

**THE MILITARY VALUE AND POLITICAL
IMPLICATIONS OF THE USE OF RIOT CONTROL
AGENTS IN WARFARE**

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In November 1969, President Richard Nixon enunciated United States chemical warfare policies that made it clear that a basic United States objective was the elimination of biological and chemical weapons from the arsenals of the world. He announced a unilateral halt in all U.S. activities in the field of offensive biological warfare, reaffirmed that the United States would not use lethal chemicals except in retaliation, and proposed to seek Senate approval for ratification of the Geneva Protocol. While the President made no official pronouncement on the use of riot control or harassing chemical agents, it was indicated afterward that the United States government did not include such agents in the category of proscribed chemicals. Similarly, the President made no references to such chemicals when he submitted the Protocol to the Senate on 19 August 1970, but Secretary of State William P. Rogers' report accompanying this submission stated that "it is the United States understanding of the Protocol that it does not prohibit the use in war of riot control agents."

Over the past five years, U.S. military forces in Vietnam have been making increasing use of the riot control agent CS. Initially the only munition available was the standard hand grenade designed for use in crowd control. It was supplied with the announced expectation that its use would be confined to defensive and rescue operations and to situations where enemy soldiers were intermingled with noncombatants. However, once CS was used in Vietnam, chemical staffs as well as regular soldiers and field commanders found a widening variety of roles for it. Under pressure from the battlefield, new types of CS munitions were developed and came to be applied over a wide range of combat operations.

In parallel with the increased combat use of CS in Vietnam, there has been increasing concern over the possible long-term arms control and political costs to the United States of maintaining its option to use harassing agents in war. Thus, on the one hand, CS is militarily useful against the enemy in Vietnam, but, on the other hand, any use of gas in war, even riot control agents, is a departure from the long-standing policy of the major powers to avoid the initiation of gas warfare of any kind. Furthermore, a large number of parties to the Geneva Protocol of 1925, which prohibits the use of gas warfare, have asserted that in their opinion, it does apply to riot control agents.¹ The arms control risks of using riot control agents arise from the resultant stimulation of worldwide military interest in the potential of chemical warfare and from the possibility of battlefield escalation from these agents to more toxic chemicals.

Thus, although there is no great difficulty in identifying qualitatively the opposing gains and costs of using riot control agents in war, there is a very difficult problem in attempting to quantify the various considerations and then to place values on them in order to reach conclusions. This paper attempts to bring additional perspective to the various considerations described above.

Background on the Military Use of Harassing Chemicals

Chemical warfare in the modern sense was initiated at the very beginning of World War I. The chemicals first employed in World War I were tear gases and respiratory irritants which, in today's terminology, would be designated nonlethal.² This was not by intent, however, and more toxic chemicals soon issued from the laboratories of the warring powers and then were employed on the battlefields on a massive scale. Nevertheless, lachrymatory and irritant agents remained in use, since they could effectively harass unmasked personnel and force the wearing of gas masks at much lower concentrations than could the lethal agents. In all, 6,000 tons of lachrymators and 7,000 tons of respiratory irritant gases were ex-

pended by both sides during the First World War. Amos A. Fries (the then Chief of the U.S. Army Chemical Warfare Service) and Clarence J. West predicted that "so great is the harassing value of tear and irritant gases that the next war will see them used in quantities approximating that of the more poisonous gases."³ They were mistaken; chemicals—both lethal and nonlethal—sat out the next two major wars.

Chloroacetophenone (CN) was developed in the United States near the end of World War I. The war ended before it could be used, but CN was thereafter adopted by many civilian police agencies as their standard tear gas. During World War II, CN grenades and other munitions were stockpiled by the United States, Germany, and Japan. A vomiting agent, diphenylchloroarsine (called Adamsite and designated DM), was also stockpiled by both sides. However, despite their availability, neither gas was used in the Second World War. In large measure, the reason for this avoidance of even nonlethal gases seems to have been that neither side could see a clear advantage in their introduction into the war; there was also a genuine repugnance to gas warfare on the part of many civilian and military leaders. According to Albert Speer, both of these reasons were instrumental in forestalling Germany's use of chemical weapons against the Allies late in 1944, even though the idea was proffered by Hitler himself.⁴ No gas of any kind was used in combat in Korea. Although authorization for tear gas was occasionally requested, it was never granted.

