

# WEAPONRY

## Fritz Haber said of his chemical agents, especially mustard gas, 'It is a higher form of killing.'

By Clyde Ward

**THERE IS NO GOOD WAY TO KILL**, but poison gas seems more alchemy than combat. In the fall of 1916, however, it seemed to the German high command that only a sorcerer could save its fortunes on the Western Front. Its armies' advances, though apparently stalled, still held the nation's faith. The strictly censored truth, however, was that after two years of blockade and attrition, Germany's manpower and materiel were nearly exhausted. When American troops began to arrive in the spring of 1917, only a miracle could stop them. The generals demanded that miracle from Fritz Haber, head of the Kaiser Wilhelm Research Institute.

Haber's ammonia synthesis had replaced imported munitions nitrate, denied by the British blockade in 1914, with condensed atmospheric nitrogen. The process he developed to make it would bring him a Nobel Prize in 1919.

In April 1915, he had engineered a massive chlorine gas attack that had nearly cracked the Western Front, failing only due to a lack of troops to follow up. After that, Haber was promoted from a reserve sergeant to captain and ordered to develop war gases. The genie was out of the bottle, however; that first chlorine gas attack had also convinced Britain and France to develop gas masks and chemical agents of their own.

Given Germany's advanced chemical industry, Haber had kept the lead in this science-run-amok sort of war, but Allied respirator improvements had kept pace. By the end of 1916, gas masks were nearly impregnable. That and the defensive requirement turned Haber's "gas men" in a new direction, leading to the development of bis-2-chloroethylsulfide: mustard gas.

German artillery near Ypres received the first mustard shells, identified by their

yellow Lorraine crosses, in July 1917. British Tommies saw the shells burst, but they neither saw, smelled nor tasted any agent, nor did they feel any immediate effects. Deciding not to let the Hun have his way with a ruse, they didn't don masks.

"But within an hour or two strange symptoms began to appear among the men occupying the recently bombarded area," a field doctor recorded. "They developed violent conjunctivitis [pink eye]—so severe that their eyes closed up. Great areas of skin under their arms and between their legs turned fiery red and blistered. Many of them began to cough, and enough laryngitis to cause hoarseness was almost universal."

Mustard gas is dangerously insidious, a volatile oil, the fumes of which are but faintly malodorous and quickly desensitize the olfactory system. No symptoms appear for hours, although both vapor and liquid will accumulate in exposed tissue. During the latency period, mustard binds to DNA and enzymes, thereby ravaging cell metabolism. Layers of affected tissue liquefy as dying cells rupture.

The victims' inflamed skin erupted into massive yellow blisters up to a foot long, while their incessant, useless coughing foretold worse complications. Within 24 hours, some 500 men suffocated in a thin, frothy, blood-stained fluid. Autopsies revealed thick, yellowish pseudo-membranes clogging their upper respiratory tracts. Another 1,000 victims healed over weeks, months and decades. No cure for its effects has ever been found.

Mustard was "in a class by itself so far as casualty producing power is concerned," admitted Britain's gas brigade commander. One drop of evaporated mustard gas can cause skin burns within 10 cubic meters; half a drop burns the eyes. Contact with the liquid or aerosol droplets is catastrophic. A heavy shell could deliver 19 liters of liquid agent.

Haber had a winner. A medium shell containing half a liter of mustard agent could effectively contaminate 148 square yards of front for several days. Shrapnel shells laced with mustard poisoned the shell holes into which soldiers flung themselves, their masks frequently damaged by the explosion, if not blown off.

Gas masks were no longer enough, in any event. Although mustard was less lethal than diphosgene or chlorine, the burn and blister victims it produced burdened logistic and medical resources. Within three weeks of its introduction, mustard gas caused as many casualties as had all other lethal agents during the preceding year. In a war of attrition, mustard gas emerged as king. Paradoxically, the British had rejected using it in the spring of 1916 because it wasn't deadly enough.

Chronic shortages of high explosive ammunition had also delayed British gas shell development. Fifteen minutes of gas fire, however, proved more effective against personnel than firing high explosive for six days, since direct hits weren't necessary and the heavy vapor clouds penetrated shellproof bunkers.

**WHILE GERMANY** manufactured tons of mustard agent in quickly converted aniline dye plants, Britain and France, with inferior expertise, had to construct new plants from scratch. American firms declined, figuring the market for mustard gas would end with the war. Meanwhile, French troops unearthed German duds from which to refill their own gas shells.

Gas attacks, prior to mustard's introduction, had dissipated within hours and had left little trace. Mustard, however, was a persistent agent. "Owing to [mustard's] high boiling point," a British expert observed, "some of it is scattered on the ground and continues to give off gas for some time." Wood or soil may retain it for years. Troops bedding down in shell holes awoke in agony. It rendered whole towns uninhabitable for weeks. Contaminated equipment, weapons and clothes spread the fuming oil-like contagion.

Decontamination required more than a breeze. The wife of a prominent British physicist insisted, however, that a canvas fan, hinged to flutter up on the down stroke, would be the most efficient device with which to draw vapor out of a trench, and the British army ordered 100,000 of these Ayrton fans. The American Expeditionary Force ordered another 50,000, unaware that the British endorsement was more a concession to politics than ef-

ficiency. Tommies and doughboys soon concurred that the most efficient manner in which to create an updraft was to burn Ayrton fans in a pile.

Physical exertion intensified mustard's burns. Warm skin absorbed the poison faster. Remaining still minimized injury. Preventing exposure was the best solution, but there was no curricula or time for gas training.

