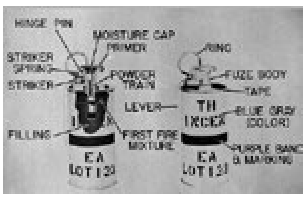

**M50 Incendiary Bomb**. After observing the German use of incendiary bombs against London and Paris early in World War II, the Ordnance Department developed the M50 4-pound incendiary bomb in 1941. However, shortly after its initial design, Ordnance transferred the program to the CWS. The M50 consisted of a magnesium case just under 2 feet long and 3 inches in diameter. Once ignited, the case would burn hotly for almost 10 minutes. The bombs were placed in cluster bombs of various sizes. They had an enormous impact on the war in Europe where over 30 million were dropped on Germany and its allies, helping to knock Germany out of the war.

## THE DOOLITTLE RAID INCENDIARY BOMB



**M54 Incendiary Bomb.** Limited stocks of magnesium in 1941 led to the development of the M54 steel case incendiary bomb. It was the same size as the M50 Incendiary Bomb but lacked the magnesium. Although approximately 13 million of the bombs were produced, most were placed in reserve, and only a few were used during the war. The most famous use occurred when Lieutenant Colonel James H. Doolittle obtained 48 500-pound clusters of M54 bombs produced at Edgewood Arsenal for use during his Tokyo raid in early 1942.

## BEST U.S. INCENDIARY GRENADE DURING WORLD WAR II

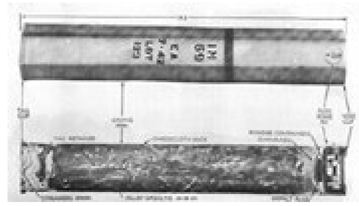



**M14 Incendiary Grenade.** The CWS was asked to develop an incendiary grenade in 1942. Utilizing the standard tin can design for smoke grenades, the CWS filled it with thermite. Designed to burn especially hot, it could cut through tank armor, destroy vehicles and artillery, and start fires in wooden structures. Over 8 million were procured but not used extensively during the war. Over the years, the grenade was improved and is still used today as a special purpose hand grenade.

## EMERGENCY DESTRUCTION DEVICES

**Safe Destroying Incendiary.** There was a military requirement for an incendiary to destroy classified cryptographic equipment and documents stored in safes in case of emergency. The CWS developed a unit in 1942 that was filled with thermite and set off by electric squibs. Additional modifications and versions were designed during the war, and over 18,000 were made by 1945. Additional versions were designed during the Korean War.

## THE PRIMARY U.S. INCENDIARY BOMB FOR JAPANESE TARGETS

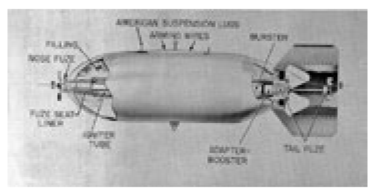


**M69 Incendiary Bomb.** The need for a specially designed clustered incendiary bomb for use in Japanese style buildings resulted in the development of the M69 6-pound Oil Incendiary Bomb in 1942. The bomb was stabilized by cloth streamers that slowed its descent. When it went through a roof, it was designed to eject its thickened gasoline upward, sticking to the underside of the roof. The destructiveness of the M69 was demonstrated on Tokyo when 2,000 tons of them destroyed 16 square miles of the city.

## SECRET AGENT SABOTAGE DEVICE

**M1 Pocket Incendiary.** The U.S. Office of Strategic Services (OSS) had a requirement for a small incendiary device for sabotage. The CWS designed the M1 Pocket Incendiary in 1943. It was about the size of a cigarette case and held thickened gasoline. A delay mechanism allowed the operator to leave the area. Over 400,000 were produced during the war before the OSS took over further development.

## THE HEAVIEST U.S. INCENDIARY BOMB DURING WORLD WAR II



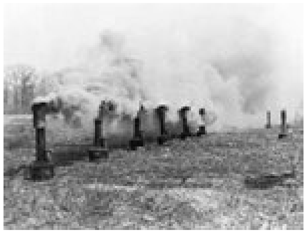

**M76 Incendiary Bomb.** After the Germans began using heavy incendiary bombs, the United States decided to develop its own. The Air Force provided a 500-pound bomb and the CWS provided the incendiary filling, nicknamed goop, that was a mixture of magnesium particles, asphalt, and thickened gasoline. The result was the M76 500-pound Incendiary Bomb, standardized in 1944. This was the heaviest incendiary bomb mass-produced by the United States during the war. Over 39,000 of these bombs were dropped on Germany and 38,000 on Japan.

## NEW FIELD EXPEDIENT

**Fire Bombs.** Fire bombs were a field expedient discovered when a pilot dropped a gasoline tank and then ignited the gas with tracer bullets. This led to the intentional use of tanks as fire bombs. The CWS was asked to assist by designing the igniter for fire bombs. Over 12,000 fire bombs were dropped in the European Theater and 24,000 in the Pacific Theater.

## SMOKE SCREENING

### FIRST LARGE-AREA SMOKE-SCREENING DEVICE

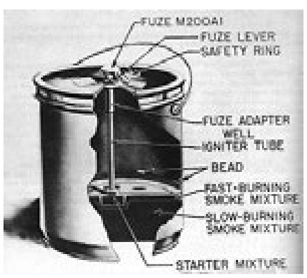


**M1 Stationary Oil Smoke Generator.** The Army's need for a large-area smoke-screening apparatus led to the development of the M1 Oil Smoke Generator in 1941. This was a stationary device that could produce smoke for about one and a half hours.

### LIGHTWEIGHT SMOKE SCREENING DEVICE


**M1 Miniature Smoke Pot.** At the beginning of World War II, the Armored Forces requested a small smoke pot for training purposes. This resulted in the M1 Miniature Smoke Pot filled with HC smoke agent. The pot was small in size and produced smoke for about three minutes.

### FIRST U.S. FLOATING SMOKE PRODUCER

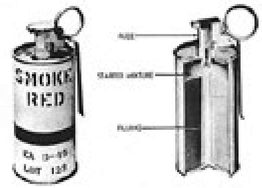



**M4 Floating Smoke Pot.** The need to screen amphibious landings led to the standardization of the M4 Floating Smoke Pot in 1942. It held HC smoke agent and produced smoke for about 10 to 15 minutes. Additional improvements during the war added a better ignition system and an air droppable version.

### COMBINATION SMOKE AND INCENDIARY GRENADE


**M15 Smoke Hand Grenade.** The need for a bursting-type, rapid smoke producing grenade to screen and attack armored vehicles led to the development of the M15 White Phosphorus (WP) Smoke Hand Grenade in 1942. The grenade disseminated WP over about 25 yards in diameter and the smoke lasted about 60 seconds. This grenade was not obsoleted until 1975.

### FIRST U.S. COLORED SMOKE GRENADE




**M18 Colored Smoke Grenade.** The Army requested a colored smoke grenade for marking front lines and signaling for help. In response, the CWS standardized the M18 grenade that produced smoke for about 90 seconds. It came in eight colors initially: green, red, violet, yellow, orange, blue, black, or white. The last four colors were dropped after the war. The M18 grenade is still used today as a signaling device.

### NEW SMOKE AGENT

**Fog Oil.** Fog oil, a special type of oil, was developed for use in the new mechanical smoke generators during World War II to produce a high quality white smoke. It came in two versions, Smoke Generator Fuel No. 1 (SGF1) for normal temperate climates, and Smoke Generator Fuel No. 2 (SGF2) for colder weather use.

### FIRST LARGE-AREA SMOKE SCREEN GENERATOR

**M1 Mechanical Smoke Generator.** In 1942, the CWS provided the first mechanical large-area smoke generator. This was a large unit weighing over 5,000 pounds and was mounted on a truck, although it could not be moved during smoke operations. It burned fog oil to generate the smoke. The unit could operate for over 10 hours without maintenance. The M1 generator was successfully used in North Africa and Italy, especially during the Anzio Campaign.

### FIRST LIGHTWEIGHT LARGE-AREA SMOKE SCREEN GENERATOR

**M2 Mechanical Smoke Generator.** The need for a smaller, more lightweight system, led to the M2 Mechanical Smoke Generator in 1943. This unit weighed 180 pounds and drew fog oil directly from 55-gallon drums. It could quickly be positioned to create smoke clouds and could be moved to adjust for changing wind directions.

## BETTER SMOKE POT FOR MOIST CLIMATES


**M1A1 Smoke Pot.** The Army improved upon the pre-war M1 Smoke Pot by creating a better lid that would keep out moisture and also allowed the smoke posts to be stacked. The new M1A1 Smoke Pot was standardized in 1944 and produced HC smoke for about six minutes.

## FASTER SMOKE-PRODUCING SMOKE POT


**M5 Smoke Pot.** Although the new mechanical smoke generators were effective in producing smoke screens, they took some time to set up and start. To solve that problem, the CWS developed the M5 Smoke Pot in 1944 that produced smoke 15 seconds after ignition and continued for about 12 to 22 minutes.

## LONGER SMOKE-PRODUCING MATERIAL

**Plasticized White Phosphorus (PWP).** Regular WP had a tendency to produce a narrow column of smoke. To solve this problem, the CWS developed PWP in 1944. PWP was a mixture of WP and synthetic rubber that coated the WP particles. When disseminated, the particles burned slower and therefore produced a longer smoke screen over a larger area.

## BETTER SMOKE PRODUCERS

**Artillery Projectiles, Bazooka, Mortar, and Rocket Smoke Warheads.** The CWS developed smoke projectiles for most weapon systems during the war. These included the 81-millimeter mortar, 57-millimeter, 75-millimeter, 76-millimeter, 90-millimeter, 105-millimeter, and 155-millimeter guns and howitzers, the 2.36-inch bazooka; 4.2-inch mortar, and the 7.2-inch rocket.

# CHAPTER 5 | THE 1950s

## The Korean War

In June 1950, the Army Chemical Center supported its first major military action with the onset of the Korean War. The Chemical Corps quickly implemented an increased procurement program to supply the Army with a retaliatory chemical capability if needed and improved defensive equipment. The ACC was the focus of those increased demands.

Like during World War II, the United States did not change its policy about no first use of chemical weapons. Although the action in Korea brought up the subject of whether to initiate chemical warfare to save lives, neither side chose to initiate chemical or biological warfare. Although the North Koreans and Chinese claimed that U.S. forces employed biological weapons on the battlefield, this was only a propaganda campaign to discredit the United States.

The Army did, however, use riot control agents to quell prisoner of war riots. This was the beginning of much greater interest in the development of nonlethal riot control equipment.

*New construction during the Korean War period included adding an annex to the World War II main administrative building.*

The Chemical Corps supported the war through its many other programs, particularly smoke, incendiary, and flame. Napalm proved to be a key weapon. It was first used three days after the North Koreans crossed the 38th parallel and proved very effective against tanks and personnel. It was also used as a ground weapon to help defend camp perimeters.

Following the 1953 armistice, the Chemical Corps was again reduced in size and funding, although not to the degree after World War II. The heating up of the Cold War ensured that the Chemical Corps and the ACC would remain an important asset in national defense.

## Changes to the Army Chemical Center

During the 1950s, the Chemical Corps conducted several extensive studies to improve its organization and training capabilities. One result of those studies was to redesignate the Technical Command to the Chemical Corps Chemical and Radiological Laboratories (C&RL) in 1951. At the same time, the Medical Research Division became the Chemical Corps Medical Laboratories.

The activation of a new Chemical Corps training center at Fort McClellan, Ala., in 1951 offered more space and training options than ACC could offer. The Chemical School, after more than 30 years at Edgewood, moved there early in 1952.

*The Human Volunteer Program answered many questions about how various chemical agents effected humans.*

## Medical Research on Human Volunteers

The Chemical Corps' continuing concern with the effects of nerve and other chemical agents on soldiers led to extensive studies to determine dangers of exposure and proper kinds of treatment. These studies, ongoing since World War I, exposed soldiers to low levels of agents to demonstrate the effects of treatment and to answer questions about how agents affected humans. Prior to the 1950s, however, the use of humans in testing had been conducted somewhat on an ad hoc basis, with little documentation surviving.

The Human Volunteer Program, a more formal volunteer program, was established at ACC during the 1950s. This program drew on local military installations and utilized a specific consent procedure that ensured each volunteer was pre-briefed and was truly a volunteer in the experiment. Between 1955 and 1975, over 6,000 soldiers participated in this program and were exposed to approximately 250 different chemicals.

### New Mission: The Incapacitant Program

During the 1950s, the Corps became interested in developing chemical weapons that incapacitated rather than killed its targets. In 1951, the Corps awarded a contract with the New York State Psychiatric Institute to investigate the clinical effects of mescaline and its derivatives. The contractor tested six derivatives, while the Corps tested 35 others. The results of the investigation indicated that mescaline and its derivatives would not be practical as an agent because the doses needed to bring about the mental confusion were too large.

In 1955, the Chemical Corps officially established a new project called Psychochemical Agents. The next year, the program was redesignated K-agents. The objective was to develop a non-lethal, but potent incapacitant that could be disseminated from airplanes in all environments. The program was conducted at the ACC and examined non-military drugs like lysergic acid (LSD) and tetrahydrocannabinol (related to marijuana). None of these drugs, however, were found to be of military worth.

### Additional Name Changes

In 1956, ACC and the Chemical Corps again reorganized their research laboratories. The C&RL and the Medical Laboratories merged to form the Chemical Warfare Laboratories (CWL).


*The Technical Escort Unit loads a barge of radioactive waste for eventual sea disposal.*

### New Mission: Radioactive Waste Disposal

The same year, the Chemical Corps was assigned the responsibility for disposing of all radioactive waste material for the entire Department of the Army. The Technical Escort Detachment assumed this mission and coordinated the disposal of the waste through the ACC for eventual sea disposal. In recognition of their growing importance and special missions, in 1957, the Detachment was redesignated the U.S. Army Chemical Corps Technical Escort Unit.

## INDIVIDUAL PROTECTION

### FIRST U.S. STANDARD TANK MASK

**M14 Tank Mask.** The need for a collective protection system for tank crews resulted in the development of the M14 Tank Mask in 1953. The mask had a single plastic lens, a hose connection to the tank's air purifier, and a cable to connect the mask's microphone to the tank's communication system. When outside the tank, the mask used a standard canister.

### IMPROVED CIVIL DEFENSE MASK

**M16 Civilian Mask.** The need for a mask for Civil Defense workers to replace World War II masks led to the development of the M16 Civilian Mask in 1957. The mask had a single plastic lens and a standard canister and came in six sizes, including a special small canister for the children's masks.

### FIRST U.S. STANDARD MASK WITH A VOICEMITTER

**M17 Protective Mask.** To resolve problems with the heavy canister of the M9 series masks, the Chemical Corps designed a new mask in 1959. The M17 mask eliminated the canister, placed the filter material in cheek pockets, and added a voicemitter. This design also eliminated the need for right- and left-handed masks. The M17 became the Army's standard mask.

### IMPROVED MASK FOR WOUNDED

**M18 Headwound Mask.** In 1959, the Chemical Corps developed an improved headwound mask, designated the M18, which allowed wounded soldiers to have mask protection in contaminated environments. The head covering itself was made from the filter material, thus eliminating the need for a canister and exhaust valve.

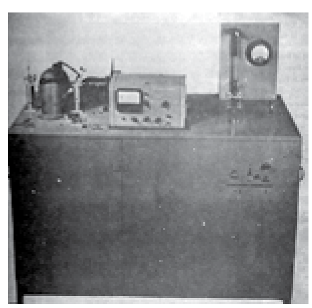
### NEW MASK LEAKAGE TESTER

**M2 Eyepiece Leakage Indicator.** The M2 Indicator was standardized in 1952 along with the M1A1 Maintenance and Repair Set for working on M9 Protective Masks. The unit used compressed air to check for leakage around the eyepieces. The test required about seven seconds and, if no leak was detected, a green light would indicate the result.

### NEW MASK LEAKAGE TESTER

**M4 Outlet Valve Leakage Indicator.** The need to check outlet valve leakage in protective masks led to the standardization of the M4 Indicator in 1958. It was a large, 40-pound unit that identified a problem with a mask by indicating a red light. It could test the M3, M4, and M9 series masks. In 1961, an improved unit was standardized as the M4A1 Indicator which could service the M17 series masks.

### NEW NAVY MASK LEAKAGE TESTER



**M14 Protective Mask Leakage Tester.** The Navy developed the initial prototype of the M14 Tester, designated Q14, and type classified it in 1959 for use with the Navy Mark V ND mask. The Army then modified the unit to test the M17 series masks and type classified it in 1966 as the M14. The unit used dioctylphthalate (DOP) for testing for leaks.

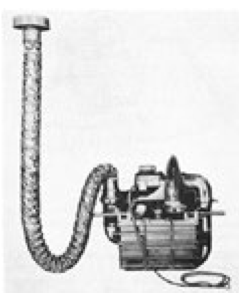
## PROTECTIVE CLOTHING

### IMPROVED PROTECTIVE OUTFIT


**M3 Impermeable One-Piece Protective Suit.** In 1951, the Chemical Corps standardized a new impermeable protective suit to replace the earlier versions that were no longer useful after the discovery of nerve agents and the possible use of biological agents. Although issued by the Quartermaster Corps, the Chemical Corps designed and tested the improved outfit and related articles, include the M3 Hood, M3 Gloves, M1 Boot Covers, and the M1 Cooling Suit.

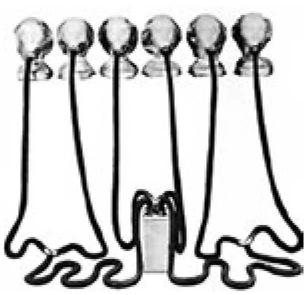
## COLLECTIVE PROTECTION

### NEW FIELD COLLECTIVE PROTECTION



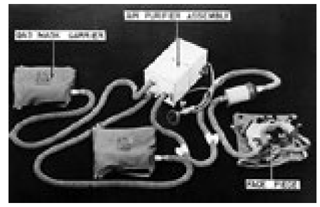
**M6 Collective Protector.** The earlier collective protection systems for buildings were large, heavy units. In 1950, the Chemical Corps approved the M6 Collective Protector, renamed the M6 Gas-Particulate Filter Unit in 1956. The unit weighed about 250 pounds and could be hand-carried. A gasoline engine powered the blower that delivered purified air to a protective shelter.

### IMPROVED HOSPITAL COLLECTIVE PROTECTION



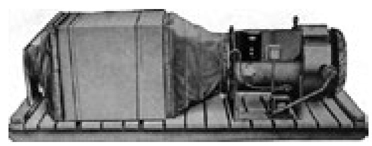
**M7 Six-Man Hospital Collective Protector.** The Chemical Corps improved the earlier M5 Hospital Collective Protector and standardized the new version in 1952. It was renamed the M7 Six-Man Hospital Gas-Particulate Filter Unit in 1956. The M7 used six M13 hospital headpieces with a central air purifier. Additional improvements led to the M7A1 version in 1955.