Both CN and DM were used in the early days in Vietnam. Among the munitions supplied to the South Vietnamese army (ARVN) early in the course of U.S. involvement was a quantity of standard hand grenades containing CN and a CN-DM mixture. While these probably were intended for riot control, the ARVN made occasional military use of them, notably in flushing enemy personnel from caves and bunkers. However, employment of gas grenades was relatively infrequent and *ad hoc*, rather than integral to a tactical plan. CN and DM have now been almost completely superseded by CS.

CS munitions made a somewhat inauspicious debut in Vietnam in December 1964. On two occasions CS grenades were airdropped as part of an attempt to rescue U.S. prisoners of

war. The results were inconclusive in that in neither case was contact actually made with the enemy. Early in 1965, the Commander of the U.S. Military Advisory Command in Vietnam directed American advisory teams to draw masks and CS grenades for their own defense. It was thought that in certain cases in which advisory teams had been overrun by the Viet Cong the last-ditch use of CS might have caused the Viet Cong to avoid an area large enough for the organization of effective counter-action.

In March 1965, *The New York Times* reported on the operational employment of nonlethal chemicals by the ARVN. The story quoted a U.S. spokesman as saying: "Even if it (the use of nonlethal chemicals) does work, there is a real problem in getting it accepted . . . the idea of it all brings back memories of World War I and mustard gas." The report provoked considerable controversy in the American and foreign press. The official attitude of the U.S. government, as conveyed by the statements of the then Secretary of State Dean Rusk and the then Secretary of Defense Robert McNamara, held that the United States and its allies were not in contravention of the principles of the Geneva Protocol, arguing that the chemical agents used were not war gases but riot control types of weapons. Moreover, Rusk stated that "we do not expect that gas will be used in ordinary military operations . . . the anticipation is, of course, that these weapons will be used only in those situations involving riot control or situations analogous to riot control."⁵ For five months following this statement, U.S. forces in Vietnam did not employ riot control agents and a quiet effort was made to discourage South Vietnamese use of them. Simultaneously, an assessment of the pros and cons of employing riot control agents was conducted within U.S. military and political circles.

While this was going on, an event occurred that was probably more important in formulating subsequent policy than any government study. On 5 September 1965, the Commander of the 2nd Battalion, 7th Marine Regiment, faced with the problem of flushing a Viet Cong force out of a tunnel (in which he had reason to believe there were also women and children) elected to employ CS to help clear it. As a result,

some 400 persons, including 17 armed Viet Cong, were removed without injury to the noncombatants. Since the use of CS was then contrary to Command policy, a Board of Inquiry was convened, but it eventually determined that the action taken had been in the best interest of all concerned.

Shortly thereafter, without any public announcement, a new policy sanctioning the expanded use of CS was settled upon, and CS in its various forms came to be regarded as a normal military weapon to be exploited operationally as deemed useful by field commanders, subject, of course, to the same constraints that pertain to other weapons and munitions.

Initially, it was expected that CS would be used primarily to reduce civilian casualties and the destruction of civilian property. Subsequently, however, the use of CS expanded rapidly to encompass a wide range of battlefield operations. The procurement for Southeast Asia of CS and its later forms, CS1 and CS2, rose very rapidly in fiscal year 1966, although it was significant even in fiscal year (FY) 1964 (Table 1). The differences between CS, CS1, and CS2 are discussed in the next section.

Table 1

Procurement of CS, CS1, and CS2 for Southeast Asia
(thousands of pounds)

	<u>FY1964</u>	<u>FY1965</u>	<u>FY1966</u>	<u>FY1967</u>	<u>FY1968</u>	<u>FY1969</u>
CS	225	93	378	437	714	2018
CS1	142	160	1217	770	3249	160
CS2	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>228</u>	<u>3885</u>
Total	367	253	1595	1207	4191	6063

Source: *Congressional Record* H4775, 12 June 1969.

Agent CS and CS Munitions

The initial development of CS as a riot control agent was carried out in the United Kingdom in the early 1950s. The compound was named after B. B. Corson and R. W. Staughton, the American chemists who first reported its synthesis in 1928.

The technology was soon transmitted to the U.S. Army Chemical Corps and most research on the agent since then has been done under U.S. auspices.

CS, orthochlorobenzylidene malononitrile, is a whitish solid of low volatility. It is only slightly soluble in water. Exposure to CS results in severe irritation of the eyes, nose, and respiratory tract, with copious tearing and blepharospasm (involuntary closure of the eyes), racking cough, and a feeling of difficulty in breathing. High doses may result in nausea and vomiting. CS can also produce a somewhat painful stinging on damp skin, which is harassing but not by itself incapacitating. Intense exposure to CS under humid conditions can cause severe blistering that takes several days to heal. Individuals may become sensitized to the agent after an initial exposure.