Rumormongering doughboys convinced one another that German gas would cause their fingers and toes to fall off and their eyes to drop out, which hardly prepared anyone to diagnose exposure to a delayed-action agent. Line officers simply released complainers to aid stations before they might have to be carried. An inspection of one field hospital revealed only 90 genuine victims out of 251.

As a result, doctors tended to be skeptical. The most innocuous approach was to offer a suspected malingerer a hearty meal—after which it would be clear that a genuine victim was still ill. Physicians sometimes asked patients to smoke diphosgene-laced cigarettes, since only those who had actually been gassed could inhale the smoke without choking.

Mustard's latency period duped many a soldier into pulling off his mask, especially when the goggles fogged, and relying upon the mask's mouthpiece for breath alone. Some American gas officers became hysterical, exhorting men to remain masked, post gas sentries, arrange alarms and cover supplies with tarpaper or oilcloth. Prescribing hot, soapy baths as a treatment for mustard exposure completed the troops' antagonism in the trenches. "Knowledge and real efficient training," a division commander asserted, "came after hard experience." Hard experience left little room for error, however.

Immediate response to an attack depended upon the agent used. The gas officer quickly lifted and released his mask, filling his nose with a shallow sniff in between. He then tried to recall the ephemeral odor. Phosgene smelled like musty hay, chlorine like bleach, diphosgene like chocolate, etc. Chemical agent detectors did not exist, and even today a portable device that can rapidly and reliably identify agents in minute concentrations remains more a goal than a reality. "Tasting" the garlic aroma of mustard, the gas officer would call for chlorinated lime and shovels.

Lime destroyed the oil phase of mus-

*Continued on page 72*

# WEAPONRY

Continued from page 20

tard, but its venomous vapors compelled decontamination squads to dress in overboots, masks, mittens and linseed oil-treated coveralls, in which it might be difficult for squad members to endure more than half an hour. Relief, sleep and shelter required sanctuary. Selected dugouts were gas-proofed. A glycerin-soaked blanket covered the entrance, supported by a sloping framework. Rocks tied to the blanket's edge closed a seal. Boots were decontaminated in lime-filled shuffle boxes before entry. It was an involved, laborious process, but reduced casualty statistics revealed the value of good housekeeping.

Meanwhile, the Germans incorporated mustard into offensive color "shoots," named after the colored crosses that identified gas shell fillings. Battery fire deluged target areas with lethal agents without warning, since the ranging shots to achieve direct hits were unnecessary. Periodic mustard fire then hampered enemy use of the shelled terrain for as long as desired.

Food, water, tobacco and physical relief endangered the unwise in these "Yellow Zones of Defense." Leather, rope and canvas rotted. Tar, paint and lubricating oils deteriorated. Weapons had to be disassembled and boiled in bicarbonate solution. Wool uniforms resisted rot, but became saturated. Even rubber ponchos, gas capes and treated coveralls only delayed mustard's penetration. Movement in gas suits produced a bellows effect, drawing vapor through the inevitable leaks, and contaminated sweat seeped under the masks of men and horses alike.

Artillery units planned alternate firing positions and accepted the downtime to move the guns. Infantrymen, who had to take and hold ground, had to make do where they were. Stubborn pride and unbridled fighting spirit, however, resulted in unnecessary casualties.

One alternative to the gas suit was SAG ("Salve, Anti-Gas"), a "carbulated Vaseline" that provided some skin protection. Perspiration caked it, however, and reportedly many a gunner shaved his body before "his underwear is soldered to him with 'sag paste.'" SAG eventually saturated, making its effectiveness against mustard temporary, but it did help guard against lice.

Haber's miracle sustained Germany's defense during the last critical months of a two-front war. After Russia's capitulation,

production of nonpersistent gases took priority for the final German offensives of 1918. Yellow Zones of Defense, however, protected the flanks of the German assaults. "Even in open warfare," a German officer wrote, "the troops were soon calling for gas supporting fire."

Allied medics established gas casualty stations close to the front, where victims could quickly strip and shower. Medics sprayed their noses, eyes and throats with bicarbonate solution. Medics also strung ropes to the nearest ambulance, by which whole columns of blinded men groped their way to the rear.

**RETALIATION WAS PERHAPS** the most effective response, and in the summer of 1918 France retaliated with mustard gas, while the American and British armies started up their own mustard plants. None could satisfy the demand, although nearly every worker in the British plant was injured in the attempt. Of the French workers, 90 percent lost their voices, and constant itching deprived all of sleep.

German soldiers received boxes of bleaching powder and permanganate, which deactivated the gas' effects. Many failed to realize in time, however, that they'd been exposed.

American chemists also concocted Lewisite, a rapid-acting blister agent that could be mixed with mustard to lower its freezing point for the winter campaign that never came. Haber had already rejected Lewisite, 2 chlorovinyl dichloroarsine, because its burns healed quickly. Allied propaganda, however, now heralded the use of gas as an example of good triumphing over evil, after years of berating it as Hun brutality.

News of Germany's capitulation on November 11, 1918, brought "terrible days and worse nights" to one young German mustard gas convalescent, who wrote that "the shame of indignation and disgrace burned my brow. What was all the pain in my eyes compared to this misery?" Mustard gas-induced hoarseness remained an obstacle with which Adolf Hitler later contended whenever he spoke for long periods.

Of the war's 29.5 million casualties, gas caused 1.3 million. Despite mustard's late introduction, 80 percent of the gas casualties—of which 2.5 percent were fatalities—have been attributed to it. It was the war's only decisive chemical agent. It remains in the stockpiles of a dozen countries and has been used as recently as 1979-88, by Iraq against Iran. **MH**