### NEW TANK CREW COLLECTIVE PROTECTION




**M8 Three-Man Tank Collective Protector.** The need for a collective protection system for tank crews led to the development of the M8 Tank Collective Protector in 1953. It was renamed the M8 Three-Man Tank Gas-Particulate Filter Unit in 1955. The M8 connected three M14 Tank Masks with an air purifier unit and the tank communication system. The M14 masks allowed the crew to exit the tank independently of the central unit. Additional improvements led to the M8A1 version in 1955.

### NEW COLLECTIVE PROTECTION UNITS



**Gas-Particulate Filter Units.** After the M6 Collective Protector was designed for field use, the Chemical Corps developed four larger units, designated Gas-Particulate Filter Units, that came in different sizes and produced various amounts of purified air. The four, designated the M9 (see picture), M10, M11, and M12, were standardized in 1958.

## DETECTION AND ALARMS

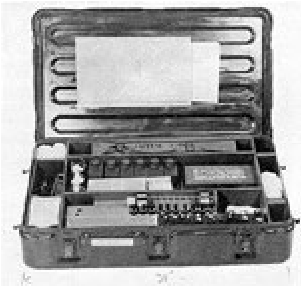
### KIT FOR TESTING WATER

**M2 Chemical Agents Water Testing Kit.** During World War II, the Army Medical Service developed water testing kits. In 1952, the program was transferred to the Chemical Corps resulting in the standardization of the M2 Water Testing Kit in 1953. The kit could detect contamination of water by most chemical warfare agents.

### KIT FOR TESTING FOOD

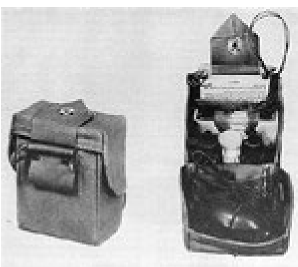
**M3 Chemical Agents Food Testing and Screening Kit.** Originally designed during World War II by the Army Medical Service, the M3 Food Testing and Screening Kit was standardized by the Chemical Corps in 1953. It was designed to test for most chemical warfare agents. Over 10,000 kits were procured for medical units, veterinary inspectors, and bakery units.

## IMPROVED WATER TESTING KIT



**M4/M4A1 Poisons Water Testing Kit.** The Chemical Corps standardized the M4 Water Testing Kit in 1953. The kit was designed for Army Medical Service personnel to certify drinking water supplies and could detect most chemical warfare agents and heavy metal poisons. A later version standardized in 1959 improved the packaging and added greater detection capabilities. The Air Force procured M4A1 Kits for use in Vietnam during the early 1960s.

## LIGHTWEIGHT DETECTOR KIT



**M15/M15A1 Chemical Agent Detector Kit.** The requirement for a simplified detector kit originated with the Navy based on the need for a shipboard detector to determine whether masks should be donned or removed. To meet this requirement, the Chemical Corps standardized the M15 Kit in 1956. It could detect vapor concentrations of nonpersistent nerve agents and mustard agent. Over 9,000 kits were procured for the Navy and for Civil Defense. In 1967, the M15A1 version added persistent nerve agent detection. The Army and Navy procured over 43,000 of the kits during the 1960s.

## SAMPLING KIT FOR BIOLOGICAL WARFARE

**M17 Biological Agent Sampling Kit.** The M17 Kit was standardized in 1957 to meet a need for sampling biological agent contaminated air, soil, and other materials for dispatch to an appropriate medical laboratory for positive identification. The Army, Navy and Civil Defense were the primary users of the kit.

## IMPROVED LIGHTWEIGHT DETECTOR KIT

**M18 Series Chemical Agent Detector Kit.** The need for a lightweight, more sensitive, and easier use detector kit resulted in the M18 Kit in 1957. The kit was designed to confirm the continuing presence of a chemical agent to determine when soldiers could remove their masks. Over 19,000 of the kits were procured until 1965. Later versions added a persistent nerve agent (VX) detection capability and improved detection paper.

## FIRST U.S. AUTOMATIC NERVE AGENT ALARM

**M5 Automatic G-Agent Fixed Installation Alarm.** The inability to instantly detect nerve agents and to sound an alarm to alert surrounding troops was the primary concern during the 1950s. The M5 Automatic G-agent Fixed Installation Alarm, standardized in 1958, was the first detector and alarm for nerve agent GB. The unit could detect GB and sound an alarm in about 10 seconds. Unfortunately, the unit was 7 feet tall and 2 feet square. It was primarily used at Rocky Mountain Arsenal during GB production and filling.

## FIRST U.S. AUTOMATIC NERVE AGENT ALARM FOR FIELD USE

**M6 Automatic G-Agent Field Alarm.** The M6 Automatic G-Agent Field Alarm, standardized in 1958 for the Navy, was the first automatic electronic alarm for the detection of nerve agent GB that was light enough for use in the field. The Navy procured over 500 units for monitoring dockyards and onboard ships.

# DECONTAMINATION

## IMPROVED DECONTAMINANT

**Supertropical Bleach (STB)**. Despite the Chemical Corps concentrating on nerve agent decontamination during the 1950s, there was one significant improvement for mustard agent decontamination. In 1950, the Corps standardized Supertropical Bleach (STB) as the best decontaminant for persistent agents. The new bleach was more stable in long-term storage, particularly in temperature extremes, and was easier to spread from a decontaminating apparatus due to its more uniform consistency.

## FIRST U.S. TREATMENT KIT WITH ATROPINE


**M5A1/A2 Protection and Treatment Kit.** Following the Allied discovery of the German nerve agents at the end of World War II, atropine was quickly identified as the treatment for nerve agent casualties. In 1950, the M5 Protective Ointment Kit was modified by removing one of the M5 Ointment tubes and replacing it with a syrette of atropine. In 1959, the syrette was replaced with an automatic self-ejector unit and designated the M5A2 kit.

### IMPROVED SKID-MOUNTED DECONTAMINATION DEVICE

**M6 Decontaminating Apparatus.** During the Korean War, the Navy requested a skid-mounted decontaminating unit suitable for shore installations and placement on barges. The design included a 400-gallon steel tank and was standardized in 1952.

### IMPROVED TRAILER-MOUNTED DECONTAMINATION DEVICE

**M7 Decontaminating Apparatus.** The Navy requested a trailer-mounted power-driven decontamination unit. In response, the Chemical Corps developed the M7 series Decontaminating Apparatus in 1954. The trailer held a 150-gallon steel tank, a pump, and gasoline engine.

### IMPROVED TRAILER-MOUNTED DECONTAMINATION DEVICE

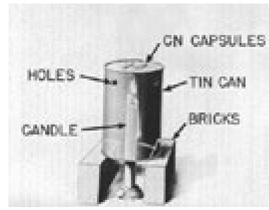
**M8 Decontaminating Apparatus.** The Navy requested a new trailer version of decontamination apparatus for shore base use that was lighter but had a larger tank. The Chemical Corps responded by standardizing the M8 series in 1958. The unit had a 200-gallon steel tank but weighed only 1,800 pounds. The M8A1 version met a request from the Marines for a slightly different trailer design. Further improvements led to the M8A2 version used by the Navy, Marines, and the Army. The unit sprayed decontaminant, but could also spray paint, fungicides, insecticides, and water to fight fires.

### IMPROVED DECONTAMINATION TRUCK

**M9 Decontaminating Apparatus.** In 1958 the Chemical Corps completed work on an improved spray truck. The new unit had a 400-gallon steel tank and could also be used for showers and fire fighting. The truck had seats on the front fenders for soldiers using handheld spray nozzles. Using both sides, the spray could cover a 12-foot wide path. Over 300 of the units were procured by the Army until it was finally obsoleted in 1976.

## TRAINING

### IMPROVED TRAINING ITEM



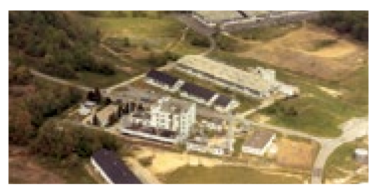

**M2 Tear Gas Pellet.** The M2 Pellet, made of chloroacetophenone (CN), was an improvement of the World War II CN Capsule used for creating tear gas for training purposes, testing the fit of gas masks, and to simulate a chemical warfare attack. The pellets were developed in 1952 and were used by the Army, Navy, Air Force, and Marines.

## RETALIATORY CHEMICAL WEAPONS

### IMPROVED GROUND CHEMICAL MORTAR

**M30 4.2-inch Chemical Mortar.** During the Korean War, the continued need for greater range for the 4.2-inch mortar led to the development of the M30 4.2-inch Mortar in 1951. The M30 added a better baseplate and greater range of 5,050 yards.

### NEW NERVE AGENT PRODUCTION PLANT



**Non-Persistent Nerve Agent**. The requirement for GB nerve agent production started with a pilot plant at ACC. This plant produced the first large production of GB agent in 1952. Based upon the work done in this pilot plant, the Chemical Corps built a large-scale production plant at Rocky Mountain Arsenal, Colo. It produced GB from 1953 to 1957.

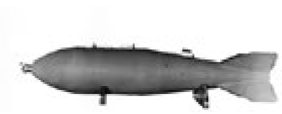
### NEW NERVE AGENT

**VX Persistent Nerve Agent.** Chemists at Imperial Chemicals, Ltd., in the United Kingdom, while searching for new insecticides, came across compounds that were extremely toxic to humans. The British shared the discovery with the United States in 1953. The Chemical Corps examined the new compounds and determined that a new series of nerve agents had been discovered that were more persistent and much more toxic than the German nerve agents. This series of agents was designated V-agents in 1955, because they were "venomous" in nature. Of the compounds investigated, VX was selected in 1957.

## FIRST U.S. NERVE AGENT CLUSTER BOMB

**M34 GB Cluster Bombs**. During the 1950s, the Chemical Corps concentrated on the weaponization of Sarin (GB). For air delivery, the first items standardized in 1954 were the 1,000-pound M34 and M34A1 cluster bombs.

## FIRST U.S. NERVE AGENT BOMB



**MC-1 GB Bomb.** In 1959, the Chemical Corps standardized the first nonclustered nerve agent bomb, designated the MC-1 750-pound GB bomb.

## FIRST U.S. NERVE AGENT PROJECTILES FOR THE ARTILLERY

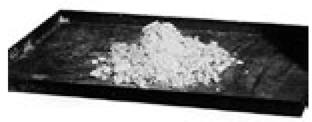
**Nerve Agent Projectiles.** For ground delivery, the Chemical Corps standardized the M360 GB 105-millimeter and the M121 GB 155-millimeter shells (see picture) in 1954.

# RIOT CONTROL

## NEW LARGE-AREA RIOT CONTROL AGENT DISPERSER

**M2 Skid-Mounted Irritant Gas Disperser.** The Military Police needed a device that could disseminate riot control agents over a large area to use against rioters. This led to the standardization of the M2 Irritant Gas Disperser in 1957. The design allowed it to be placed on a truck for mobile use. It could disperse several different types of powdered riot control agent.

## IMPROVED RIOT CONTROL AGENT



**CS Riot Control Agent.** The Chemical Corps standardized the riot control agent designated CS in 1959. Although intended for domestic disturbances and training, CS was used on the battlefield during the Vietnam War to drive the enemy from tunnels and dense jungles. Today, it is still used by military and civilian police forces.

# FLAME

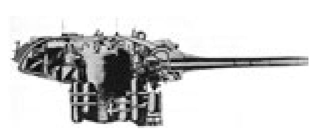
## NAPALM FIELD EXPEDIENTS

**Flame Fougasse.** During the Korean War, napalm was used extensively as a ground weapon, particularly as a perimeter defensive weapon. The flame fougasse consisted of a 55-gallon drum filled with napalm that had two explosive charges. The first blew the drum 10 to 20 feet in the air. The second shattered the drum and ignited the napalm. Another version was a 5-gallon land mine activated by a trip wire that covered 30 yards in diameter with burning napalm. Similar flame weapons were also used during the Vietnam War.

## IMPROVED PORTABLE FLAMETHROWER

**M2A1 Portable Flamethrower.** Improvements to the World War II M2 Portable Flamethrower resulted in the standardization of the M2A1 version in 1950. The new flamethrower had an easier-to-replace pressure tank and added safety features. In 1957, the gun was redesigned with simpler and added safety features. The M2 series could project a flame approximately 45 to 60 yards for about 10 seconds. Over 12,000 were procured and used in both the Korean and Vietnam Wars.

## IMPROVED MAIN ARMAMENT MECHANIZED FLAMETHROWER



**M7 Mechanized Flamethrower.** To update and improve the World War II mechanized flamethrowers, the Chemical Corps developed the M7 Flamethrower in 1954. When placed in the M48 medium tank as the main armament, the combination was designated the M67 Flamethrower Tank. The M7 could shoot a jet of flame for about 60 seconds at a range up to 195 yards. A second version, designated the M7A1, was standardized in 1958 for later versions of the M48 tank.

## FIRST U.S. ONE-SHOT FLAMETHROWER

**M8 Portable One-Shot Flamethrower.** To reduce the logistical requirements of having to refill portable flamethrowers in the field, the Chemical Corps standardized the M8 one-shot flamethrower in 1957. It weighed only about 27 pounds, less than half the weight of the M2 series flamethrowers, and could project a flame about 70 yards for four to five seconds.

# INCENDIARY

## IMPROVED FIRE BOMB FOR JET FIGHTERS

**M116 Fire Bomb.** The M116 was standardized in 1953 for use by the new F-100 Super Sabre jet fighter. An improved version was standardized as the M116A1 in 1954. The third version, M116A2, was standardized in 1958. The fire bombs held 100 gallons of napalm.

# SMOKE

## A SAFE TRAINING SMOKE POT FOR THE NAVY

**M6 SGF-2 Training Smoke Candle.** The M6 Smoke Candle was standardized in 1950 to provide a safe, nontoxic training smoke candle for the Navy. It was intended to simulate battle damage on board ships. HC Smoke, used in most smoke pots, was considered too toxic to use in enclosed spaces, so this one used fog oil. The M6 was the size of a smoke grenade and weighed only 1.82 pounds but produced smoke for about two minutes. The Navy ordered 12,000 of the training smoke candles.

## NEW LARGE AREA SMOKE-SCREENING CAPABILITY

M3 Pulse Jet Mechanical Smoke Generator. In 1952, the Chemical Corps standardized the M3 Pulse Jet Smoke Generator to meet large-scale smoke-screening requirements for military forces during the Korean War. The M3 Smoke Generator produced smoke by vaporizing fog oil using the heat of combustion gases produced by a gasoline engine. The fog oil was then dissipated through three discharge nozzles and condensed to form thick white smoke. The M3A1 Smoke Generator was standardized in 1953 with many improvements from the earlier version. Over 1,700 of the improved units were procured and performed well in Korea. The M3A2 Smoke Generator was standardized in 1954 with additional improvements and the M3A3 Smoke Generator in 1958. The latter version produced smoke 30 seconds after ignition.

## IMPROVED FLOATING SMOKE POT

**M7 SGF-2 Floating Smoke Pot.** The M7 Pot was standardized in 1953 to provide smoke screening on water, but it could also be used on land. The M7 used fog oil and produced smoke for about eight to 13 minutes.

## NEW IMPROVED SMOKE GRENADE


**M34 WP Smoke Hand and Rifle Grenade.** The M34 Smoke Grenade was standardized in 1959 to replace earlier grenades. It was a bursting-type grenade that could be thrown by hand up to about 30 meters or projected by rifle to 175 meters.

# CHAPTER 6 | THE 1960s

### The 1960 Reorganization

In 1960, the Chemical Warfare Laboratories was redesignated the Chemical Research and Development Laboratories (CRDL). The same year, the Nuclear Defense Laboratories separated from CRDL and became an independent activity.

### The 1962 Army Reorganization

Starting in 1960, the Chemical Corps stressed the need for a greater sense of urgency in attaining chemical, biological, and radiological preparedness. In January 1961, Secretary of Defense Robert S. McNamara initiated about 150 projects aimed at giving him an appraisal of national defense capabilities. Two of these projects had significant impact on the chemical and biological defense program. Project 112 had as its objective the evaluation of chemical and biological weapons both for use as strategic weapons and for limited war applications. The result of this study was a recommendation to increase funding in the long-term. Project 80 resulted in a committee to review the organization of the Army. The conclusion of this committee was to eliminate the technical services (such as the Chemical Corps) and distribute their functions to various elements of the new Army organization. Secretary McNamara felt that the Chemical Corps' knowledge, experience, and training was not being integrated into the rest of the Army. The problem appeared to be that the combat troops were structurally separated from the Chemical Corps, particularly in the areas of research and development, and training.

Based on these problems, in 1962 the Defense Department ordered a far-reaching realignment of functions. The Technical Services, including the Chemical Corps, were discontinued as separate headquarters, and their subordinate organizations merged into three field commands. The chemical training mission was assigned to the Continental Army Command, the development of chemical doctrine to the new Combat Development Command, and the chemical and biological logistical function, including all arsenals, laboratories, and proving grounds, to the equally new Army Materiel Command (AMC).

### Renaming of Edgewood Arsenal

In 1963, the Army Chemical Center became Edgewood Arsenal, returning to its original designation. Both the organization and the installation assumed the name. At the same time, CRDL was assigned to Edgewood Arsenal, ending the chemical laboratories past decades of also reporting to the Chemical Corps.

### Beginning of the Vietnam War

The growing guerrilla war in South Vietnam during the early 1960s led to many demands for the Chemical Corps' research and development capabilities. Although chemical and biological warfare agents were not used during the war, the Army did utilize flame, incendiary, smoke, chemical defoliants, and riot control agents in large quantities. The use of defoliants and riot control agents caused a worldwide concern that required the Army to explain the differences between these items and lethal chemical warfare agents.

The Expediting Non-Standard, Urgent Requirements for Equipment (ENSURE) Program was one particularly useful initiative. This program allowed Edgewood Arsenal to quickly send developmental items to Vietnam for testing on the battlefield without having to wait for the item to complete the normal review and testing process. Many of the Edgewood Arsenal items were riot control devices.

*During the Vietnam War, Edgewood Arsenal provided protective masks, riot control equipment, and flame and incendiary materiel.*

The fluctuating war with growing casualties made the Army again reexamine the no first use of chemical weapons policy. In 1963, one military writer stated: "The best way for the U.S. to achieve its military aims in Southeast Asia would be to rely on chemical warfare." He described how soldiers could "sanitize" a particular area with gases and sprays that killed everything from vegetation to humans. In 1966, a retired Army general suggested mustard agent could be used as an invaluable weapon for clearing Vietnamese tunnels. He thought the use of low-lethality chemicals would save both American and Vietnamese lives by rendering the tunnels useless.