One reason CS is useful as a military agent is that it produces incapacitation rapidly—in five to thirty seconds, depending upon the dose received. Incapacitation extends throughout the period of exposure, and for an additional one to ten minutes. The eye effects occur first, followed by the respiratory signs. Evidence from animal experimentation extrapolated to humans indicates that for CS the difference between an incapacitating exposure and one that might produce serious lasting effects is quite large, a factor of many thousands. Nevertheless, exposures in some cases in Vietnam may have exceeded the human lethal dosage estimated from laboratory experiments with animals, although no deaths resulting from the use of CS have been confirmed. It is not yet clear whether there have indeed been none, or if there have been some that have not been verified.

Depending upon a number of individual human variables, chiefly sensitivity and motivation, the combined effects of CS result in varying degrees of incapacitation. Unmasked troops who are exposed to CS for the first time or who are deficient in training and/or discipline may react by abandoning their positions, attempting to flee from the cloud. Experienced troops are less likely to leave their positions; nevertheless, under the influence of CS, their fighting proficiency will be considerably impaired. Unprotected troops forced to assault through a cloud of CS are likely to falter.

The original form of the agent is designated simply CS. It is mixed with a pyrotechnic material which, upon ignition, vaporizes the CS and ejects it through ports in the munition. In contact with the air, the vapor resolidifies into an aerosol cloud whose travel is entirely a function of air movement. This material has a low volatility and is inactivated by water and thus usually presents a negligible residual hazard. When it is used in an attack on an enemy position, it may be followed closely with an advance of unmasked troops, although a certain amount of caution is prudent because of the danger of lingering pockets of contaminated air. CS has been manufactured in two other forms—CS1 and CS2, both formulated specifically to produce an agent with high persistency. CS1, however, is considerably less persistent than CS2 and was really an interim development. While a great deal of CS1 was used in Vietnam from about 1966 to 1969, CS2, now that it is available in quantity, is considered the agent of choice. CS2 does not react readily with water, and effective concentrations will persist in caves, bunkers, and tunnels for several weeks. CS2, in fact, is so resistant to wetting that it can be placed on the surface of a small body of water, and any agitation of the surface (as by the wind or by wading) may generate an effective aerosol of CS.

The variety of CS munitions has increased substantially from the two ground and two aerial weapons available in 1966. Hand grenades, which are similar to those used domestically for riot control, are the basic infantry CS weapon. Also in widespread use is a 40-millimeter CS round for the M-79 grenade launcher. Other infantry weapons are the 4.2 inch chemical mortar, firing a shell that ejects four pyrotechnic submunitions, which burn on the ground to form a dense cloud of CS, the 105 millimeter CS howitzer projectile and the man-portable E8 rocket launcher, which fires a large number of skittering submunitions and is useful for submerging small structures in a cloud of CS to facilitate their assault by troops. High-capacity blowers are sometimes used to flush cave and tunnel complexes with CS2. Aerial disseminators and canister dispensers have been developed to enhance close air support of ground troops. Several bulk systems, such as 80-

pound drums with a burster charge, have been developed for terrain interdiction and area denial.

Only the U.S. forces in Vietnam have this variety of CS munitions at their disposal. The ARVN has a much more restricted capability, and the forces of other allied powers are limited in the main to hand grenades.

Defense Against CS

An effective gas mask, such as the U.S. standard M-17 or the newer, lightweight XM-28E4, provides adequate protection of the face and respiratory tract against CS. The Soviet Shlem mask is equally effective. The two-piece Communist Chinese mask affords a lower degree of protection but may suffice to mitigate the effects of light concentrations of CS. The Viet Cong field-expedient masks, which consist solely of a filter comprising several layers of gauze and cotton (sometimes with a small amount of charcoal), provide only minimal protection.

There is also a problem of protection against the skin-irritating effects of CS. Normal clothing, fairly tight-fitting around the neck, wrist, and ankles is adequate against light to moderate concentrations. Personnel with less protection (that is, wearing short pants and short sleeves) attempting to move through heavy concentrations of the agent will be considerably harassed, though in the case of well-motivated troops, probably not to the point of incapacitation.