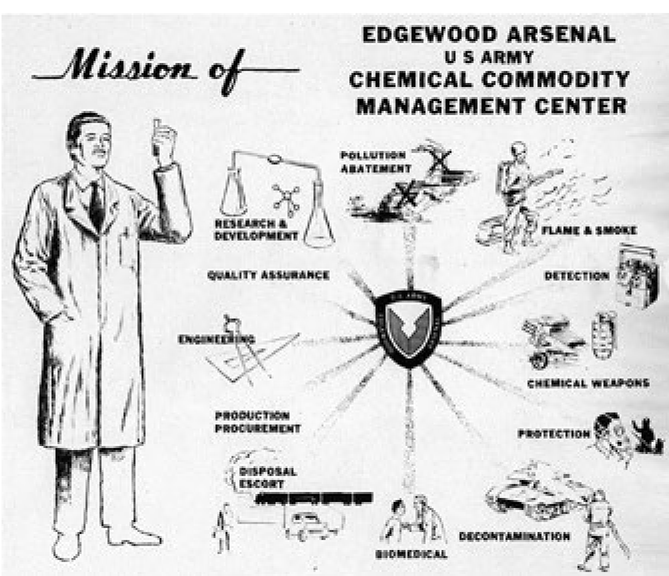
Edgewood Arsenal continued to research and develop lethal chemical weapons throughout the 1960s in case retaliatory weapons were needed in Vietnam or anywhere around the world during the continuing Cold War. The U.S. policy of no first use remained in place, but a continuing strengthening of chemical, biological, and radiological defense programs kept Edgewood actively supporting the war and national defense.

The public opinion of flame and incendiary weapons also changed during the conflict. Although napalm was a very effective weapon, dropping it from high-speed jets proved inaccurate, and reports of friendly and civilian casualties multiplied. Graphic photographs of casualties led to protests at the chemical companies that made napalm.

### Foreign Wars

While the United States was still involved in the Vietnam War, another small war in the Middle East brought the subject of chemical warfare back from being only hypothetical. In 1962, Yemeni dissidents overthrew the monarchy and declared a republic. Egypt recognized the new republic and sent military forces to help defeat the royalist troops, who were supported by the kingdoms of Saudi Arabia and later Jordan. Apparently growing impatient with the successful royalist guerilla tactics, the Egyptian air force allegedly dropped chemical filled bombs on pro-royalist villages to terrorize and/or kill the local inhabitants and possibly to get at the royalists hiding in caves and tunnels. The Egyptians denied ever using chemical warfare during their support of republican forces. Newspaper articles described additional chemical attacks as taking place during 1963 to 1967, although most disagreed on the dates, location, and effects of the attacks.

Still another Middle East war, the Arab-Israeli conflict in 1967, was described as having come very close to being the first major war where both combatants openly used nerve agents and biological warfare. Fearing a pending attack from its Arab neighbors, on June 5, 1967, the Israelis launched a preemptive strike against Jordan, Egypt, and Syria. Newspaper reports soon appeared that the Egyptians allegedly had stored artillery rounds filled with nerve agents in the Sinai Peninsula for use during a war. The Israelis, reflecting on Egypt's possible testing of the weapons in Yemen earlier in the year, suddenly realized their troops and cities were vulnerable to attack. The fact that chemical weapons were not used during the war was possibly due to the Israelis preemptive action or possibly to the newspaper reports of the Yemen Civil War. The Israelis felt threatened enough to place frantic orders for gas masks with Western countries. The Egyptians, on the other hand, claimed Israel was preparing for biological warfare. A United Nations—sponsored ceasefire ended the fighting on June 10, 1967, and the potential chemical/biological war did not occur.




### Army's Chemical Commodity Center

In 1966, Edgewood Arsenal disestablished CRDL and replaced it with three new organizations. There were the Research Laboratories, Weapons Development and Engineering Laboratories (WDEL), and the Defense Development and Engineering Laboratories (DDEL). At the same time, Edgewood Arsenal was designated the Army's Chemical Commodity Center. Fort Detrick was designated the Army's Biological Commodity Center.

### Changes to the National Chemical and Biological Program

The growing protests over the U.S. Army's role in Vietnam, the use of defoliants, the use of riot control agents both in Southeast Asia and on the home front, and heightened concern for the environment, gradually increased the public hostility toward chemical and biological weapons. Three events particularly galvanized public attention.

The first occurred in March 1968 in Skull Valley, adjacent to Dugway, one of the Army's open-air testing sites for chemical weapons. Local sheepherders reported that thousands of their sheep were sick and they wanted to know if the Army was to blame. Experts from the Army Chemical Center were called in to investigate, but the Army decline to immediately take responsibility for the incident. The general public opinion seemed to be that nerve agents had somehow drifted out of the test area during aerial spraying and had sickened or killed the sheep. The Army paid damages, but the end result was bad publicity and, even more damaging, Congressional outrage.

The second event was the sea dumping of old chemical weapons. Operation Cut Holes and Sink 'Em (CHASE), an already ongoing program disposing of conventional ammunition, began accepting chemical weapons for disposal in 1967. CHASE 11 in June 1968 and CHASE 12 in August of the same year removed chemical weapons from their storage sites and disposed of them by sinking them in surplus ships. The CHASE program created two major concerns. The first was that the weapons were being shipped by railroad from their storage depots to the loading docks. Public fear of an accident along the way was paramount. Second, the environmental concerns of sea dumping and the effects on marine life became an issue of protest and commercial concerns.

The third event was a serious chemical accident. On July 8, 1969, the Army announced that 23 U.S. soldiers and one U.S. civilian had been exposed to GB nerve agent on Okinawa. The soldiers were cleaning GB-filled bombs in preparation for repainting them when the accident occurred. Although none of the individuals died, the public announcement created two controversies. First, up until that time, the Army had kept secret the forward positioning of chemical weapons on Okinawa. The acknowledgement that the United States was storing chemical weapons outside the country created international concerns. Second, the accident pointed out the dangers of long-term storage of chemical weapons. With chemical weapons stored at continental U.S. sites near cities and residential areas, the public concern escalated that a similar accident could occur in the continental United States. In response to these concerns, the Defense Department announced July 22 that they would accelerate the previously planned removal of the chemical agents from Okinawa.

The same year as the third incident, the Secretary of the United Nations released a report on chemical and biological weapons that condemned production and stockpiling of weapons of mass destruction. Then, the U.S. Congress revealed to the general public that the Army was conducting open-air testing with nerve agents at Edgewood Arsenal and at Fort McClellan during training events. Within a short time of the disclosure, over 100 protestors were at the gates of Edgewood Arsenal. Three days later, buckling to the pressure, the Army temporarily suspended open-air testing at the two sites. Quickly rushing an independent committee together, the Army promised to conduct a safety review of all such testing. In October, the committee reported that the open-air testing program was safe and was not a threat to surrounding areas.

Before testing could resume, however, Congress passed Public Law 91-121 in November that imposed controls on the testing and transportation of chemical agents within the United States, and the storage, testing, and disposal of agents outside the United States This law effectively ended further open-air testing of lethal chemical agents.

A few days later, President Richard M. Nixon took executive action against the chemical and biological program. First, he reaffirmed the no first use policy for chemical weapons. Second, he decided to resubmit the 1925 Geneva Protocol to the Senate for ratification. The U.S. Senate had refused to ratify the treaty when it was first signed and President Harry Truman had withdrawn the treaty from the Senate in 1947. Third, he renounced the use of biological weapons and limited research to defensive measures only. These actions effectively stopped the production of lethal chemical and biological weapons in the United States.

## INDIVIDUAL PROTECTION

### IMPROVED CIVILIAN MASK WITHOUT CANISTER

**M22 Civilian Mask.** The need for an effective but inexpensive civilian mask led to the standardization of the M22 mask in 1960. Putting the filter material directly into the cheeks of the mask eliminated a need for a canister. It came in six sizes including one for a small child.

### NEW PROTECTOR FOR BABIES

**M2 Infant Protector.** The M2 Infant Protector was standardized in 1960 for Civil Defense use. The protector used three gas-particulate filter panels and allowed only purified air to enter the protector. Unlike the World War II version, it did not require bellows to move the air through the filters.

### FIRST U.S. STANDARD MASK FOR AIRCRAFT CREWS

**M24 Aircraft Mask.** The requirement for a protective mask for Army aircraft crews led to the development of the M24 mask in 1962. The mask was a modified M14 Tank Mask that included an oxygen adapter for the aircraft's internal air system. The mask was produced during the 1960s and 1970s.

### IMPROVED MASK FOR TANK CREWS

**M25 Tank Mask.** An update to the M14 series Tank Masks resulted in the M25 Tank Mask in 1963. It had a better microphone system, and later versions modified the original head harness. The mask was produced throughout the 1970s.

### FIRST U.S. STANDARD MASK WITH A DRINKING CAPABILITY

**M17A1 Protective Mask.** One of the major needs for helping nerve agent casualties was the capability to provide artificial respiration while wearing a mask. Another need was a drinking capability to allow for longer wear of the mask during a chemical incident. In 1966, the Chemical Corps added a resuscitation hose and a drinking tube to the new M17A1 mask.

### LIGHTWEIGHT MASK FOR THE VIETNAM WAR

**M28 Riot Control Agent Mask.** During the Vietnam War, the need for a lightweight protective mask suitable for dense vegetation and that only needed to protect soldiers against tear gas led to the development of the M28 mask in 1968. The mask placed the filtering material in the cheek pockets. Over 270,000 of the masks were produced during the war.

## PROTECTIVE CLOTHING

### IMPROVED PROTECTIVE OUTFIT FOR CHEMICAL PLANT WORKERS

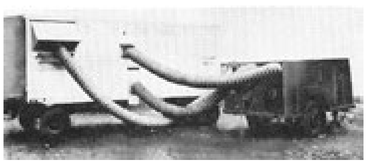
**M4 Supplied-Air Impermeable Protective Suit.** Workers in chemical plants needed protective clothing that could be worn for lengthy time periods and had a cooling capability. The result was the M4 Protective Suit standardized in 1960. Related articles standardized at the same time included the M2A1 Boots and the M4 Gloves. The entire ensemble was designated the M5 Supplied-Air Impermeable Protective Outfit.

## COLLECTIVE PROTECTION

### IMPROVED COLLECTIVE PROTECTION SYSTEM FOR TANKS AND ARMORED VEHICLES

**M13 Gas-Particulate Filter Unit.** The M13 Gas-Particulate Filter Unit (GPFU) was developed in 1961 and later improved as the M13A1 GPFU in 1963. It provided clean air to the crews of the M60 Tank and later the Abrams Tank, Bradley Fighting Vehicle, Multiple Launch Rocket System, and other vehicles.

### FIRST COLLECTIVE PROTECTION SYSTEM FOR VANS AND TRAILERS



**M1 Collective Protection Equipment.** The need to provide air conditioning and protection against chemical and biological agents to workers in the Army's vans, trailers, and command vehicles resulted in the development of a trailer-mounted collective protection system. The first version was for the NIKE-HERCULES missile van, standardized in 1963 as the M1 Collective Protection Equipment. Additional versions were completed throughout the 1960s and 1970s.

## DETECTION AND ALARMS

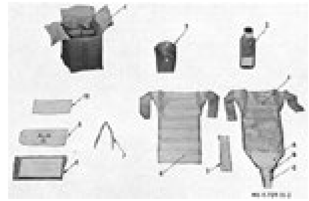
### IMPROVED CHEMICAL AGENT DETECTOR PAPER

**M8 Chemical Agent Detector Paper.** Using a Canadian design, the Army standardized M8 Detector Paper in 1963. The paper came in a booklet with perforated sheets for easy removal. The sheets changed color depending upon the agent contamination. In addition to the United States, many other countries procured M8 Detector Paper.

### IMPROVED SAMPLING KIT FOR TECHNICIANS

**M19 Chemical-Biological-Radiological Agent Sampling and Analyzing Kit.** The M19 Kit was standardized in 1964 to meet the needs of chemical laboratory technicians and chemical intelligence teams to identify enemy warfare agents.

### NEW KIT FOR SAMPLING SOIL AND WATER



**M34 Chemical-Biological Agent Sampling Kit.** The M34 Kit, standardized in 1964, was originally intended as a refill kit for the M19 Kit. It later became a standalone kit for training personnel in soil and water sampling.

### IMPROVED NERVE AGENT ALARM FOR FIELD USE

**M7 Automatic Field V-G Agent Alarm**. The M7 Alarm was standardized in 1965 for field detection of both GB and VX. The Army procured over 400 of the alarms and the Navy over 40.

### MOST SIGNIFICANT ADVANCEMENT IN NERVE AGENT DETECTION

**M8 Automatic Chemical Agent Alarm.** The 1967 Arab-Israeli War demonstrated the important need for a better automatic field alarm system. In 1968, the Army standardized the M8 Alarm. The alarm consisted of the M43 detector unit and the M42 alarm unit. The detector unit used an electrochemical cell for detecting most chemical agents and was small and light enough for field use. The M8 Alarm was one of the most significant accomplishments in chemical defense and remained in use until it was obsoleted in 1996.

### NEW CHEMICAL AGENT ALARM

**M42 Alarm Unit.** As part of the M8 Automatic Chemical Agent Alarm, the M42 Alarm Unit was also standardized in 1968. The alarm was connected to the detector by wire and sounded an audio signal and activated a visual blinking light when the detector detected a chemical agent. The M42 Alarm was one of the most significant accomplishments in chemical defense and continued to be used with more advanced chemical agent detectors over the years.

## DECONTAMINATION

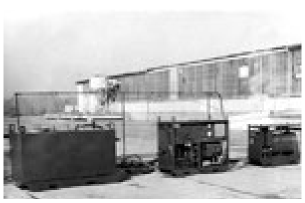
### IMPROVED DECONTAMINANT

**Decontaminating Solution 2 (DS2).** In 1960, the Chemical Corps made a significant improvement in the area of decontamination. Previous decontaminants had proven to be particularly corrosive to the brass parts of the M2 Decontaminating Apparatus, so the Chemical Corps spent almost two decades developing DS2. The new decontaminating agent was less corrosive to metals and less destructive to plastics, rubber, and fabrics. DS2 remained the Army's primary decontaminating agent for decades.

### IMPROVED HAND-HELD DECONTAMINATING DEVICE

**M11 Decontaminating Apparatus.** In conjunction with the standardization of DS2 in 1960, the Chemical Corps also developed the M11 1-1/2-quart Portable Decontaminating Apparatus, a fire extinguisher type unit compatible with DS2, used to decontaminate vehicles and weapons. Although small in size, it could spray up to 8 feet away.

### IMPROVED DECONTAMINATION DEVICE



**M12/M12A1 Decontaminating Apparatus.** The continuing need for a multipurpose decontaminating apparatus suitable for the Navy, Marines, and the Air Force resulted in the standardization of the M12 Skid-Mounted Power-driven Multipurpose Decontaminating Apparatus in 1961. In addition to decontamination, the unit could be used for fire fighting, deicing of aircraft, cleaning of aircraft and vehicles, hot or cold showers, and the spraying of insecticides and fungicides. Improvements in 1966 led to the M12A1 version that became a primary decontaminating device for decades. These units were deployed during Operation Desert Shield/Storm in 1990 to 1991. Additional improvements in 2003 added a diesel engine and a longer operation time before refueling.

### IMPROVED DECONTAMINATION KIT

**M13 Individual Decontaminating and Reimpregnation Kit.** In 1965, the Army replaced the earlier M5 Protective Ointment with a new individual decontaminating kit. It contained special decontaminating agents for equipment, skin, and reimpregnation powder for permeable clothing. The Army procured over 500,000 of the kits until it was replaced in 1989.

## RETALIATORY CHEMICAL WEAPONS

### FIRST LARGE SCALE VX NERVE AGENT PRODUCTION PLANT

**VX Production Plant.** The Army Chemical Center assisted with the design and operation of the first large-scale VX nerve agent production plant that was completed at Newport, Ind., in 1961. The production plant was only operated for seven years, and, in 1968, it was placed in standby.

### FIRST U.S. NERVE AGENT LAND MINE

**M23 VX Land Mine.** In 1960, the Chemical Corps standardized the first nerve agent land mine, designated the M23 2-gallon VX Land Mine. It was designed to be activated by either a vehicle running over it or by an antipersonnel anti-tampering fuse.

### NEW U.S. NERVE AGENT ARTILLERY PROJECTILES

**Nerve Agent Projectiles.** In 1961, the Chemical Corps standardized two new VX projectiles for artillery. The M121A1 was an improved version of the earlier GB round. It held about 6.5-pounds of agent. The M426 8-inch GB or VX projectile (see picture) held over 15.5-pounds of agent.

## FIRST U.S. MULTI-LAUNCH NERVE AGENT ROCKETS

**M55 Rockets.** The early 1960s was the peak of the nerve agent rocket program. The program was first started at the end of World War II to duplicate the German V-2 missiles used against England. The United States eventually developed both short range and long-range rockets. For short-range tactical support, the Chemical Corps standardized the M55 115-millimeter rocket in 1960. Described as the first significant ground capability for the delivery of chemical agents since the 4.2-inch chemical mortar, the M55 was loaded with VX or GB nerve agent. The range was over six miles. Each launcher held 45 rockets that could be fired simultaneously.

## FIRST U.S. NERVE AGENT ROCKET WARHEADS

**Chemical Missile Warheads.** For middle-range tactical support, the Chemical Corps standardized the M79 GB warhead (see picture) for the 76-millimeter Honest John rocket in 1960. The rocket had a range of 16 miles. A smaller warhead was standardized in 1964 for the 318-millimeter Little John rocket. The first long-range rocket warhead was standardized the same year for the Sergeant missile system. The missile had a range of 75 miles. Additional developmental projects added chemical warheads to other long-range missiles such as the Pershing missile that had a range of over 300 miles.

## FIRST U.S. CHEMICAL/BIOLOGICAL DRONES

**Drones.** In addition to the rocket program, the Chemical Corps examined several drones for chemical agent delivery. The SD-2 Drone was a slow (300 knots) propeller-driven remote-controlled recoverable drone that could hold over 200 pounds of either nerve agent or biological agents. It had a range of about 100 nautical miles and could disperse agent over about five to 10 nautical miles. The SD-5 (see picture) was an improvement that used a jet engine that gave it speeds of over Mach .75 and a range of over 650 nautical miles. The added horsepower allowed it to hold about 1,260 pounds of chemical or biological agent.