Operational Employment of CS Munitions in Vietnam⁶

Area Denial

The largest part of the CS used in Vietnam has been dispensed as bulk CS1 or CS2 with the intention of denying the use of terrain or field fortifications to the enemy. Contamination of large parcels of terrain or of terrain not accessible to friendly ground troops is effected by means of air-delivered fifty-five gallon drums fitted with an explosive charge. Each of these releases eighty pounds of agent. The drums are

dropped by helicopter, up to thirty per sortie, and are exploded just above the ground. The result is a roughly circular pattern of visible contamination, high enough in concentration to preclude habitation in the near vicinity. The targets, usually base camps, rest areas, or infiltration routes, are requested by divisional sub-elements, evaluated by the intelligence branch, and passed along for action to the division chemical staff. A survey in 1968 of division activity reports indicated that these missions constituted a major part of the effort of the chemical staffs.

Bulk CS1 or CS2 is also used to contaminate field fortifications such as bunkers, caves, and tunnels. This is sometimes more effective than the usual destructive methods for denying use of the facility to the enemy for several weeks or more. In these cases, the agent is either hand-sown or scattered by detonating a grenade inside a container of agent—often one of the small eight-pound polyethylene bags in which the chemical is shipped—or, if the space is fairly small, exploding a CS2 grenade in it. Sometimes CS will be combined with explosive destruction—on a bunker, for example—to retard renovation for reuse.

Offensive Combat Operations

CS munitions are also used in Vietnam in direct engagement of the enemy during offensive combat operations. These operations fall into several roughly distinct categories: assault against point targets; assault against area targets; flushing of bunkers, caves, and other structures; use in conjunction with antipersonnel artillery and air strikes; suppression of small arms fire around helicopter landing zones; and reduction of enemy resistance to facilitate taking prisoners or to minimize the danger to noncombatants in close proximity to resisting troops.

Typical point targets include single bunkers, automatic weapon emplacements, and small buildings. The preferred munition in these cases is often the 40-millimeter CS round for the M-79 grenade launcher. In the hands of a skilled grenadier, it can be fired through a window or port from a distance

of 200 or 300 meters. Within a few seconds, any occupants lacking protection will be incapacitated.

CS munitions are also used to reduce friendly casualties when artillery support is either not available or impractical due to other considerations. U.S. Marines found the extensive employment of CS to be particularly desirable during the Battle of Hue in February 1968 while fighting in congested areas and assaulting fortified positions. In that battle, close contact between enemy and friendly troops (usually 20 to 150 meters), coupled with poor weather conditions, limited the use of artillery and air support, and forced the troops to depend largely on the organic weapons they had at hand. CS launchers and hand grenades were used as an effective alternate means of supporting the almost continual assaults on fortified positions and of routing the enemy from hallways and rooms in the many buildings.

As described in Army training manuals,⁷ CS is also used in conjunction with artillery and air strikes. If the chemical agent is placed on the target immediately prior to bombardment with antipersonnel munitions, the enemy may be panicked into leaving his cover to escape the CS and thereby be rendered more vulnerable to conventional arms. There is good evidence that this tactic works against poorly disciplined troops. In an action against a well-entrenched enemy force on the Bon Son Plain in May 1967, the 1st Air Cavalry Division combined CS attacks with air strikes on the enemy position, followed closely by an infantry/tank assault. The action resulted in seventy-four enemy deaths. A captured North Vietnamese lieutenant reported that the CS had caused his troops to leave their positions, resulting in increased casualties.

According to field observation and prisoner interrogations, the discipline of the Viet Cong and the North Vietnamese Army (VC/NVA) is improving as the troops become more familiar with CS and U.S. tactics for using it. Experienced soldiers, having learned that CS is often used in coordination with artillery or air strikes or infantry assault, may choose to remain in protected positions—even though nearly incapacitated. This may or may not be a safer course of action than exposed flight, depending upon the attacker's plan. It prob-

ably is safer if the attacker intends only an antipersonnel strike. If the CS attack is followed by an infantry assault, however, the defenders will be placed in the position of trying to defend themselves in close combat at a very low level of proficiency.

CS may also be used as a flushing agent to force the enemy out of caves and tunnels whose farthest reaches are not accessible to conventional munitions. The agent can be dispensed by means of grenades aided by a blower, if one is available. In addition, its smoke-like visibility serves to disclose hidden openings to caves and tunnels.