# RIOT CONTROL

## NEW PORTABLE RIOT CONTROL DISPERSER

**M3 Portable Irritant Gas Disperser.** To meet a requirement for a portable riot control dissemination device, the M2A1 Flamethrower was modified to include a new gun and the capability to spray micro-pulverized dry riot control agent. Standardized in 1960, the M3 could spray the agent about 40 feet in short bursts for about 30 seconds.

## NEW PORTABLE LARGE RIOT CONTROL DISPERSER

**M4 Helicopter or Vehicle Mounted Irritant Gas Disperser.** A requirement for an air-to-ground delivery capability for riot control agent led to the standardization of the M4 Disperser in 1960. The unit could be placed on either a helicopter or a vehicle and could spray dry micro-pulverized riot control agent to disperse a large disorderly crowd.

## IMPROVED PORTABLE LARGE RIOT CONTROL DIS PERSER

**M5 Helicopter or Vehicle Mounted Riot Control Agent Disperser.** The M4 Disperser was redesigned to be simpler and less costly to make yet still capable of meeting the requirements to disseminate riot control agent over a large crowd. The result was the M5 Disperser approved in 1962.

## BACKPACK RIOT CONTROL GRENADE LAUNCHER

**M8 CS Cartridge Launcher.** In 1966, the Army and Marine Corps approved initial production of a backpack grenade launcher that could shoot off 64 riot control grenades. Over 18,000 were authorized for use in Vietnam by 1968.

## RIOT CONTROL AGENT BACKPACK BLOWER

**M106 Riot Control Agent Disperser.** The M106 Mity-Mite was a commercial agricultural duster-sprayer that was adopted by the Army in 1965 to disperse dry riot control agent. During the Vietnam War, it was used primarily to flush tunnels and underground fortifications.

## SMALL RIOT CONTROL GRENADE

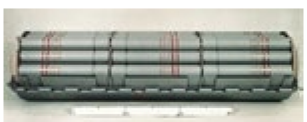
**M58 CS Pocket Hand Grenade.** The requirement for a small, easily thrown riot control grenade was met by the development of the M58 Grenade in 1969. The grenade was only 3 inches in length and just over 1 inch in diameter. It produced tear gas for up to 28 seconds.

# INCAPACITANTS

## FIRST U.S. INCAPACITATING AGENT

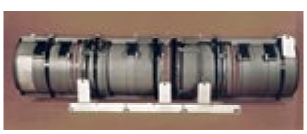
**Agent BZ.** The first and only incapacitant agent the Army standardized was Agent BZ in 1962. BZ, 3-quinuclidinyl benzilate, was a solid but was disseminated as an aerosol. The major problem with the agent for military purposes was its prolonged time of onset of symptoms. The estimate was two to three hours before the enemy would become confused and therefore vulnerable. This was a disappointment to those hoping for a quick-use nonlethal agent as an alternative to lethal agents. A second problem was its visible cloud of smoke during dissemination, which limited the element of surprise.

## FIRST U.S. INCAPACITATING BOMB



**M43 BZ Cluster Bomb.** In 1962, the Corps standardized the M43 750-pound BZ Cluster Bomb. It was never used on the battlefield.

## FIRST U.S. INCAPACITATING GENERATOR CLUSTER



**M44 BZ Generator Cluster.** The M44 175-pound BZ Generator Cluster was standardized in 1962. It was never used on the battlefield.

# FLAME

## IMPROVED AND LIGHTWEIGHT PORTABLE FLAMETHROWER


**M9 Series Portable Flamethrower**. The M9 flamethrower, standardized in 1960, replaced the M2A1 in use in Vietnam. The new flamethrower was lighter in weight. The Marines had over 1,000 M9 flamethrowers in Vietnam by 1969. An even lighter-weight version, designated the M9A1 and standardized in 1970, weighed only 50 pounds and had a simplified field refilling system. Approximately 950 M9A1 units were shipped to Vietnam.

## IMPROVED MECHANIZED FLAMETHROWER FOR TROOP CARRIERS

**M10 Mechanized Flamethrower.** The M10 Mechanized Flamethrower was standardized in 1962 and was intended to reduce fortifications and suppress enemy fire. It could shoot a stream of fire for up to 32 seconds over 200 yards. A M10 flamethrower was added to a standard M113 armored personnel carrier to create the M132 Self-propelled Flamethrower Carrier, standardized in 1963. The Army prepared 240 of the units and, by 1968, there were 28 in Vietnam. In 1967, a M132 on an Armored Troop Carrier in the Mekong River delta fired its flamethrower to suppress enemy troops. This led to the M10 flamethrower being mounted in assault craft for what was called the riverine operations in southern South Vietnam.

## FIRST U.S. MULTI-BARREL FLAME ROCKET

**M202 66-Millimeter Rocket Launcher.** The problems with most portable flamethrowers were the short distance, short duration, and weight of the flamethrowers. To solve all three of the problems, the Army developed the four-barreled M202 Rocket Launcher in 1969 that fired the M74, a rocket with a triethylaluminum (TEA)-filled warhead. Nicknamed the FLASH for Flame Launcher, Assault, Shoulder or Hip-Fired, the launcher had a range of over 200 yards for point targets and over 700 meters for area targets. It only weighed 27 pounds. Edgewood Arsenal conducted much of the research and development on the warhead. An improved version of the launcher was standardized in 1971 as the M202A1 Launcher. The M202A1 launcher and the M74 warhead replaced the flamethrower as the infantry's primary flame weapon.

# SMOKE

## NEW SMOKE SCREENING FOR HELICOPTERS

**M52 Helicopter Smoke Generating Subsystem.** The need for a smoke-screening capability for helicopters led to the development of the M52 system in 1965 with limited production starting in 1968. The system used fog oil and the exhaust from the helicopter's turbine engine to create and disseminate the smoke.

# CHAPTER 7 | THE 1970s

## Additional Controls on the Chemical and Biological Weapons Program

Throughout the 1970s, the U.S. chemical and biological weapons program experienced further restrictions and tightened controls. In February 1970, President Nixon added toxins to the banned weapons and ordered all existing stocks of toxin agents destroyed.

About a month later, the Army announced that the chemical weapons on Okinawa would be moved to Umatilla Army Depot in Oregon. This triggered a series of lawsuits that attracted the concern of Congress. The next year, Public Law 91-672 prohibited the Army from moving the weapons from Okinawa to anywhere on the U.S. mainland. Finally, Operation Red Hat in 1971 moved the stockpile on Okinawa to Johnston Island, a small U.S. island in the South Pacific, for long-term storage and eventual demilitarization.


## Edgewood Arsenal Reorganization

In 1971, Edgewood Arsenal (the installation) was consolidated with Aberdeen Proving Ground and was designated the Edgewood Area, APG. The same year, within Edgewood Arsenal (the command), the Research Laboratories, WDEL, and DDEL were replaced by the Chemical Laboratory, the Biomedical Laboratory, and two directorates: Development & Engineering and Manufacturing Technology.

## Chemical and Biological Weapon Demilitarization

Demilitarization of the existing chemical weapons stockpile was not an easy project in the 1970s with the heightened environmental concerns. One last chemical weapons sea dump took place in 1970 when CHASE 10 (out of numerical order) was finally completed despite much negative press. Two years later, Public Law 92-532 prohibited the further sea dumping of chemical munitions.

To find a replacement program for sea disposal, the Army created the Program Manager for Demilitarization of Chemical Materiel in 1972 at Picatinny Arsenal, N.J. The organization moved to Edgewood Area in 1973 and two years later changed its name to the Army Project Manager for Chemical Demilitarization and Installation Restoration.

Between 1971 and 1973, all remaining biological weapons were destroyed at Pine Bluff Arsenal, Rocky Mountain Arsenal, and Fort Detrick. In 1972, the United States signed the Convention on the Prohibition of the Deployment, Production, and Stockpiling of Bacteriological and Toxin Weapons. This document banned development, production, stockpiling, acquisition, and retention of biological agents toxins and the weapons to deliver them. As part of these changes at Fort Detrick, the Biological Defense Materiel Division was transferred to Edgewood Arsenal.

## Changes to the Chemical Corps

In 1973, with the signing of the Vietnam peace pacts in Paris to end the Vietnam War and the end of the draft, the Army recommended reducing the Chemical Corps in size and merging it with the Ordnance Corps. As the first step, the Army disestablished the Chemical School at Fort McClellan, Ala., and combined it with the Ordnance School at APG. Congress, however, did not act on the proposal to completely disestablish the Corps.

## 1973 Arab-Israeli War

The 1973 Arab-Israeli War, commonly called the October War, lasted only Oct. 6–24, 1973, but the ramifications for the U.S. chemical program lasted much longer. Following the war, the Israelis analyzed the Soviet-made equipment they captured from the Egyptians and Syrians. They discovered portable chemical-proof shelters and decontamination equipment for planes and tanks and that most Soviet vehicles had air-filtration systems on them to remove toxic chemicals.

Overall, the experts reported finding sophisticated chemical defense materiel and a "superior quantitative capability for waging a chemical war." The indications were that the Soviets were ready for extensive chemical warfare and might actually be planning to initiate chemical warfare in a future war. Soviet division commanders were thought to already have authority to initiate chemical warfare.

## Ratification of the Biological Warfare Convention and Geneva Protocol

In 1974, the Senate finally ratified the 1925 Geneva Protocol, and

President Gerald R. Ford officially signed it on Jan. 22, 1975. He did, however, exempt riot control agents and herbicides from inclusion in the agreement. The Senate also ratified the 1972 Biological Warfare Convention in 1974. President Ford signed it in 1975.

### U.S. Binary Chemical Weapons Program

Although President Nixon stopped the production of chemical weapons in 1969, he did not stop research and development of other types of lethal chemical weapons. The U.S. chemical weapons stockpile consisted of unitary chemical munitions, meaning that the lethal agent was produced at a plant, filled into the munitions, and then the filled munitions were stored ready to be used. Since most chemical agents were extremely corrosive, unitary munitions were logistical nightmares for long-time storage.

To solve this problem, back in the 1950s, the Army had begun looking at binary chemical weapons as a replacement for the existing chemical weapons stockpile. The binary concept was to use two nonlethal chemicals that mixed in flight to create the lethal nerve agent. Since the two nonlethal chemicals could be stored separately, this solved the problem of long-term storage of chemical weapons and also allowed for safe handling during production and transportation.

In 1976, the Army had standardized the M687 155-millimeter projectile, the first binary chemical weapon. In addition to the M687, the Army also started work on the BIGEYE binary bomb for the Navy and a warhead for the Multi Launch Rocket System (MLRS), but none of these were ever standardized. The standardization of the M687, however, did not lead immediately to production. The same year the M687 was standardized, Congress passed a Department of Defense Appropriation Authorization Act that restricted production of binary chemical weapons unless the President certified to Congress that such production was essential to the national interest.

### Restoring the Chemical Corps

Due to the world situation, the United States decided that their chemical/biological defense materiel needed to be equivalent to or better than that of any potential enemy. In addition, the physiological and logistical burden of the equipment had to allow for long-term use and had to be integrated to include individual protection, collective protection, decontamination, warning and detection, and safe training devices that allowed for realistic training. To meet this objective, the Army needed a strong technological base that was responsive to user needs and that could quickly develop the proper materiel.

In 1976, the Secretary of the Army reversed the decision to abolish the Chemical Corps. He cited the heightened awareness of the Soviet Union’s capability to wage chemical warfare as the primary reason.

### Reorganizations at Edgewood

In 1976, the primary lead for smoke and obscuration systems was assigned to the Project Manager for Smoke/Obscurants. The new organization was formed in the Aberdeen Area of APG.

After the merger of Edgewood Arsenal (the installation) with APG, Edgewood Arsenal (the command) also was abolished. In 1977, the elements of Edgewood Arsenal were broken up between various commands and the main chemical research organization became the Chemical Systems Laboratory (CSL), a tenant organization at APG.

In 1978, the Project Manager for Chemical Demilitarization and Installation Restoration became the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). The next year, the new organization started operating the first chemical agent pilot incineration facility, designated the Chemical Agent Munitions Disposal System (CAMDS), in Utah. CSL personnel supported the USATHAMA project in numerous areas to include protection, filtering, and chemical analysis.

### Growing Danger of International Chemical and Biological Warfare

During the late 1970s, reports of the use of chemical and biological agents in various small wars in Southeast Asia and Afghanistan began to attract the attention of the United States. Interviews with Hmong villagers in Laos indicated that Vietnamese and Soviet forces had used chemical and possibly toxins against their people. In 1978, similar reports from Kampuchea claimed the Vietnamese and their allies killed villagers using chemical weapons. Prior to the Soviet invasion of Afghanistan in December 1979, reports were already circulating that their troops were using chemical weapons against the Mujahidin soldiers.

The reports were taken as indications that the Soviets were continuing an offensive chemical and biological program despite their denials. In April 1979, a sudden outbreak of anthrax in Sverdlovsk in the Ural Mountains was blamed on naturally occurring spores in the soil contaminating cattle that were later consumed by humans. U.S. intelligence officers doubted the story and used the incident to push for better chemical and biological warfare preparedness in the U.S. Army. Not until 1992 did Russian President Boris Yeltsin confirm that military researchers working with the agent had indeed caused the epidemic.

### Additional Organizational Changes

In 1979, the Biomedical Laboratory was separated from CSL and transferred to the U.S. Army Medical Research and Development Command, Office of the Surgeon General, but remained as a tenant at APG.

The same year, the Chemical School was separated from the Ordnance Corps at APG and reestablished at Fort McClellan, Ala.

## INDIVIDUAL PROTECTION

### NEW AIR FORCE AND NAVY MASK

**MCU-2/P Mask.** The MCU-2/P Mask started as an Army development program designated the XM30 mask (see picture). It was unique in that it had a large, flexible lens, front and side voicemitters, and a drinking device. The Army decided not to approve it for several reasons, but the Navy and Air Force used the design for the MCU-2/P Mask.

## COLLECTIVE PROTECTION

### FIRST U.S. COLLECTIVE PROTECTION TENT

**M51 Shelter System.** Work on a protective tent during the 1960s resulted in the standardization of the M51 Shelter System in 1971. The unit was an easily transportable pressurized enclosure that could be air dropped or towed to provide protection in the field. Despite these developments, in 1977, Congress included a section that requested collective protection systems for all armored vehicles in the Department of Defense Appropriation Authorization Act. This law launched an intensive effort to determine the chemical vulnerability of all Army vehicles.

## DETECTION

### NEW CHEMICAL AGENT DETECTOR KIT

**M256 Chemical Agent Detector Kit.** The Army continued to improve the basic detector kit and approved the M256 Chemical Agent Detector Kit in 1977. The M256 Kit could detect chemical agents in the air and liquid chemical agent contamination on surfaces. The primary use was to notify troops as to when they could unmask after a chemical attack.

### FIRST BIOLOGICAL DETECTION SYSTEM


**Biological Detection and Warning System (BDWS).** The BDWS started development in 1974 to meet the growing critical need for a field biological agent detection system. The BDWS consisted of the XM19 Chemiluminescence Biological Agent Automatic Alarm, the XM2 Biological Agent Sampler, and a M42 Alarm. The XM19 Alarm detected airborne biological material and gave an alarm when it satisfied predetermined criteria. The XM2 Biological Agent Sampler collected and concentrated biological agent aerosols manually or automatically when the XM19 Alarm activated. The sampler then kept the samples viable until they could be examined in a medical laboratory. The BDWS ended development in 1983 due to problems with the XM19 Alarm unit.

## DECONTAMINATION

### NEW DECONTAMINATION CAPABILITY FOR SKIN


**M258 Skin Decontamination Kit.** The Army standardized the M258 Skin Decontamination Kit in 1975. It used two containers of decontamination material to neutralize nerve and blister agents. In an emergency, it could also be used to decontaminate individual equipment. The Army also standardized the M58 Skin Decontaminating Training Aid along with the M258 kit. It used simulants instead of the actual decontaminating solutions.

## TRAINING

### NEW CHEMICAL ATTACK SIMULATOR SYSTEM

**M9 Simulator, Projectile Airbust, Liquid (SPAL).** The need for a useful but safe training device led to the development of the M9 SPAL in 1978. The M9 SPAL consisted of 20 projector assemblies holding a chemical agent simulant used to simulate a toxic rain attack for chemical training purposes.

## RETALIATORY CHEMICAL WEAPONS

### FIRST BINARY CHEMICAL WEAPON

**M687 GB2 155-millimeter Projectile.** The first and only binary chemical weapon standardized was the M687. It consisted of a projectile holding two canisters of less-than-lethal chemicals. For safety reasons, the canisters were stored separately and only loaded into the projectile prior to firing. While in flight, the canisters mixed their ingredients to create the nerve agent.

## RIOT CONTROL

### HANDHELD RIOT CONTROL SPRAYER

**M32 CSX Manually Carried Disperser and Riot Control Agent.** The need for a handheld pressurized sprayer to subdue or control rioters or trespassers led to the development of the M32 Disperser in 1973. It used a solution of CS that could be targeted at an individual and was carried in a pouch worn on the belt.

### NEW PORTABLE BACKPACK RIOT CONTROL DISPERSER

**M33 Portable Riot Control Agent Disperser.** The M33 was an improved backpack disperser from the converted flamethrowers used during the 1960s. The M33 was standardized in 1973 and sprayed CS powder out for 40 feet for about 40 seconds. An improved version, the M33A1 (see picture) was added in 1974 and could disseminate either CS or the new CR tear gas solution.

### HANDHELD RIOT CONTROL SPRAYER


**M36 CR Manually Carried Disperser and Riot Control Agent.** The M36 was similar to the M32 Disperser except that it sprayed CR tear gas solution. It was standardized in 1974 and could spray CR up to 12 feet for about 25 seconds.

### NEW RIOT CONTROL GRENADE

**M47 CS Riot Hand Grenade.** The requirement for a riot control grenade that did not explode and could not easily be picked up and thrown back led to the development of the M47 Grenade in 1974. The grenade was made of rubber and dispensed CS for about 25 seconds.

### NEW RIFLE GRENADE LAUNCHER FOR RIOT CONTROL

**M234 Riot Control Projectile Launcher.** The M234 Launcher was standardized in 1978 and attached to the end of the M16A1 rifle barrel. It fired a ring airfoil that either held CS agent or used kinetic energy to hit a target. It had a maximum range of 100 meters, which meant it could keep rioters far enough away to prevent them from throwing rocks.

## SMOKE

### SMOKE GRENADE LAUNCHERS FOR COMBAT VEHICLES

**Smoke Screening Grenade Launchers.** During the 1970s, the Army developed several smoke grenade launchers that were mounted on combat vehicles to provide an emergency smoke capability. The early designs used a plastic tube holding a white phosphorus smoke grenade and a HC smoke grenade (M176) or two HC smoke grenades (M226). Additional designs (M239 [see picture], M243, and M250) used two four- or six-barreled dischargers firing the L8A1 Red Phosphorus Smoke Grenade.