Among the several other applications of CS in the offensive combat role in Vietnam is the suppression of ground fire around helicopter landing zones. This is usually accomplished with one of the air-delivered weapon systems. A 4th Infantry Division soldier vividly recalled jumping off a helicopter which had landed within twenty meters of a North Vietnamese soldier armed with an AK-47, who, fortunately, had been completely incapacitated by the preparatory CS fire.

CS has been found useful in foiling the Viet Cong tactic of hugging close to U.S. positions in order to thwart support by artillery and air strikes. On occasion, U.S. units have been able to lay a curtain of CS between themselves and the enemy and then pull back quickly, putting sufficient space between the two to permit artillery and tactical air strikes to be brought in.

Defensive Combat Operations

Several concepts of defensive employment of CS have become fairly standard throughout all the divisions, for example, the use for perimeter defense of the E8 launcher, which blankets an area quickly with a dense cloud of agent.

Bulk CS1 or CS2 is used to impede the approach to, and passage through, a perimeter, and to restrict passage in the area around stockpiled supplies. In the latter case, this is often aimed at civilians rather than enemy troops, as all large camps in the vicinity of civilian centers have a problem with looting. Emplacing bulk agent in proximity to friendly troops presents some wind hazard, so some of the divisions mix the

agent with waste oil, which keeps the agent from being picked up by the wind. Yet anyone walking through the mixture gets enough exposure to CS to be made very uncomfortable.

Just as CS can be used to place distance between two close-in forces to permit artillery and tactical air support, so can it also be used in support of withdrawal operations to enable a smaller force to break contact with a superior force. CS grenades are regularly carried by some long-range patrols especially to facilitate such action.

As a defensive counterpart to landing-zone preparation, CS is also used to cover removal of troops by helicopter. In this case the CS cover is usually supplied by one or two helicopters performing the fire-suppression mission, employing a combination of machine gun fire, rockets, and air-delivered CS.

CS has also been used in a counter-ambush role on vehicular convoys. Several divisions have fitted various kinds of vehicles with side-mounted CS launchers. These are spaced at intervals throughout the convoy, and set to be command detonated (electrically) if the convoy is ambushed.

Reconnaissance by fire, using CS rather than conventional ordnance, has become a recognized tactic. The CS is particularly useful for checking heavily wooded areas, where it is likely to yield much better coverage of ambush fortifications than that provided by high explosives. CS munitions have also been used to probe the far bank of a canal before it is crossed. And since the airborne personnel detector ("people sniffer") missions are also flown by the division chemical staff, CS and the personnel detector are occasionally employed together. The 9th Division reported an incident in which the placement of CS on a spot indicated by the personnel detector resulted in flushing nine suspected Viet Cong into the arms of a waiting patrol.

One final example of the use of CS in Vietnam may be more aptly described as a vignette rather than a repeatable operational concept. It is, however, a very good example of how the men in the field use their ingenuity to employ whatever munitions they have available. In the period immediately after Tet, the Commanding General of an ARVN unit, in an attempt to curtail the Viet Cong resupply efforts, decreed

that the villagers in the area would not be allowed to transport large amounts of foodstuffs at any one time. He received U.S. support in the form of gunship surveillance. Within a few days the airmen observed bicycle and scooter riders with large bags of rice slung across the backs of their vehicles. At first, a few warning shots "across their bow" succeeded in turning them around, but in very short order they were back again. This time, in addition to the rice, they carried women and children. Knowing that the Americans would not shoot to kill, they did not respond to the warning shots. However, one of the gunners had some CS grenades aboard and he dropped them in front of the bicycles, which got to the edge of the cloud and then promptly turned around. Word was rapidly circulated that an effective means had been found to thwart the transport of food by this brazen method by the enemy.

CS as a Nonlethal Weapon: Present and Potential

Any discussion of CS as a nonlethal weapon perforce draws heavily on the U.S. experience in Vietnam; it is necessary to look at the past five years for indicators of the future.

It is important to emphasize that CS is an agent with two distinct roles. On the one hand, it can be used to flush or to overcome the enemy with the aim of rendering him more susceptible to conventional lethal weapons (small arms, artillery, air strikes); and on the other hand, it can combine military effectiveness with the possibility of a nonlethal final consequence to enemy soldiers and, more importantly, to nearby noncombatants.