### CANOPY SMOKE MARKERS

**Colored 40-millimeter Smoke Markers.** The requirement for a capability to signal from a dense jungle or woods led to the development of colored smoke markers that could be fired from either the M79 Grenade Launcher or the M203 Grenade Launcher attached to the M16 Rifle. These markers shot up about 300 feet and then descended using a parachute.

# CHAPTER 8 | THE 1980s

## Foreign Chemical Wars

During the 1980s, the United States continued to consider the Soviet Union the number one potential chemical warfare opponent, particularly with its alleged use of chemical weapons in Afghanistan. Another war in the Middle East, however, gradually began to erode that status. In September 1980, Iraq invaded Iran and, when neither side achieved dominance, the war quickly became a stalemate. To stop Iranian human wave attacks, the Iraqis used chemical weapons against unprotected Iranian infantry.

Iraq failed to reach a military conclusion despite its use of chemical weapons. Chemical weapons caused approximately five percent of the Iranian casualties. Although there were rumors of Iranian use of chemical weapons also, less attention was devoted to verifying those reports. In August 1988, Iraq finally accepted a United Nations cease-fire plan, and the war ended politically with little gained from the original objectives.

The end of the fighting did not end new chemical warfare reports from circulating. Within a month of the end of the Iran-Iraq War, Iraq was again accused of using chemical weapons against the Kurds, a minority group in Iraq seeking autonomy. Shortly before this incident, there were reports of Libya using chemical weapons obtained from Iran during an invasion of Chad. The United States rushed 2,000 gas masks to Chad in response. There were also reports of the Cuban-backed government of Angola using nerve agents against rebel forces.

## Edgewood Reorganizations

In 1981, the Biomedical Laboratory, formerly the Medical Research Division, became the U.S. Army Medical Research Institute of Chemical Defense (MRICD).

Two years later, AMC created the new U.S. Army Armament, Munitions and Chemical Command (AMCCOM), headquartered at Rock Island, Ill. As part of this reorganization, the Chemical Systems Laboratory (CSL) became the Chemical Research and Development Center (CRDC) and reported to AMCCOM. In 1986, the name was changed to Chemical Research, Development and Engineering Center (CRDEC).

Also in 1986, USATHAMA split into two separate organizations. The demilitarization program became the Program Manager for Chemical Munitions. The environmental restoration program became the U.S. Army Environmental Center.

The same year, the Project Manager for Binary Munitions was formed to coordinate the development of binary chemical weapons.

## U.S. Chemical Weapons Program

In response to the continued use of chemical agents in the Middle East and elsewhere, to drive the Soviets to the bargaining table, and to restore U.S. chemical defense and retaliatory capability, the Army instituted a three-pronged chemical program for the 1980s. First, the Army improved its defensive equipment. Second, the Army began production of chemical weapons for the first time since the 1969 ban. Third, the Army improved its chemical warfare training and updated its training manuals. Reflective of the improved defensive equipment were a number of physical protection, collective protection, detection, and decontamination developments.

The subject of renewed chemical weapon production was a very politically sensitive one. In 1984, Congress created the Chemical Warfare Review Commission to look at several issues related to the military's chemical warfare preparedness. This committee visited numerous sites, interviewed experts, reviewed policy, and examined intelligence reports. Among their findings was that a defensive policy alone was not an adequate response to the Soviet chemical threat. President Ronald Reagan agreed and determined that the United States should retain a chemical retaliatory capability as a deterrent until an effective treaty or weapons ban could be implemented.

In 1985, Congress passed Public Law 99-145 authorizing production of binary chemical weapons and two years later, President Reagan certified to Congress that all their conditions had been met. The production of the M687 binary projectile began on Dec. 16, 1987, at Pine Bluff Arsenal. This was no small feat considering modern environmental and general public concerns. To resolve political concerns, one of the two nonlethal canisters in the M687 was filled and stored at Pine Bluff Arsenal. The other canister was produced and filled at Louisiana Army Ammunition Plant. The shell bodies and one filled canister were then stored at Tooele Army Depot, Utah. In time of need, the parts could be combined and would provide the Army with a chemical retaliatory capability. In addition to the M687 projectile, development work continued on the Bigeye binary bomb and the binary warhead for the MLRS. Production plants for these items were also started at Pine Bluff Arsenal.

## Soviet/U.S. Agreement on Chemical Weapons

The United States' increased retaliatory and defensive capability, along with internal changes in the Soviet Union, helped convince the Soviets to look closely at a new chemical weapons treaty. In 1987, after admitting for the first time that they possessed chemical agents, the Soviets agreed to halt chemical weapons production. In September 1989, the "Memorandum of Understanding (MOU) Between the Government of the United States and the Government of the USSR. Regarding a Bilateral Verification Experiment and Data

Exchange Related to Prohibition of Chemical Weapons," otherwise known as the Wyoming MOU, started the talks between the two countries.

### U.S. Demilitarization Program

While the United States was producing the new binary agent weapons, it was also still trying to get rid of the old unitary chemical weapons stockpile. This demilitarization program proved a far greater challenge than originally expected. In 1982, the Army announced that incineration was the best option for disposing of the chemical agents. The construction of the first such disposal system was started on Johnston Island in 1985 to dispose of the chemical weapons shipped there from Okinawa. In 1989, construction on a second disposal system was started at Tooele, Utah.

The Army also started destroying the stockpile of the incapacitant agent BZ at Pine Bluff Arsenal. This project was completed in 1990.

### Creation of New Organizations

As a result of the President's Blue Ribbon Commission on Defense Management (commonly called the Packard Commission) recommending streamlining the Army's acquisition process, the Army created several Program Executive Officers (PEO). In 1987, the PEO Chemical/Nuclear was established in the Edgewood Area. It consisted of the new Program Manager (PM) for NBC Defense, PM Smoke Obscurants, and PM Binary. The new PEO lasted only two years and, in 1989, was disestablished. The three PMs were assigned to CRDEC, and the Commander of CRDEC was designated the focal point for nuclear, biological, and chemical (NBC) research, development, and acquisition matters.

In 1989, the PM for Chemical Munitions was reorganized to become the PEO-Program Manager for Chemical Demilitarization.

## INDIVIDUAL PROTECTION

### IMPROVED U.S. STANDARD FIELD MASK

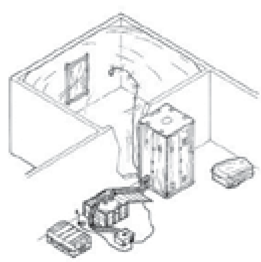
**M40 Protective Mask.** Perhaps the most significant development during the 1980s was the standardization in 1987 of a new protective mask for the military to replace the M17 series masks. The new mask, designated the M40, returned to a canister design that provided increased protection against everything from chemical agents to toxins, smokes, and radioactive fallout particles. The canister used North Atlantic Treaty Organization (NATO) standard threads and could be worn on either side of the mask. The mask also had improved fit and comfort, voice communications, and drinking capability. It came in three sizes, which helped eliminate the logistical burden of four sizes for the M17A2 and six different stock numbers for the M9A1.

### IMPROVED U.S. STANDARD TANK MASK

**M42 Protective Mask.** In conjunction with the M40, the Army also standardized the M42 Combat Vehicle Mask to replace earlier tank masks from the 1960s.

## COLLECTIVE PROTECTION

### FIRST U.S. COLLECTIVE PROTECTION SYSTEM FOR ROOM CONVERSION



**M20 Simplified Collective Protection Equipment.** The Army standardized the M20 Simplified Collective Protection Equipment in 1986. This system turned one room of a building into a protected area by lining the walls with a chemical/biological vapor-resistant polyethylene liner and providing 200 cubic feet of filtered air per minute.

### NEW COLLECTIVE PROTECTION FOR VEHICLES AND SHELTERS

**Modular Collective Protection Equipment (MCPE).** The Army concentrated on MCPE for chemical threats to vehicles, vans, and shelters. The Department of Army identified 43 systems in 1980 that required chemical protection. New vehicles, vans, and shelters developed after 1980 created a major long-term project to correct the deficiency discovered after the 1973 Arab-Israeli War.

## DETECTION AND ALARMS

### IMPROVED ADHESIVE BACKED DETECTION PAPER

**M9 Detector Paper.** M9 Detector Paper was an adhesive-backed paper containing a dye that turned red when contaminated with any known liquid agent. Standardized in 1980, the paper was attached to a soldier's arms or legs or to the outside of his vehicle and provided an indication of a chemical attack.

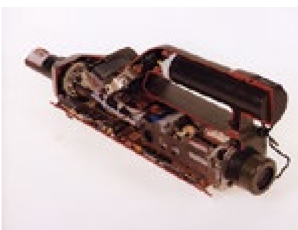
### IMPROVED CHEMICAL AGENT DETECTION CAPABILITY


**M8A1 Automatic Chemical Agent Alarm.** The development of the improved M43A1 Detector Unit that used an alpha radiation source instead of an electrochemical process, led to the standardization of the M8A1 Automatic Chemical Agent Alarm in 1981. The new alarm continued to use the original M42 Alarm Unit.

### NEW WATER TESTING KIT

**M272 Chemical Agents Water Testing Kit.** The need for a replacement for the M2 Water Testing and Screening Kit led to the development of the M272 Chemical Agents Water Testing Kit, approved in 1983 for field use. It was lightweight, compact, expendable, and easy to use. The kit could detect most chemical agents in raw and treated water. It also contained simulants for training. It was intended for Quartermaster and Medical personnel to verify that water was free from chemical contamination.

### FIRST U.S. DETECTOR FOR MONITORING EQUIPMENT AND PERSONNEL



**M1 Chemical Agent Monitor (CAM).** The CAM, standardized in 1988, was used to detect chemical agent contamination on personnel and equipment. It detected vapors by sensing molecular ions of specific mobilities and used timing and microprocessor techniques to reject interferences. Its development history was particularly interesting in that it was based on a United Kingdom (U.K.) design originally standardized by the U.K. four years earlier.

### IMPROVED RADIOLOGICAL DETECTOR

**AN/PDR-75 Radiac Set.** The AN/PDR-75, first fielded in 1988, provided a capability to monitor and record the exposure of personnel to gamma and neutron radiation.

### IMPROVED RADIOLOGICAL DETECTOR

**AN/VDR-2 Radiac Set.** The AN/VDR-2, first fielded in 1989, could be used as a handheld detector or to perform ground radiological surveys from a vehicle.

## DECONTAMINATION

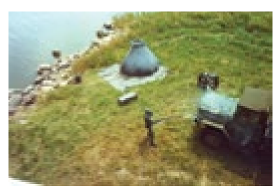
### IMPROVED LIGHTWEIGHT DECONTAMINATION DEVICE

**M13 Decontaminating Apparatus.** The need for an improved portable vehicle decontaminating capability to replace the M11 Decontaminating Apparatus resulted in the Army standardizing the M13 Decontaminating Apparatus in 1983. It provided a larger decontaminant capacity and also included a scrubbing brush to remove mud from the vehicle.

### FIRST U.S. JET ENGINE DECONTAMINATION SYSTEM

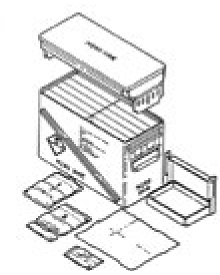
**XM16 Decontamination Apparatus.** Not all research and development utilizing current technology or foreign intelligence resulted in the standardization of a new item. One example was the truck-mounted jet-exhaust decontaminating apparatus, designated the XM16, that was researched during the early 1980s. Based on intelligence collected on the Soviet TMS-65 decontamination system, the U.S. project consisted of a J60-P-6 jet engine with a control cab mounted on a 5-ton military truck. The idea was to direct high-velocity streams of hot exhaust gases onto the outer surfaces of vehicles for decontamination. In addition, the jet engine could be used as a smoke generator by adding smoke liquids onto the exhaust. Due to several deficiencies in the system, the project was cancelled in 1986, but the principle was continued in related development projects.

### NEW DECONTAMINATION CAPABILITY



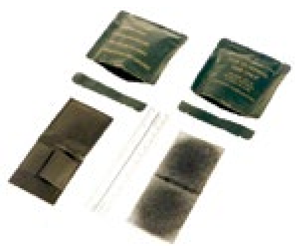
**M17 Decontaminating Apparatus.** The need for a lightweight decontaminating system to replace the M12A1 Decontaminating Apparatus led the Army to examine a Norwegian device called the NBC SANATOR. Designated the A/E32U-8 by the Air Force, it consisted of an air-cooled engine, water pump, heater, 1,450-gallon rubberized fabric collapsible tank, and an accessory kit. In 1984, the Army standardized the A/E32U-8 for urgent limited procurement of 705 units through the Air Force. After additional developmental work, the XM17E1 unit was standardized as the M17 Lightweight Power-Driven Decontaminating Apparatus in 1987. The standardized version used a 1,580-gallon water tank instead of the smaller version. The M17 was designed to decontaminate equipment and personnel using either water or decontaminating agents. The personnel showers could handle up to 12 soldiers at one time. The unit was designed to draw water from any natural source and deliver it heated and under pressure on demand.

## IMPROVED PERSONNEL DECONTAMINATION KIT



**M280 Individual Equipment Decontamination Kit (DKIE).** The M280 Kit, designed to partially decontaminate a soldier's personal equipment, including gloves, hood, mask, and weapon, was standardized in 1985. The kit had 20 individual packages, each containing two wipe packets holding treated towelettes.

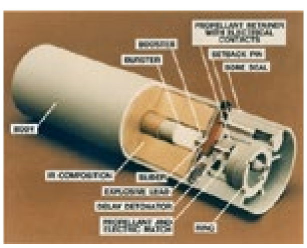
## IMPROVED SKIN DECONTAMINATION CAPABILITY



**M291 Skin Decontaminating Kit.** The M291 was standardized in 1989 to decontaminate skin without possible long-term harmful effects. Developed by the U.S. Army Medical Materiel Development Activity at Fort Detrick, Md., it consisted of a wallet-sized pouch holding six foil packets designed to fit in the pocket of their protective suit.

# SMOKE/OBSCURATION

## NEW ARMORED VEHICLE SMOKE GRENADE



**M76 Infrared Screening Smoke Launcher Grenade.** The M76 Grenade was standardized in 1985 to provide infrared and visual smoke-screening capability for armored vehicles. It could be fired from multiple types of grenade launchers and was the first munition designed to defeat for at least 45 seconds all threat weapon sensors operating in the visual through far infrared regions of the electromagnetic spectrum.

## NEW MOBILE SMOKE GENERATOR SYSTEM

**M157 Mechanical Pulse Jet Smoke Generator Set.** The Army standardized the M157 Smoke Generator Set in 1986. It consisted of two modified M3A3 Smoke Generators, designated the M54 Smoke Generator, mounted on the rear of a M113 armored personnel carrier or an HMMWV. The M113 configuration (see picture) was designated the M1059 Smoke Generator Carrier and was used to screen armor and mechanized infantry missions. The HMMWV version, designated the M1037 and nicknamed the Lynx, was used to screen artillery, troop movements, and stationary installations.

# CHAPTER 9 | THE 1990s

## Chemical Weapons Destruction Agreement

In June 1990, with the fall of many of the communist governments in Eastern Europe and the improved relations with the Soviet Union in 1990, the United States and the Soviet Union signed a bilateral chemical weapons destruction agreement. In support of this agreement, the Secretary of Defense canceled most of the new chemical retaliatory program, and the Army decided to mothball its new binary chemical production facilities in 1990.

*Operation Retrograde removed the U.S. chemical weapons stockpile from Germany in 1990.*

Shortly after the signing of the bilateral chemical weapons destruction agreement, the Army began Operation Retrograde to remove all U.S. chemical weapons from Germany. The project started in July and finished in November 1990, with all the munitions safely moved to Johnston Island for eventual destruction.

In 1992, Public Law 102-484 instructed the Army to restudy incineration as the best process for demilitarization due to continuing opposition by the general public. The Army then began researching neutralization and neutralization followed by biodegradation as alternate disposal options.

## First Gulf War (Operation Desert Shield/Desert Storm)

Despite the ongoing political efforts to abolish chemical warfare, world events just two months later dictated that chemical and biological weapons would again be the subjects of daily news reports. On Aug. 2, 1990, Saddam Hussein sent Iraqi troops into Kuwait. In response, President George H. W. Bush ordered U.S. forces sent to Saudi Arabia at the request of the Saudi government as part of what became Operation Desert Shield. Not since World War I had U.S. troops been sent to face an enemy that had used chemical weapons extensively within the last few years and had an active biological weapons program.

Iraq had a large biological agent production facility at al-Hakam that produced botulism, anthrax, and other agents. Started in 1988, the plant had produced about 125,000 gallons of agent by 1991. After stating for years that the plant was used to produce animal feed, the Iraqis admitted in 1995 that the plant was a biological warfare production facility. In addition to the agent production capability, they conducted live agent tests on animals. The Iraqis also later admitted they had prepared 199 biological missiles and bombs.

The United States' preparation for the military phase of the Gulf War had to consider all threats. Vaccines for the various threat biological agents were given to the U.S. troops moving into the area. All military units were fully equipped with the latest chemical and biological defensive equipment, and training was continuous.

On Jan. 16, 1991, the actual attack on Iraq started and was designated Operation Desert Storm. The initial air attack concentrated on Iraqi chemical production facilities, bunkers, and lines of supply. The Allies began the ground war Feb. 23. Although chemical agent alarms went off during the ground war, the Iraqis made no known, overt, large-scale chemical or biological attacks. On Feb. 27, Allied troops liberated Kuwait City and finished destroying the Iraqi units in Kuwait.

A number of reasons surfaced after war as to why the Iraqis had not initiated large-scale chemical or biological warfare. Vice Admiral Stanley Arthur, commander of U.S. naval forces, thought that because the wind suddenly changed from blowing south at the start of the land battle, the Iraqis had probably realized chemical weapons could harm their own troops. Some thought the speed of the campaign was the critical reason. Others reported that the combination of Allied bombing and resulting Iraqi logistical nightmares prevented the chemical weapons from ever reaching

*Checking an Iraqi missile for chemical agents using a Chemical Agent Monitor.*

the front lines. General H. Norman Schwarzkopf, commander of Allied forces, mentioned that Iraq might have feared nuclear retaliation.

After the war, allegations of chemical agent exposure began to surface. Initially, the Department of Defense could not confirm any exposures had taken place. Veterans of the war claimed the opposite, and their ailments collectively became known as Gulf War Syndrome. Within five years of the end of the war, almost 60,000 Gulf War veterans claimed some sort of medical problems directly related to their war activities. Extensive research by the Department of Defense failed to find any single cause for the problems, although one suggestion was that a combination of the vaccines, burning oil fumes, and possible nerve agent residue may have been the causative source.

### Additional Chemical Warfare Allegations

Shortly after the fighting was over between Iraq and Allied forces, reports circulated that Hussein was using chemical agents against rebellious Kurds and Shiite Moslems. The United States intercepted a message ordering the use of chemical weapons against the cities of Najaf and Karbala. President Bush's response was that such use of chemical weapons would result in Allied air strikes against the Iraqi military organization using the chemicals. Thus, despite the end of fighting, Iraqi chemical weapons continued to be a problem for the world.

Likewise, U.S. intelligence sources detected increased chemical development activity in Libya. Libya constructed a chemical weapons plant at Rabta that produced about 100 tons of chemical agents. In 1990, Libya claimed a fire destroyed the plant. New disclosures surfaced in 1996 that Libya was constructing a second chemical production plant at Tarhunah. U.S. intelligence sources claimed this would be the largest underground chemical weapons plant in the world, covering roughly 6 square miles and situated in a hollowed-out mountain. With Scud missiles having a range of 180 to 300 miles, this created a significant threat to its neighbors. Libya strongly denied the accusation.

### Reorganizations at Edgewood

In 1992, there was another reorganization at the Edgewood Area. Portions of CRDEC were removed and used to create a headquarters staff for the new Chemical and Biological Defense Agency (CBDA). This new organization also included the Technical Escort Unit. At the same time, the remainder of CRDEC was renamed the Edgewood Research, Development, and Engineering Center (ERDEC) under CBDA.

The next year, CBDA and Chemical Materiel Destruction Agency, renamed the Chemical Demilitarization and Remediation Activity (CDRA), merged to form the new Chemical and Biological Defense Command (CBDCOM).

### Chemical Weapons Convention

In 1993, the United States, Russia, and other countries signed the Chemical Weapons Convention. This treaty prohibited development, production, stockpiling and use of chemical weapons. Ratification by the Senate, however, was delayed for various reasons until 1997. One reason was that reports of a Russian chemical development program surfaced. A Russian scientist claimed that Russia developed a new highly toxic binary nerve agent called Novichok in 1991. According to the scientist, the nerve agent was undetectable by U.S. chemical detectors and may have been used in the Gulf War by Iraq to produce some of the Gulf War Syndrome symptoms. Despite these claims, the negotiations continued and additional agreements were signed with Russia. The United States even agreed to help fund the Russian demilitarization program.

### Spring Valley Environmental Remediation

While supporting international ongoing operations, APG South also supported environmental remediation projects within the United States. In January 1993, construction workers building new houses discovered World War I chemical weapons near American University in Washington, D.C. The chemical munitions were buried shortly after World War I when a chemical testing area adjacent to American University was shut down. The site remained untouched until 1993 when the pit was discovered while digging a sewer line to a new house under construction. Operation Safe Removal eventually recovered 144 items from the pit. Of these, most were non-chemical weapons or scrap metal. Thirty-five projectiles were determined to be liquid filled and were successfully moved to Pine Bluff Arsenal for storage. A few were sent for analysis to APG South and at least one was found to still contain potent mustard agent. After almost a full month of deploying personnel to the site, the site was cleaned up without accident or incident. After the initial discovery, additional analysis and historical research disclosed other potential sites in the area. This led to the initiation of a major remediation project led by the Corps of Engineers to ensure no further chemical munitions were in the area. Both ERDEC and the Technical Escort Unit provided extensive support to the ongoing cleanup.

*Assessing recovered chemical munitions at Spring Valley in 1993.*

### Terrorism and Counterterrorism

The use of chemical or biological weapons for terrorism became a key concern of the Army in the 1990s. In 1994, a Japanese religious cult, Aum Shinri Kyo, released nerve agent in a residential area of Matsumoto that killed seven and injured 500. A second attack on

March 20, 1995, spread sarin through a crowded Tokyo subway. This act of terrorism killed 12 and sickened more than 5,500 civilians. After the attacks, the Japanese discovered that the cult had developed a helicopter to spray toxins, a drone for unmanned attacks, and their own strains of botulism. They had also attempted to obtain the Ebola toxin from Zaire.

Chemical or biological terrorism was not limited to foreign countries. The first conviction under the Biological Weapons Anti-Terrorism Act of 1989 occurred in 1995 when a U.S. citizen was sentenced to 33 months in prison for possession of 0.7 gram of ricin. The same year, a nonprofit organization accidentally shipped bubonic plague bacteria to a white supremacist.

### Additional Reorganizations at Edgewood

In 1995, the Edgewood Chemical Activity, responsible for the chemical stockpile located at the Chemical Agent Storage Yard in the Edgewood Area, and other stockpile sites around the country were assigned to CBDCOM. At the same time, the merger of the chemical research and development mission with the chemical demilitarization program ended when CDRA was removed from CBDCOM and became the Program Manager Chemical Demilitarization, remaining in the Edgewood Area.

### Anti-Terrorism Initiative

The growing chemical and biological terrorism threat led many state and local officials to notify Congress that they did not have the training or equipment to combat a chemical or biological act of terrorism. In 1996, Congress responded by passing a new anti-terrorism training bill to prepare the United States for future chemical or biological terrorism incidents. In addition to using military experts to equip and train local response teams, the bill also provided funding for former Soviet republics to destroy their own chemical and biological weapons to keep them out of the hands of terrorists.

### New Organizations

Due to some concerns about the Army's chemical incineration program, Congress created a new organization in 1997 called the Program Manager Assembled Chemical Weapons Assessment (PM ACWA). Its mission was to examine alternative demilitarization technology for the chemical weapons stockpiles at Blue Grass Army Depot, Ky., and Pueblo Chemical Depot, Colo. Their headquarters was located in the Edgewood Area.

In 1998, CBDCOM, along with ERDEC, merged with the Soldier Systems Command, located at Natick, Mass., and became the Soldier Biological Chemical Command (SBCCOM), with the headquarters remaining in the Edgewood Area. Along with the new command, ERDEC was renamed the Edgewood Chemical Biological Center (ECBC).

The destruction of the old chemical stockpile in the Edgewood Area took its first step in 1999 when construction of the Aberdeen Chemical Agent Disposal Facility (ABCDF) started adjacent to the Chemical Agent Storage Yard.

## INDIVIDUAL PROTECTION

### FIRST U.S. MASK FOR APACHE HELICOPTER CREWS

**M43 Aircraft Mask.** In 1990, the M43 Chemical and Biological AH-64 Aircraft Mask was standardized for use in Apache helicopters. The unique aspect of the mask was its compatibility with AH-64 display sighting system. An improved version, designated the M43A1, was standardized in the 1991. The mask was designed to operate either inside the helicopter using internal power or outside using battery power.

### IMPROVED STANDARD FIELD MASK

**M40A1 Protective Masks.** Although the new M40 series was an improvement over the M17 series mask, complaints from soldiers about the M40 masks resulted in the standardization of the M40A1 Field Mask in 1993. The M40A1 Mask added the Quick Doff Hood/Second Skin (QDH/SS) that allowed doffing the hood without removing the mask. This feature resulted in faster, more efficient decontamination operations.

### IMPROVED STANDARD ARMORED VEHICLE MASK

**M42A1 Protective Mask.** The M42A1 Combat Vehicle Mask was standardized in 1993. The M42A1 Mask added the QDH/SS and a canister-interoperability system that allowed the use of NATO canisters in the system. These changes increased soldier survivability on the battlefield. In 1995, a detachable microphone that simplified production was added and designated the M42A2 mask.

### IMPROVED MASK TESTING SYSTEM

**M41 Protective Assessment Test System (PATS).** The PATS is a simple, rapid, and accurate test kit for validating the facepiece fit and function of protective masks. Due to sand and dust areas in Iraq, the PATS were included in shipments to test to make sure the masks were operating correctly. The PATS started production 1994.

### NEW MULTI-USE MASK

**M45 Chemical-Biological Mask.** The Army requirement for a better aviator's mask resulted in the M45 mask being standardized in 1996. The mask included a drink tube, microphone, close-fitting eye lenses, front and side voicemitters, and a hose assembly for both hose and face-mounted configurations. The mask provided protection without the aid of forced ventilation air while still being compatible with the sighting systems and night vision devices of rotary-wing aircraft (except the Apache AH-64 helicopter). The mask came in four sizes and was used by soldiers who could not be fitted with M40A1 or M42A2 masks.

### IMPROVED APACHE HELICOPTER CREW MASK

**M48 Apache Aviator Mask.** Within six years, the Army improved the M43 mask and standardized the new version as the M48 Chemical and Biological Aviator's Mask in 1996. The mask used a lightweight, less bulky motor blower that was mounted to the Apache armored seat panel during flight operations, had a quick disconnect mechanism for emergency egress, and could be worn by the user during dismounted operations. The blower battery also was a standard battery instead of the custom battery required by the M43 mask and had longer battery life.

### NEW GENERAL AVIATION MASK

**M49 General Aviation Mask.** Improvements to the M43A1 mask led to the standardization of the M49 General Aviation mask in 1996. The mask included a form-fitting facepiece with closely-mounted lenses, an integrally-attached hood and skull-type suspension system, electronic microphone, drinking mechanism, and a man-mounted lightweight motor blower subsystem.

## PROTECTIVE CLOTHING

### IMPROVED PROTECTIVE OUTFIT

**Joint Service Lightweight Integrated Suits (JSLIST).** The JSLIST is a lightweight protective suit that provides 24-hour protection up to 45 days and six launderings. It consists of a jacket and trousers and can be worn over the duty uniform. The JSLIST dissipates heat quickly to keep soldiers cooler. It provides protection against all known or suspected chemical or biological agents. Procurement of the suits began in 1997, and AMC shipped 94,000 during Operation Iraqi Freedom starting in 2003.

## COLLECTIVE PROTECTION

### MOBILE MEDICAL OPERATIONS SHELTER

**M8 Chemically and Biologically Protected Shelter (CBPS).** The CBPS was initially standardized in 1995 to provide a contamination-free, environmentally controlled medical work area. Developed by the U.S. Army Natick Research, Development and Engineering Center, the CBPS was tested at Edgewood using simulated chemical agents to determine its protective capabilities. The CBPS was first fielded during Operation Iraqi Freedom in 2003 and went through several improvements since then.

## DETECTION AND ALARMS

### FIRST U.S. MOBILE RECONNAISSANCE SYSTEM

**M93 Nuclear, Biological, Chemical (NBC) Reconnaissance Systems.** . In 1990, the Army issued the first XM93 series NBC Reconnaissance Systems (Fox) (NBCRS), a dedicated system of NBC detection, warning, and sampling equipment integrated into a high-speed, high-mobility armored carrier. A later version, the M93A1, was standardized in 1996. The Fox was capable of performing NBC reconnaissance on primary, secondary, or cross-country routes throughout the battlefield and had the capability to find and mark chemical and biological contamination. While conducting the reconnaissance, the crew was protected by the inclusion of an on-board overpressure system.

### EMERGENCY BIOLOGICAL DETECTION SYSTEM

**Biological Detection and Warning System (BDWS).** When the BDWS program was canceled in 1983 after the XM19 Alarm failed technical and user testing, the program would have been forgotten if it was not for Operation Desert Shield/Storm in 1990–1991. In response to an emergency requirement for a biological detector, the XM2 Sampler was retrieved from “off the shelf,” refurbished, tested, and prepared for deployment to Saudi Arabia by January 1991. To complement the XM2 Sampler, the Army added disposable Sensitive Membrane Antigen Rapid Test (SMART) Biological Agent Detector Tickets, developed for laboratory use for clinical tests. The SMART Tickets used the wet collection fluid to give a positive/negative indication of the presence of a specific biological agent within 10 to 20 minutes. Positive results were indicated by a red or pink dot. Over 80,000 SMART Tickets were rushed into production at the rate of 30,000 per month to support the XM2 Sampler. By the middle of March 1991, 11 XM2 Samplers were deployed to the frontlines with over 20,000 SMART Tickets. This combination was described as “an extremely successful and reliable” detection system. Although the XM2 Sampler filled a critical deficiency during Desert Storm, the unit was never standardized.

### NEW POINT DETECTOR

**Improved Chemical Agent Monitor (ICAM).** Starting in 1989, the Army began a program to improve the Chemical Agent Monitor (CAM) by replacing the electronics board. The ICAM was standardized in 1993 and improved startup time and added the ability to be programmed for new threat agents. The ICAM was also more reliable, reduced maintenance costs, and eliminated the need for depot repair. It could be used for a variety of missions to include area reconnaissance, monitoring decontamination levels, and medical triage operations.

### FIRST U.S. STAND-OFF CHEMICAL AGENT SENSOR

**M21 Remote Sensing Chemical Agent Alarm.** The remote sensing research started back in the 1950s finally resulted in a detector in 1995 when the M21 Remote Sensing Chemical Agent Alarm was standardized. The M21 was an automatic scanning passive infrared sensor that detected nerve and blister agent vapor clouds based on changes in the background's infrared spectra caused by the presence of agent vapor. This capability allowed the detector to "see" agent clouds out to 5 kilometers.

### FIRST U.S. STANDARD BIOLOGICAL DETECTION SYSTEM

**M31 Biological Integrated Detection System (BIDS).** After the Gulf War, General Colin Powell testified to Congress that the United States was vulnerable to biological warfare. One reason was that the United States had been unable to standardize a good biological agent detector. In 1995, the Army standardized the first biological alarm. Designated the M31 Biological Integrated Detection System (BIDS), the BIDS was a small truck packed with sampling and detection equipment. Each vehicle could provide 24-hour monitoring with identification of the agent following an alarm in about 30 minutes. An improved version, designated the M31A1, was completed in 1998. It had increased detection sensitivity and added automation.

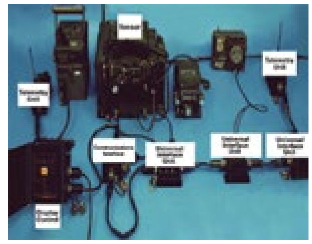
### FIRST U.S. LONG RANGE BIOLOGICAL DETECTION SYSTEM

**M94 Long Range Biological Standoff Detection System.** For long-range detection, the Army standardized the M94 Long Range Biological Standoff Detection System in 1995. The system was used on airplanes and helicopters and provided early warning, tracking, and mapping of aerosol agents.

### IMPROVED AUTOMATIC CHEMICAL AGENT ALARM

**M22 Automatic Chemical Agent Detector Alarm (ACADA).** The M22 Automatic Chemical Agent Alarm was standardized in 1997. The M22 was an advanced point-sampling chemical agent alarm system that replaced the M8A1 alarm and augmented the CAM as a survey instrument. The unit detected both nerve and blister agent vapor and was suitable for monitoring collective protective shelters.

### INTEGRATED DETECTION, WARNING AND REPORTING SYSTEM



**Multipurpose Integrated Chemical Agent Detector (MICAD).** The requirement for the MICAD was to automate the nuclear, chemical, and biological warning and reporting process throughout the battlefield. The MICAD could be used with combat, armored vehicles, and tactical van and shelter units. It was standardized in 1999.

### IMPROVED RADIOLOGICAL DETECTOR

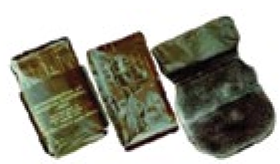
**AN/PDR-77 Radiac Set.** The AN/PDR-77, first fielded in 1994, detected and measured alpha, beta, gamma and X-ray radiation.

### IMPROVED RADIOLOGICAL DETECTOR

**AN/UDR-13 Radiac Set.** The AN/UDR-13, first fielded in 1998, was a handheld device capable of measuring gamma and neutron radiation from a nuclear event.

## DECONTAMINATION

### IMPROVED EQUIPMENT DECONTAMINATION



**M295 Individual Equipment Decontamination Kit.** The M295 kit was standardized in 1992 to enhance a Warfighter's capability to decontaminate his individual equipment in the field. The kit consisted of four wipe-down mitts used to dispense a sorbent powder on equipment. It is small enough to fit in the pocket of a protective outfit.

### FASTER EQUIPMENT DECONTAMINATION

**M22 High-Pressure/Hot Water System (HPW).** The need for quicker equipment decontamination and less water usage led to the standardization of the M22 HPW in 1998. The M22 was trailer-mounted and provided high pressure and high volume of hot or cold water and liquid detergents to remove dirt, mud, and chemical agents.

## TRAINING

### TRAINING ON RESPONDING TO A CHEMICAL OR BIOLOGICAL TERRORIST ACT

**Domestic Preparedness Training.** Under the Domestic Preparedness Program started in 1996, SBC-COM led an interagency team to provide planning, training, and exercises to over 100 cities across the United States. First responders; hospital workers; and city, state, and local officials learned how to respond to weapons of mass destruction incidents, building on the existing hazard/response capabilities.

## RIOT CONTROL

### IMPROVED RIOT CONTROL SPRAYER

**M37 Disperser.** The M37 Riot Control Disperser was a lightweight, reusable tear gas sprayer developed for peace keeping operations and law enforcement. The cylinder held the liquid tear gas CR, which was sprayed out up to about 8 meters. It was part of the Army's Non-Lethal Capability Set (NLCS) and was standardized in 1999.

## SMOKE/OBSCURATION

### NEW TRAINING SMOKE POT

**M8 Practice Screening Smoke Pot.** The need for an adequate simulation for a M4A2 Smoke Pot led to the standardization of the M8 Practice Screening Smoke Pot in 1994. The M8 was for training for crossing hazardous areas, beach landings, and other battlefield situations where smoke was required. It provided smoke for about four minutes.

### NEW SAFER SMOKE GRENADE


**M83 Smoke Grenade.** The M83 Smoke Grenade was standardized in 1994 to meet a requirement for a safe practice smoke grenade. The smoke-producing ingredients included common sugar and terephthalic acid (TA). After the standard M8 Smoke Grenade was determined to be a health hazard, the M83 became the standard tactical smoke grenade even though it produced less smoke.

### MOBILE MULTISPECTRAL SMOKE SCREENING SYSTEM

**M56 Mechanical Smoke Generator.** The Army standardized the M56 Mechanical Smoke Generator mounted on a High Mobility Multipurpose Wheeled Vehicle (HMMWV) in 1994. Nicknamed the Coyote, it was the Army's first multispectral large area smoke screening system providing both visual and infrared obscuration on the battlefield.

### MECHANIZED MULTISPECTRAL SCREENING SYSTEM

**M58 Mechanized Smoke Obscurant System.** The M58 Mechanized Smoke Obscurant System mounted on a M113A3 Armored Personnel Carrier was standardized in 1996. Nicknamed the Wolf, it was the first mechanized multispectral obscurant system.

### NEW VEHICLE SELF DEFENSE SYSTEM

**Light Vehicle Obscuration Smoke System (LVOSS).** The LVOSS was designed to provide a self-defense smoke and riot control device for light military vehicles. It consisted of the M7 grenade discharger and the installation kits for the various vehicles. The system was standardized in 1997 for use by the Army and Marines.