Large-scale use of riot control agents was originally publicly justified largely on the basis of minimizing civilian casualties. While this is still a popular conception of the use of CS, in actuality it seldom has been used in Vietnam with this as the primary goal. It is difficult to find specific incidents where CS was used primarily because of its nonlethal character. One instance, in fact, was described in 1968 as ". . . the only known employment of CS in such a manner in the Nth division area of operation." It occurred during Tet when

an enemy force closed on an ARVN compound in the vicinity of New Plei Do Lim (Pleiku Province), herding a large group of Montagnards mixed with their own troops. As the enemy neared the compound, the ARVN defenders threw a number of CS grenades upwind of the attackers. When the agent reached them, the civilians panicked, some dropping to the ground, some ignoring the Viet Cong and running away. The enemy, deprived of civilian cover, turned and fled.

While other examples could be cited, CS is rather infrequently used only to spare civilian lives. One is led to wonder why. The answer is somewhat surprising in view of the considerable number of civilian casualties the war has produced. It appears that CS is rarely used against mixed groups of enemy and noncombatants because such groups are rarely encountered. Despite all the discussion of the Viet Cong and North Vietnamese soldiers invading a friendly or neutral village and then battling to hold it, one thing is clear: before the battle develops, the villagers remove themselves from the battlefield. On this point, the troops in the field are unanimous and adamant. Civilians hardly ever become embroiled in a firefight unless it develops very suddenly—and that is not a common occurrence. When the Viet Cong set up fighting positions in or around a village, they may force the villagers to help dig trenchworks, but they almost always permit the civilians to leave once the work is finished. The result is that before the battle begins the villagers are gone. As a matter of fact, it is well known among U.S. troops in Vietnam that one of the surest indicators that a patrol approaching a village can have of impending trouble is the absence of villagers from view.

The first problem in analyzing whether CS could be more effectively used to spare noncombatants is to determine how civilian lives are lost, and subsequently, to examine the possibility that CS could in some way affect these situations. The details behind the bare casualty figures are very difficult to uncover. However, from discussions with experienced officers and troops in the field, from on-the-spot reports, and from certain news accounts, some indicators of the principal casualty sources emerge.

Certainly some significant fraction must be laid at the doorstep of the Viet Cong and North Vietnamese. Their use of mines on heavily traveled roads, of explosives planted in public places, and of mortars and rockets against nonmilitary targets is part of a calculated campaign to terrorize and coerce the civilian populace of South Vietnam.

By contrast, injuries to civilians caused by U.S. and South Vietnamese forces are usually unsystematic and unpremeditated. They arise from a variety of causes. One is simply mistaken identification—for example, air or artillery attacks on individuals mistakenly thought to be enemy soldiers. Targeting error is another. Into this category falls the rare, but very damaging, bombing of a village incorrectly designated as enemy. A third cause might be labeled errors of judgment, as when aircraft are drawn into an attack upon a village by enemy fire intended to provoke just such a response. Also there are cases in which civilians either enter or fail to evacuate a "free fire" zone, knowingly or not, and fall victim to artillery fire or air strikes.

In addition to these examples, there are also instances in which heavy ordnance, such as artillery and bombs, although aimed at proper targets, strike wide of the mark by a significant margin. Given the existing imprecision of air-delivered ordnance and a preponderance of unobserved artillery fire, casualties have undoubtedly resulted when civilians have not moved sufficiently far away from what they have judged to be the battle area. Moreover, while they would be reasonably safe from small-arms fire in below-ground shelters—even uncovered ones—this would not necessarily be the case if they were subjected to bombing and shelling.

In sum, it appears that a large proportion of the civilian casualties caused by U.S. and South Vietnamese forces result from bombs and large ordnance rather than small-arms fire. If this is truly the case, then greater use of CS is not likely to have a significant effect on the civilian casualty rate, since it is hardly conceivable that CS could very often serve to replace large high explosive ordnance. Nevertheless, it is worth noting that the record does show a number of occasions when such ordnance was foresworn in favor of CS because of the

proximity of noncombatants to enemy forces. It is simply a matter of placing these opportunities in perspective by pointing out that they do not arise very often.

There is one paradox in the use of CS around civilians that must be noted. Over the years a bomb shelter—a dugout in the floor, sometimes covered—has become a standard appurtenance of dwellings in Vietnam. If a villager does not have sufficient time to flee when he believes a battle is going to develop, he and his family may take refuge in this shelter. There is the possibility then that the use of CS in the village may have the effect of driving the villagers out of their relatively safe positions, and as they attempt to flee the cloud, increase their vulnerability to air strikes and to artillery and small-arms fire.

The Potential of CS for Minimizing Destruction

In addition to a potential for reducing civilian casualties, non-lethal chemical agents may also have potential value for reducing destruction to civilian housing and facilities during combat in built-up areas. Again, the experience of its use in Vietnam is instructive. A number of Vietnamese cities (Hue, Ban Me Thuot, My Tho, Kontum, and Cholon, for example) sustained major damage during the Tet fighting; by the end of the counter-offensive, they presented excellent, if doleful, examples of the effects of large-scale application of artillery and bombs in an urban setting.

In Hue, Kontum, and Cholon, CS was used by U.S. and ARVN forces—and to good effect. But again, it was nearly always used for its military value, not for its nonlethal/nondestructive quality.

Although CS munitions have not in the past been used very often to save lives and limit destruction, it is pertinent to ask to what degree CS munitions might be substituted for high explosives in urban warfare. The point of departure in this calculation must be the assumption that the enemy is not equipped with proper gas masks; if he is, CS will be of little value. Even against an unmasked enemy, the choice of CS in

place of high explosives will often be equivocal, since a dead or seriously wounded enemy is far less dangerous than an enemy temporarily incapacitated. Thus, the commander on the scene must weigh the virtue of diminishing property damage against the very real possibility that he is increasing the danger to his own men. Psychologically, it is bound to be very difficult to avoid tipping the scale heavily in favor of minimizing the risk to his own personnel. Dealing with a situation in which civilians are endangered, it is not at all improbable that a soldier will accept a heightened risk to himself to reduce the risk to these noncombatants. Conceivably, national leadership could also ask a soldier to accept heightened personal risk in favor of minimizing damage to some specially treasured edifice. But what can be asked of a man facing a complex of strong-points set up by the enemy in a row of very ordinary apartment buildings? To the soldier engaged in a fight for his life, a huge explosion on the enemy position is a truly satisfying spectacle. Telling that man that, out of humanitarian and political considerations, he must forgo support by explosive ordnance and rush the position with CS and small arms could create a considerable morale problem.

It is difficult to provide a satisfactory answer to the question whether or not riot control agents have a largely untapped potential for curtailing the destructiveness of urban warfare. It is likely that there is no pat, blanket answer, but rather that each situation will have to be assessed individually. From the experience in Vietnam, it appears that although there are some occasions when CS *can* serve this purpose, there are also a great many when it cannot.

Reaction of the Viet Cong and the North Vietnamese to the Use of Riot Control Agents

Lessons in the utility of riot control agents in warfare have not been lost on the enemy. Because of a very limited supply situation, the VC/NVA do not use CS very often. But they certainly do use it, and to good effect, when they can. On 16 February 1968, Vietnamese marines fighting in the north-

east corner of the Hue Citadel were hit by eight enemy CS mortar rounds. And as recently as March 1970, a group of NVA soldiers defending the Black Virgin Mountain near Tay Ninh covered their retreat with a large quantity of gas.

The VC/NVA supply of CS munitions is thought to come mostly from captured U.S. and ARVN stock. They have U.S. grenades; in addition, it is well known that they collect bulk agent from dud barrel bombs and then use it to fill crude grenades in the field. Sixty-millimeter and 82-millimeter mortar shells have been found in which CS1 in glass vials has been substituted for a part of the high explosive charge. The enemy may also have been supplied with some Communist Chinese CS grenades although this has not yet been verified.

The defensive capability of the VC/NVA presents a mixed picture. Their defensive masks range all the way from the Soviet Shlem mask to instructions on how to cope with CS by using a cloth soaked in lemon juice or a bit of charcoal placed in the nostrils. The Shlem is a very good all-purpose mask but, being of the hood type, is probably even more uncomfortable in the tropical climate of Vietnam than our own M-17. The Soviet Shlem is not being supplied to the NVA in any great numbers, and with a few exceptions, is limited to NVA regulars in the northern half of the country.

The Chinese two-piece mask is a more common item of issue. U.S. tests have shown that this mask has several design and quality defects, and offers only fair protection against CS.

Finally, the most common protective device carried by the Viet Cong field forces is a field-expedient mask manufactured from light plastic of the type used for raincoats in Vietnam. A piece of clear plastic is sewn in for vision, and several layers of gauze and cotton, or part of a sanitary napkin, are sewn in for air filtration. Sometimes a bit of charcoal is placed between the layers of the filter. The mask is designed either as a full hood or as a face covering only. In either case, it affords only a minimal degree of protection.