# CHAPTER 10 | **THE 2000s**

### 21st Century Chemical and Biological Challenges

The beginning of the 21st century saw a sudden and dramatic increase in the interest in chemical and biological warfare. Originally feared but not experienced on the battlefield, the events of 2001 and the first significant use of an antipersonnel biological agent as a terrorist weapon in the United States put the front lines of bioterrorism in U.S. Post Offices, government buildings, hospitals, media headquarters, and even civilians neighborhoods. Homeland Defense suddenly ceased being a training exercise for a “what if?” scenario and became a theater of operation in the new war against terror. All of the chemical and biological defense organizations at APG South took on new and increased responsibilities for national defense.

### Continuing Troubles with Iraq

Dissatisfaction with Iraq’s compliance with the U.N. mandates that concluded the Persian Gulf War led to repeated bombings in Iraq throughout 2000 and 2001. Of particular concern to the United States was Iraq’s failure to report all its chemical and biological warfare research and productions. The withdrawal of U.N. monitors from Iraq led to reports that Iraq was reinitiating its biological and chemical programs.

### Reorganizations

The growing concern for the United States’ CB defense program led to the creation of a new organization. First, in 2000, PM Smoke/Obscuration became part of the PM NBC Defense, located in the Edgewood Area. Then, one year later, PM NBC Defense and the Joint Program Office for Biological Defense (JPO-BD), located in Falls Church, Va., merged to become the new Program Executive Office for CB Defense (PEO-CBD). In 2003, PEO-CBD was renamed the Joint Program Executive Office for Chemical Biological Defense (JPEO-CBD). The new organization added additional Joint Project Managers to become the single focal point for research, development, acquisition, fielding, and life-cycle support of CB defense equipment and medical countermeasures.

### Operation Enduring Freedom

The War on Terror started on Sept. 11, 2001, when four commercial planes were hijacked and two crashed into the World Trade Center buildings, one into the Pentagon, and one short of its Washington, D.C., target. Over 3,000 people died in the destruction. The loss of a significant portion of the first responders to the World Trade Center buildings added to the disaster. Almost immediately, attention focused on Osama bin Laden and his Al Qaeda organization as the responsible party. Operating out of Afghanistan, the United States began planning a military counterstrike to destroy the terrorist organization.

In October, the United States struck back with massive air attacks against Afghanistan. Special Forces troops entered the war to assist the Northern Alliance in their attack against the Taliban. In November, Osama bin Laden notified the world that he had chemical and nuclear weapons but would only use them if the United States used them first against him. A few days later, the Northern Alliance captured Kabul.

*Interior of the ECBC Biosafety Level 3 Laboratory.*

### The Anthrax Attack

Before the United States started its counterattack against Al Qaeda and Afghanistan, a covert biological attack occurred against the United States. Someone began mailing letters containing deadly anthrax spores to government buildings and the media. The letters sent shock waves throughout the East Coast postal system. Four individuals died of inhalation anthrax and others suffered through cutaneous anthrax. Government buildings had to close for decontamination. Initially blame focused on terrorists, but in November, the FBI profiled another possible source, a troubled U.S. citizen or even a scientist within the bioweapons defense program.

Only after years of investigation did the FBI finally focus on Bruce E. Ivins, a Fort Detrick scientist, as the primary suspect. Ivins committed suicide in 2008 before he was charged or arrested.

The confirmation of the first anthrax death sent shock waves throughout the United States. The need for countermeasures resulted in antibiotics being disseminated to a record number of individuals. Private companies began developing antiterrorism equipment to include a new anthrax test for more rapid analysis.

Just before the anthrax attack, ECBC completed a Biosafety Level 3 Laboratory designed to handle such toxins. This laboratory proved especially important to conducting analysis of recovered suspected items from around the country.

*Using a specially designed tool, a nerve agent bomblet is moved to the Explosive Destruction System for demilitarization.*

### Chemical Demilitarization Technologies

While the War on Terror continued, the mission to eliminate the U.S. chemical weapons stockpile and destroy recovered chemical weapons during environmental remediation continued. Some of the new technologies for chemical demilitarization included the use of the Explosive Destruction System (EDS), successfully used at Rocky Mountain Arsenal, Colo., in 2001 to destroy nerve agent bomblets without incident. The EDS had a double containment design to prevent escape of agent. Instead of having to blow up everything and risk spreading contamination, the EDS and other new technologies could handle even large numbers of chemical weapons.

### Mission and Name Changes

In 2002, Program Manager Assembled Chemical Weapons Assessment (PM ACWA) was assigned the responsibility to destroy the chemical stockpiles at Pueblo, Colo., and Lexington, Ky. Both sites would use neutralization instead of incineration. To better reflect this mission, PM ACWA changed its name to Assembled Chemical Weapons Alternatives in 2003. Four years later it also became a separate reporting activity.

The growing need for a special chemical and biological response organization led to the creation of the Guardian Brigade in 2003. The new command consisted of the Technical Escort Unit, the Chemical/Biological Rapid Response Team, and other elements.

### Operation Iraqi Freedom

Following the military action in Afghanistan, in 2003, President George W. Bush ordered operations against Iraq to eliminate its chemical and biological weapons program. U.S. and allied troops entered Iraq and overthrew Saddam Hussein. Hussein was later captured by U.S. forces and executed by the new Iraqi government. After extensive searches of Iraq, no major chemical or biological weapons stockpiles were found.

The initial military success of removing the Hussein government, however, led to a significant counterinsurgency by opposition forces. These attacks, often in the form of improvised explosive devices (IEDs), took a significant toll on the U.S. and allied forces, as well as the Iraqi people. At least one of these attacks included the use of chlorine as a chemical weapon.

APG South provided extensive support to the ongoing conflict. Major General John Doesburg, Commanding General of the U.S. Army Soldier and Biological Chemical Command, described the importance of the role of ECBC, a subordinate organization: "[E]verything we do here is of extreme importance to the soldiers, sailors, airmen and marines on the ground in Iraq. Here at ECBC, we are helping to protect these young men and women, and aid them in detecting toxic CB agents." He also added:

> *What we do for the Warfighter is almost immeasurable. Who would have thought the United States would be involved in a war where the potential use of weapons of mass destruction would be a reality? I am reassured knowing our soldiers-sailors, airman, and marines have the best equipment in the world. There is no better protective mask or detector than what our soldiers have and all of that came from Edgewood. You should take great pride in the simple fact that many of our Warfighter's capabilities are possible due to the hard work performed over the years right here.*

In addition to providing the best defensive equipment, ECBC also provided specialized training for those units facing deployment.

Iraqi's reported biological weapons program also led to concern about medical defensive measures. Due to the threat of anthrax, smallpox, and botulinum toxin, deploying soldiers were first inoculated against those threat agents.

When suspected chemical items were found in Iraq, they were sent to ECBC's Forensic Analytical Center in APG South. The Technical Escort Unit took custody of the recovered items and physically moved them to APG. The items followed a strict chain-of-custody from Iraq to Maryland to preserve legal control.

Major General Doesburg summed up the capabilities of APG South's chemical defense capabilities: "Edgewood is the center of excellence within the United States for dealing with weapons of mass destruction. There is no corollary to us outside the Department of Defense, no ECBC equivalent on the West coast, or the Midwest. Hence, in these uncertain times we will be called upon both in a direct and indirect fashion to assist with homeland defense." However, he also qualified that mission:

> *Our primary mission is to support the Warfighter and as a consequence our involvement in homeland defense will be*

*a push/pull situation where we balance responsibility to our nation and our soldiers. We take great pride in serving as a leading agency in homeland security, however, it is not possible to consistently carry out this initiative due to our commitment to our men and women in uniform. Still, because there is no greater center of expertise, we indirectly will be involved in homeland security. It took roughly 80 years to build our capabilities in CB defense and that's not easy to duplicate in 12 months or even 10 years.*

### Chemical Stockpile Destruction

Ongoing plans to destroy the chemical stockpile at Edgewood changed following the start of the War on Terror. The original plans called for the construction of a plant adjacent to the Chemical Agent Storage Yard (CASY) that would eliminate the ton containers of mustard agent onsite.

*The last one-ton container of mustard agent at the Chemical Agent Storage Yard is prepared for demilitarization.*

Following the attacks on Sept. 11, 2001, there was significant concern that terrorists could reach CASY from the Bush River. Troops were assigned to guard CASY, but the Army changed the plans and initiated a new process called Operation Speedy Neut. Instead of conducting all the operations onsite, the plant was reduced in size, and only the major processes were conducted at Edgewood. Once the mustard agent was neutralized, the remaining waste was shipped to New Jersey for completed destruction.
The new process started on April 23, 2003, and finished on March 11, 2005. This ended Edgewood's role as a chemical stockpile and was the first stock- pile to complete destruction in the continental United States.

### More Reorganization

The Guardian Brigade lasted only one year before it was replaced by a new, much larger organization. Combining the Technical Escort Unit mission with the explosive ordnance disposal (EOD) mission resulted in the creation of the 20th Support Command, established as a major subordinate command under the U.S. Army Forces Command. As the same time, the Technical Escort Unit became the 22nd Chemical Battalion and was a major element of the new command along with the 52nd Ordnance Group (EOD). A second Ordnance Group was added in 2005. In 2007, a new subordinate organization called the CBRNE Analytical and Remediation Activity (CARA) was activated using civilian personnel from the 22nd Chemical Battalion. The same year, the 48th Chemical Brigade was activated at Fort Hood, Texas, and assigned five Chemical Battalions, including the 22nd Chemical Battalion (Technical Escort), which remained located at APG South.

## INDIVIDUAL PROTECTION

### NEW STANDARD PROTECTIVE MASK

**M50 Joint Service General Purpose Mask (JSGPM) (Field).** The JSGPM is a revolutionary advancement in protective mask technology providing increased performance, reduced breathing resistance, and significant enhanced protection against chemical, biological, radiological, nuclear and toxic industrial materials. The mask is lighter weight, has a smaller profile, greater comfort, and a better field of view compared to existing masks. The mask's filters are also unique in that they have end-of-service life indicators and can be safely removed and replaced in toxic environments. The M50, standardized in 2007, will replace the M40 and MCU-2/P series masks.

### NEW STANDARD COMBAT VEHICLE CREW MASK

**M51 Joint Service General Purpose Mask (JSGPM)(Combat Vehicle).** The M51 version of the JSGPM is similar to the M50 but for combat vehicle crew members. In addition to all the M50 capabilities, it has a removable hose assembly. The microphone system is also compatible with the vehicle's communication system. The M51, standardized in 2007, will replace the M42 series masks.

### NEW EMERGENCY ESCAPE MASK

**M52 Joint Service Chemical Environment Survivability Mask (JSCESM).** The M52 JSCESM filled a need for a lightweight, single-use emergency mask for use in low-NBC threat scenarios and in military medical care situations where the use of the standard issued protective mask was not practical. The JSCESM is a one-size-fits-all mask without any spare or repair parts, minimizing the logistic burden of the system. The mask components were optimized to minimize weight and bulk while maximizing wearer performance and the ability to interface with other protective equipment, communications systems, and optical display and sighting systems. The JSCESM is a modified nondevelopmental item approved for production in 2007.

### NEW SPECIAL OPERATIONS MASK

**M53 Chemical Biological Protective Mask.** The M53 is a lightweight, positive pressure-capable protective mask with state-of-the-art technology improvements for use in direct action missions. It provides improved protection capability, better field of view, improved shooter capability, and a more comfortable fit for longer duration wear. The M53 mask requirements were developed by the U.S. Special Operations Command (SOCOM) in 2001 and approved in January 2002. The mask was approved for production in 2005.

### NEW AIRCREW MASK

**Joint Service Aircrew Mask (JSAM).** The JSAM Family of Systems was designed to replace six existing masks. Each mask provides continuous chemical and biological protection in both fixed- and rotary-wing aircraft and is compatible with life-support equipment. The MPU-5 is for all general rotary wing aircrew members. The MPU-6 (see picture) is specifically for Apache helicopter crews and their Integrated Helmet and Display Sighting System. Additional types are for fixed-wing aircrews and the Joint Strike Fighter.

### NEW PROTECTIVE MASK TESTER

**M46 Joint Service Mask Leakage Tester (JSMLT).** The M46 JSMLT is a portable device that is used to determine the serviceability, proper fit, and current status of protective masks. The tester provides an audible and visual response for masks that are defective or have improper fit. The M46 was approved for full rate production in 2005.

## DETECTION AND ALARMS

### NEW BIOLOGICAL DETECTION SYSTEM

**Joint Biological Point Detection System (JBPDS).** The JBPDS is an automated point biological detection system for all four services. The JBPDS has a detection suite that includes a detector, collector, fluid control system, and an identifier. It can be configured for vehicles or ships and decreases the detection and identification time, increases detection sensitivity, and provides automated detection capabilities.

### DISGUISED BIOLOGICAL AGENT DETECTORS

**Homeland Defense Trailers.** The need to protect the National Capital Region from a possible biological attack resulted in the design of civilian looking trailers that held the Joint Biological Point Detection System (JBPDS) and a M22 Automatic Chemical Agent Detector Alarm (ACADA). The first units were deployed within two months of the terrorist attack on the Pentagon in September 2001.

### FIRST HAND-HELD BIOLOGICAL AGENT ASSAY

**Hand-Held Immunochromatographic Assay (HHA).** The hand-held assay is an inexpensive, easy-to-use antibody-based test to identify biological warfare agents from samples. Each assay can only be used once but can identify 10 different threat agents and four simulant agents within 15 minutes. During the 2001 anthrax through-the-mail incidents, the assay was used to detect anthrax in the Hart Office Building.

### STAND-ALONE COLLECTOR OF AIR SAMPLES

**Dry Filter Unit (DFU) 1000.** The Dry Filter Unit was a contractor off-the-shelf nondevelopmental collector unit for air samples quickly assembled shortly after Sept. 11, 2001. Units were fielded in support of Operation Iraqi Freedom in 2003.

### AUTOMATED BIOLOGICAL AGENT TESTING SYSTEM

**Stations of Robotic Monitoring (STORM)** System. Shortly after Sept. 11, 2001, ECBC and the PEO for Chemical and Biological Defense jointly developed the Automated Biological Agent Testing System (ABATS) and had it in operation less than a year later. It was ideal for testing environmental samples from biocontaminants in the air, food, soil, and items like mail. In 2003, it was renamed the STORM and placed on a trailer for field use.

### IMPROVED INSTALLATION BIOLOGICAL DETECTOR

**Joint Portal Shield.** The Portal Shield was a semi-automatic biological detector first deployed in 2002. It was primarily used at ports, airfields, and bases. It consisted of a variable number of biological sensors monitored by a central computer. Each sensor could detect and identify up to eight biological agents in less than 25 minutes. The Portal Shield could also be attached to M21 and M22 detector units to provide chemical agent detection.

### NEW DETECTION TECHNOLOGY

**Patent for Biological Agent Detection.** In 2003, ECBC researchers developed a method of detecting lesion-induced resonances in DNA via wave spectroscopy. This was a significant advance in biological warfare detection for the Warfighter.

### IMPROVED CHEMICAL AGENT DETECTION SYSTEM

**24/7 Automatic Chemical Agent Alarm.** In 2004, additional improvements were made to the M22 ACADA that increased its life expectancy and decreased maintenance, allowing for a 24/7 version that could run continuously. Improvements also included the ability to detect and identify toxic industrial chemicals.

### IMPROVED BIOLOGICAL AGENT SAMPLING PROCESS

**Biological Sampling Kit (BiSKit).** The need for a simple and quick biological agent sampling capability for first responders during the anthrax attack in 2001 led to the development of the BiSKit in 2005. This kit safely handled the sampling and transport of possible biological agents for further laboratory analysis.

### FIRST JOINT SERVICE CHEMICAL AGENT DETECTOR

**M4 Joint Chemical Agent Detector (JCAD).** The JCAD was a pocket-size automatic and point chemical agent detector capable of detecting nerve, blister, blood agents, and toxic industrial chemicals. It could be configured for multiple applications, include aircraft, shipboard, and individual soldier field use. Initial production started in 2007.

### THE ARMY'S NEXT GENERATOR STANDOFF CHEMICAL AGENT SENSOR

**Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD).** The JSLSCAD was developed to provide U.S. Forces with an enhanced early warning system to prepare Warfighters for a chemical attack. The system is fully automatic and scans the surrounding atmosphere for chemical agent vapor. It started production in 2008.

### FIRST LOW COST EFFECTIVE BIOLOGICAL DETECTION SYSTEM

**TacBio.** In conjunction with the Defense Advanced Research Projects Agency (DARPA), ECBC collaborated on a low-cost but effective biological agent detection system in 2009. A second version, TacBio Generation II (see picture) reduced the cost, saved production time, and used a more energy-efficient power source.

### NEW IMPROVED RECONNAISSANCE VEHICLE

**Stryker NBC Reconnaissance Vehicle (NBCRV).** The NBCRV incorporated CBR detection equipment into the armored Stryker vehicle to locate, identify, mark, sample, and report NBC contamination on the battlefield. This included both stand-off and point detection capabilities operated from within the protected environment of the vehicle or while dismounted. In addition, the detection capabilities were available on-the-move. The NBCRV also included a remotely controlled 0.50-caliber machine gun. Fielding of the NBCRV started in 2006.

### NEW WATER TESTING KIT

**Joint Chemical, Biological, Radiological Agent Water Monitor (JCBRAWM).** The JCBRAWM provides the ability to detect, identify, and quantify biological and radiological (chemical in the future) contamination in water. It supplements the earlier M272 Water Testing Kit. The JCBRAWM was approved for production and fielding in 2008.

### NEW NBC RECONNAISSANCE CAPABILITY

**CBRN Unmanned Ground Reconnaissance (CUGR).** The CUGR is new technology to provide improved speed and capability of manned NBC reconnaissance vehicles and to improve NBC reconnaissance by unmanned vehicles to detect all types of chemical, biological, radiological, and nuclear contamination without requiring crew members to enter potentially contaminated areas or face hostile enemy fire. The detection capability includes the next-generation sensor technology for real-time sampling and identification of not only chemical warfare agents but also toxic industrial chemicals, toxic industrial material, and nontraditional agents.

## DECONTAMINATION

### ENVIRONMENTALLY SAFE DECONTAMINANT

**Decon Green.** Decon Green was developed and patented by ECBC in 2001 as a simple solution composed of common high-volume commercial chemicals that provided broad-spectrum decontamination of chemical and biological agents.

### NONTOXIC AND QUICKER DECONTAMINATION

**M100 Sorbent Decontamination System (SDS).** The M100 SDS was standardized in 2002 and replaced the M11 and M13 Decontaminating Apparatus that used DS2, a decontaminant that was no longer acceptable due to toxicity issues. The SDS used sorbent powder and two wash-mitt applicators that eliminated the need for water and decreased the time for chemical decontamination.

## ENVIRONMENTALLY SAFE DECONTAMINANT


**Defenz.** ECBC developed and patented the advance catalytic enzymatic system in 2004, which was produced by private industry as Defenz. The enzyme-based decontaminant was environmentally safe and provided effective chemical and biological agent decontamination.

## COMMERCIALLY AVAILABLE SKIN DECONTAMINANT

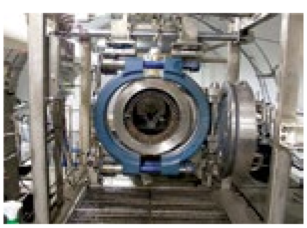
**Joint Service Personnel/Skin Decontamination System (JSPDS).** A Canadian company developed Reactive Skin Decontamination Lotion (RSDL), which was used in the JSPDS after approval by the Food and Drug Administration. The JSPDS consisted of RSDL-impregnated sponge pads stored in an easy-access wrapper. Fielding of the JSPDS started in 2008.

## NEW DECONTAMINATION SYSTEM


**M26 Joint Service Transportable Decontamination System-Small Scale.** The M26 Decontamination System was developed to replace older equipment and provide the Warfighter with a system to decontaminate current and emerging threats. The M26 consisted of an applicator and a 3,000-gallon decontaminant storage capacity. The JPEO CB Defense started fielding the M26 in 2009.

# DEMILITARIZATION

## NEW PORTABLE DECONTAMINATION CAPABILITY



**Explosive Destruction System (EDS)**. This was a joint development between CMA and Sandia National Laboratories to provide an onsite demilitarization capability for recovered chemical munitions. The EDS both destroyed the munition and neutralized any chemical agent. The first operational use of the EDS was at Rocky Mountain Arsenal in 2001.

# TRAINING

## TRAINING ON RESPONDING TO A CHEMICAL/BIOLOGICAL TERRORIST ACT

**Domestic Preparedness Training.** After the 2001 terrorist attacks, a training course was offered in conjunction with the Office of Personnel Management and the Federal Emergency Management Administration. This course focused on training executive and management-level leaders on all aspects of responding to a chemical or biological attack.

## TRAINING BEFORE DEPLOYMENT TO IRAQ

**Military Training for Chemical/Biological Warfare.** In 2003, ECBC provided training to the Technical Escort Unit personnel and other military and federal units designated for deployment to Iraq to help assist in their weapons of mass destruction response and recovery operations.

## TRAINING THE WARFIGHTER

**Buffalo Surrogate Vehicles Training.** In 2006, ECBC was asked to design and build a training surrogate for the Buffalo Mine Protective Clearance Vehicle used in Iraq. One month later, ECBC delivered the first surrogate vehicle to the National Training Center in California. The surrogate was designed to resemble the Buffalo inside and outside, but did not have the heavy armor.

# ENERGY GENERATION

## WASTE TO ELECTRICITY ON THE BATTLEFIELD

**Tactical Garbage to Energy Refinery (TGER) System**. The TGER System was designed to convert waste products like paper, plastic, packaging, and food waste to electricity by using a trailer-mounted biorefinery that uses fermentation and gasification subsystems to complete the process. The TGER system answered several needs of deployed military units including waste disposal, energy requirements, and an environmentally safe process. The first version, TGER 1.0, was deployed to Iraq in 2008, and then an improved version, TGER 2.0, was developed from the lessons learned from using the first unit.

# CHAPTER 11 | THE 2010s TO THE FUTURE

*Major General Nick Justice (right) at the APG BRAC Completion Ceremony on Sept. 15, 2011.*

### Base Realignment and Closure

The 2005 Base Realignment and Closure (BRAC) plan called for both additions and subtractions for APG. For APG South, there were few subtractions and one major addition. In 2010, the Joint Program Executive Office for Chemical and Biological Defense moved to APG to join sub-elements already there. The Chemical Biological Directorate of the Defense Threat Reduction Agency (DTRA) also moved to APG South. The 2005 BRAC changes officially ended on Sept. 15, 2011. Major General Nick Justice, the Senior Mission Commander at APG, described the significance of the changes at the closing ceremony: “The APG legacy of world-class support to the Warfighter continues as the transformation ensures APG will be relevant for decades to come.”

### Renamings

In 2012, ACWA underwent another name change. It was redesignated the Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA) to raise the program’s visibility within the Defense Department. Its mission remained the same: the safe and environmentally sound destruction of the chemical weapons stockpiles stored at the Blue Grass Army Depot, Ky., and the Pueblo Chemical Depot, Colo.

To better reflect the mission of the 20th Support Command, the name was changed to the 20th Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE) Command in 2013. The mission, however, remained the same: to integrate, coordinate, deploy, and provide trained and ready CBRNE forces.

### Syrian Chemical Weapons

Syria dissolved into a civil war in 2011 between loyalists under President Bashar al-Assad and opposition forces following various factions. Casualty rates for both civilians and fighters were extremely high, with over 100,000 killed. In 2013, the loyalist forces apparently resorted to using some of Syria’s extensive chemical weapons stockpile to attack rebel-held areas in Ghouta, a suburb of Damascus. On Aug. 21, over 1,400 men, women, and children became casualties of a sarin nerve agent attack.

Following the reported use of chemical weapons by the Syrian government, the United States threatened to retaliate with military strikes to discourage further use of chemical weapons. To avoid the attacks, Syria agreed to dispose of about 1,300 tons of chemical weapons. The Organization for the Prohibition of Chemical Weapons (OPCW) arranged to have the Syrian chemical weapons stockpile removed from Syria and safely destroyed at sea.

To accomplish the destruction mission, a joint effort with ECBC, JPEO-CBD, and CMA put two Field Deployable Hydrolysis Systems on the MV Cape Ray and deployed the ship to Europe to destroy the various types of chemical weapons in the Syrian stockpile. Actual operations started in July 2014 to destroy about 600 tons of chemical warfare material.

*The MV Cape Ray was used for the destruction of the Syrian chemical weapons stockpile in 2014.*

## PROTECTION

### ROBOTICS TO PROTECT VEHICLE CREWS

**Talon Hermit Robot Deployment System (RDS)**. This design, in 2010, allowed the crew of a Buffalo Route Clearance Vehicle to deploy an Unmanned Ground Vehicle without exposing the crew to hostile fire or other dangers.

### PROTECTING THE WARFIGHTER

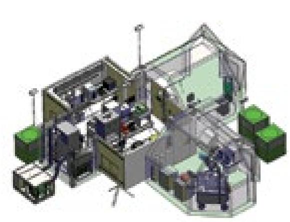
**Buffalo Mine Protective Clearance Vehicle (MPCV) Improved Spork.** To meet the needs of the Warfighter in the MPCV, ECBC designed an improved spork, the appendage used to grip and rotate discovered items. The new version allowed Warfighters to better examine a suspicious item from the safety of their vehicle. Delivery of the kits to the Marine Corps started in 2010.

## DETECTION AND ALARMS

### FIRST UNMANNED AERIAL CHEMICAL/BIOLOGICAL TRACKING SYSTEM

**Weapons of Mass Destruction Aerial Collection System (WACS).** In 2010, through a multiagency collaboration, the WACS was developed to provide unmanned aerial surveillance capability for tracking chemical, biological, and radiological plumes.

### FIRST CERTIFIED MOBILE CHEMICAL AND BIOLOGICAL FORENSICS LABORATORY



**Heavy Mobile Expeditionary Laboratory (HMEL).** In 2010, ECBC rapidly developed the first certified mobile chemical and biological agent laboratory for integrated mobile forensics. The HMEL was developed for the 20th CBRNE Command.

### QUICK RELEASE HOLSTER FOR CHEMICAL DETECTORS

**CBRN Sensor Interface Cradle.** In 2010, ECBC designed a standardized quick release holster for use of hand-held chemical detectors on vehicles.

### ENHANCED JOINT CHEMICAL AGENT DETECTOR

**M4A1 Joint Chemical Agent Detector.** A significantly improved and redesigned version of the JCAD was finalized in 2011. The M4A1 version added a state-of-the-art LED screen and better expanded detection capabilities and remained light-weight and easy to use.

### SMALL, EASY TO USE, LIGHTWEIGHT EXPLOSIVE SCREENING

**Chemical Reconnaissance Explosives Screening Set (CRESS).** The CRESS was developed to allow a Warfighter in the field to conduct a quick and simple test for homemade explosive materials. The simple design required no power source and provided a response in less than two minutes.

### SMALL, LIGHTWEIGHT, DETECTION SUITE

**Global Strike Near Real Time Battle Data Assessment (NRT-BDA) System.** The NRT-BDA was a joint development project in 2013 to provide Warfighters a complete picture of chemical threats during reconnaissance operations. The system included a small air-droppable chemical detector the size of a soda can that provided real-time information to a satellite and then to the Warfighter.

## DEMILITARIZATION

### SAFE DESTRUCTION OF OLD CHEMICAL MUNITIONS

**Pine Bluff Explosive Destruction System (PBEDS).** ECBC personnel operated the Pine Bluff Explosive Destruction System (PBEDS) under the CMA's Non-Stockpile Chemical Materiel Project that completed elimination of old recovered chemical weapons held at Pine Bluff Arsenal. The four-year project finished in 2010 with the safe destruction of over 1,200 old munitions.

### NEW DEMILITARIZATION TECHNOLOGY

**Field Deployable Hydrolysis System (FDHS).** The FDHS was a portable system designed to neutralize chemical warfare materiel in a contained process. Design and construction of the system was completed in 2013. This was a joint development process with personnel from the ECBC, JPEO-CBD, and CMA, with funding provided by the Defense Threat Reduction Agency (DTRA). The FDHS could be set up within 10 days. The FDHS was first used on the MV Cape Ray to destroy the Syrian chemical weapons stockpile

## TRAINING

### MOBILE TRAINING APPLICATIONS FOR THE WAR- FIGHTER

**Husky Mounted Detection System Surrogate (HMDSS).** The HMDSS allowed Warfighters to practice operating a Husky mounted mine and Improvised Explosive Device (IED) detection system from a mobile device (like a smart phone) without having to use an actual vehicle or be at a specific training site. In 2012, the HMDSS was provided to the Joint Improvised Explosives Device Defeat Organization (JIEDDO) as a training device.

## CONTINUING MISSION

The many reorganizations and name changes since 1917 did not change the primary mission of the various organizations located in APG South: to provide the best chemical and biological defense equipment, supplies, and procedures. The primary organizations, ECBC, CMA, PEO ACWA, MRICD, JPEO-CBD, and 20th CBRNE Command, all continue that mission today.

# ACRONYMS

## A

**ABATS** | Automated Biological Agent Testing System
**ABCDF** | Aberdeen Chemical Agent Disposal Facility
**AC** | Hydrogen Cyanide Agent
**ACADA** | Automatic Chemical Agent Detector Alarm
**ACC** | Army Chemical Center
**AEF** | American Expeditionary Forces
**APG** | Aberdeen Proving Ground
**AMC** | Army Materiel Command
**AMCCOM** | Armament, Munitions and Chemical Command
**AT** | Akron Tissot Mask
**AUES** | American University Experiment Station

## B

**BAL** | British Anti-Lewisite Protective Ointment
**BDWS** | Biological Detection and Warning System
**BIDS** | Biological Integrated Detection System
**BISKIT** | Biological Sampling Kit
**BRAC** | Base Realignment and Closure
**BZ** | Incapacitating Agent

## C

**CAM** | Chemical Agent Monitor
CAMDS | Chemical Agent Munitions Disposal System
**CARA** | CBRNE Analytical and Remediation Activity
**CASY** | Chemical Agent Storage Yard
**CB** | Chemical Biological
**CBDA** | Chemical and Biological Defense Agency
**CBDCOM** | Chemical and Biological Defense Command
**CBPS** | Chemically and Biologically Protected Shelter
**CBR** | Chemical Biological Radiological
**CBRN** | Chemical Biological Radiological Nuclear
**CBRNE** | Chemical Biological Radiological Nuclear Explosives
**CBRRT** | Chemical Biological Rapid Response Team
**CDRA** | Chemical Demilitarization and Remediation Activity
**CE** | Corrected English Mask
**CG** | Phosgene Agent
**CHASE** | Cut Holes and Sink 'Em (Demilitarization Operation)
**CK** | Cyanogen Chloride Agent
**CMA** | Chemical Materials Agency or Chemical Materials Activity
**CN** | Chloroacetophenone Riot Control Agent
**CR** | Riot Control Agent
**CRDC** | Chemical Research and Development Center
**CRDEC** | Chemical Research, Development and Engineering Center
**CRESS** | Chemical Reconnaissance Explosive Screening Set
**C&RL** | Chemical and Radiological Laboratories
**CRDL** | Chemical Research and Development Laboratories
**CS** | Riot Control Agent
**CSL** | Chemical Systems Laboratory
**CSX** | Riot Control Agent
**CUGR** | CBRN Unmanned Ground Reconnaissance
**CWL** | Chemical Warfare Laboratories
**CWS** | Chemical Warfare Service

## D

**DANC** | Decontaminating Agent Noncorrosive
**DARPA** | Defense Advanced Research Projects Agency
**DDEL** | Defense Development and Engineering Laboratories
**DFU** | Dry Filter Unit
**DKIE** | Decontamination Kit, Individual, Equipment
**DM** | Adamsite Riot Control Agent
**DOP** | Dioctylphthalate (Simulant Agent)
**DPG** | Dugway Proving Ground
**DS2** | Decontaminating Solution 2
**DTRA** | Defense Threat Reduction Agency

## E

**ECBC** | Edgewood Chemical Biological Center
**EDS** | Explosive Destruction System
**EOD** | Explosive Ordnance Disposal
**ERDEC** | Edgewood Research, Development, and Engineering Center

## F

**FDHS** | Field Deployable Hydrolysis System

**FM** | Titanium Tetrachloride Smoke Mixture

**FS** | Sulfur Trioxide Solution Smoke Mixture

## G

**GA** | German Nerve Agent A or Tabun Non-Persistent Nerve Agent

**GB** | German Nerve Agent B or Sarin Non-Persistent Nerve Agent

**GPFU** | Gas-Particulate Filter Unit

## H

**HC** | Hexachloroethane Smoke Mixture

**HD** | Distilled Mustard Agent

**HHA** | Hand-Held Immunochromatographic Assay

**HMDSS** | Husky Mounted Detection System Surrogate

**HMEL** | Heavy Mobile Expeditionary Laboratory HMMWV High Mobility Multipurpose Wheeled Vehicle

**HN** | Nitrogen Mustard Agent

**HPW** | High-Pressure/Hot Water System

**HS** | Mustard Agent

## I

**ICAM** | Improved Chemical Agent Monitor

**IED** | Improved Explosive Device

## J

**JBPDS** | Joint Biological Point Detection System

**JCAD** | Joint Chemical Agent Detector

**JCBRAWM** | Joint Chemical, Biological, Radiological Agent Water Monitor

**JIEDDO** | Joint Improvised Explosives Device Defeat Organization

**JPEO-CBD** | Joint Program Executive Office for Chemical Biological Defense

**JPO-BD** | Joint Program Office for Biological Defense

**JSAM** | Joint Service Aircrew Mask

**JSCESM** | Joint Service Chemical Environment Survivability Mask

**JSGPM** | Joint Service General Purpose Mask

**JSLIST** | Joint Service Lightweight Integrated Suit

**JSLSCAD** | Joint Service Lightweight Standoff Chemical Agent Detector

**JSMLT** | Joint Service Mask Leakage Tester

**JSPDS** | Joint Service Personnel/Skin Decontamination System

## K

**K-Agent** | Psychochemical Agent

**KT** | Kops Tissot Mask

**KTM** | Kops Tissot Monro Mask

## L

**LSD** | Lysergic Acid

**LVOSS** | Light Vehicle Obscuration Smoke System

## M

**MCPE** | Modular Collective Protection Equipment

**MICAD** | Multipurpose Integrated Chemical Agent Detector

**MLRS** | Multi Launch Rocket System

**MOU** | Memorandum of Understanding

**MPCV** | Mine Protective Clearance Vehicle

**MRICD** | Medical Research Institute of Chemical Defense

## N

**NAPALM** | Naphthenic and Palmitic Acids Incendiary Mixture

**NATO** | North Atlantic Treaty Organization

**NBC** | Nuclear Biological Chemical

**NBCRS** | Nuclear Biological Chemical Reconnaissance System

**NBCRV** | Nuclear Biological Chemical Reconnaissance Vehicle

**NC** | Stannic Chloride and Chloropicrin Mixture

**NLCS** | Non-Lethal Capability Set

**NRC** | National Research Council

**NRT-BDA** | Near Real Time Battle Data Assessment

## O

**OCPW** | Organization for the Prohibition of Chemical Weapons

**OSS** | Office of Strategic Services

## P

**PATS** | Protective Assessment Test System

**PBA** | Pine Bluff Arsenal

**PBEDS** | Pine Bluff Explosive Destruction System

**PEO** | Program Executive Officer

**PEO ACWA** | Program Executive Office Assembled Chemical Weapons Alternatives

**PEO-CBD** | Program Executive Office for Chemical Biological Defense

**PM** | Program or Product Manager

**PM ACWA** | Program Manager Assembled Chemical Weapons Assessment

**PWP** | Plasticized White Phosphorus Smoke and Incendiary

## R

**RDECOM** | Research, Development and Engineering Command

**RDS** | Robot Deployment System

**RFK** | Richardson, Flory, and Kops Mask

**RMA** | Rocky Mountain Arsenal

## S

**SBCCOM** | Soldier Biological Chemical Command

**SBR** | Small Box Respirator Mask

**SDS** | Sorbent Decontamination System

**SGF-2** | Smoke Generator Fuel No. 2

**SMART** | Sensitive Membrane Antigen Rapid Test

**SOCOM** | Special Operations Command

**SPAL** | Simulator, Projectile, Airburst, Liquid

**STB** | Supertropical Bleach Decontaminating Agent

**STORM** | Stations of Robotic Monitoring System

## T

**TA** | Terephthalic Acid Smoke Mixture

**TGER** | Tactical Garbage to Energy Refinery System

**TGY** | Toxic Gas Yard

**THAMA** | Toxic and Hazardous Materials Agency

## V

**VX** | Persistent Nerve Agent

## W

**WACS** | Weapons of Mass Destruction Aerial Collection System

**WDEL** | Weapons Development and Engineering Laboratories

**WMD** | Weapons of Mass Destruction

**WP** | White Phosphorus Smoke and Incendiary

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100 YEARS

EDGEWOOD CHEMICAL BIOLOGICAL CENTER
A U.S. Army RDECOM Laboratory

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