Conclusions on Military Usefulness

CS agent has found considerable acceptance in Vietnam as a

military weapon useful in certain situations. There is no doubt that it has, from time to time, also spared civilian lives and, to a lesser extent, property. One of the major obstacles, however, to an accurate assessment of the value of CS to the whole effort in Vietnam is the lack of quantifiable yardsticks of effectiveness. Instead of measures of value, only anecdotes can be found. No one has any idea of how many lives CS saves, or how many it fails to save. Moreover, since CS is primarily used to deny base camps, tunnels, caves, and terrain points, there probably is no solid measure of effectiveness; one can only presume that these actions contribute some unknown quantity to the cumulative pressure that is maintained against the enemy's forces. While some components of this problem could be researched on a roughly quantitative basis, for the time being it is not known how effective CS has been in the overall context of the war. In a sense, the case of CS reflects in microcosm one of the greatly unsatisfying aspects of the Vietnam war itself: an inability to discover a reliable means for measuring success and failure.

It is important, however, that the value of anecdotes not be dismissed lightly, if only because of the unmistakable trend they demonstrate. The great preponderance of a sample of U.S. troops interviewed in the field in 1968 (who had been in operations in which CS was used) responded with some enthusiasm. Only a few believed it did not contribute to their combat capability. However, by 1970 there were indications that the troops were less enthusiastic about the value of CS, possibly because of changes in the nature of the war and the tactics of the enemy. Still, these observations, although unquantified, must be construed to support the conclusion that CS possesses significant military worth, at least in certain situations that have occurred in the Vietnam war.

One measure of the effectiveness of a weapon, especially when it comprises, as does CS, a distinct class of weapons, is the enemy's response to it, that is, the effort he makes to counter it. In this case, the VC/NVA face two problems, one easily soluble, the other not.

The difficult problem is coping with base camps, bunkers, and tunnels that have been treated with persistent CS. Since

personnel cannot function very well for protracted periods while wearing a gas mask, it seems that they are forced to accept denial of the terrain or facility. This is what they do.

The other VC/NVA problem is coping with CS in direct engagement with allied forces. This can be accomplished with a good gas mask, many of which are available on the open market in the international arms trade. Yet the VC/NVA do not seem to have expended any great effort in this direction. It is not known why, but one plausible explanation could be that they are not sufficiently bothered by use of the agent to feel compelled either to spend money on masks in lieu of some other materiel or to burden their troops with them. This, of course, does not square with the impression of U.S. troops who feel that they use CS to good effect against the enemy.

Discussion, so far, has been focused exclusively on Vietnam in describing and evaluating the military utility of CS because it comprises the only U.S. experience with CS as a weapon. It must be borne in mind, however, that Vietnam is not typical of most wars, nor can it be considered the only model for the future. In Vietnam, the United States has faced an enemy far less well equipped to face and employ gas, and in this context, CS weapons have proven useful. Against an enemy better prepared to fight a chemical war, even one restricted to nonlethal chemicals, the value of CS to either side plummets drastically. The effect in a parity situation is likely to be a relatively even-handed addition to the hardships and complexities of life for the troops on both sides. As the United States continues to use CS and to provide CS weapons to its combat forces, it causes other nations' military forces to examine their defenses. This will stimulate the procurement of gas masks and gas weapons. Consequently, fewer adversaries will remain unprotected and unable to retaliate and the utility of CS to the United States will decrease proportionately. Fear of escalation to lethal weapons might deter the use of CS by the United States in such a situation.

In summary, in certain situations CS is a useful adjunct to other weapons. However, given the wide variety and enormous power of other available weapons and taking account of the various possible enemy responses, CS should not be ex-

pected to play a major role in determining the course of future wars in which the United States may become involved. Still, this in itself is no reason to renounce the weapon. Rather it provides background for an inquiry into the possible arms control and political benefits of doing so.

Factors Acting to Restrain Proliferation and Use of CB Weapons

Vietnam marks the first time since World War I that U.S. forces have employed gas weapons of any kind in war. Aside from the obscure gas campaign waged by Japan in Manchuria, Mussolini's generally condemned use of gas against Ethiopia, and the United Arab Republic's employment of chemicals against the Yemeni Royalists, it is the first extensive use of chemical weapons by any nation in forty-five years.

Several factors have operated to discourage nations from initiating chemical warfare and from making extensive preparations for waging it.⁸ Public opinion has regarded chemical warfare as particularly uncivilized and repugnant, an attitude that has also been held by not a few political and military leaders. At the top levels of military planning, chemical weapons have enjoyed little attention or support in comparison with other types of weapons. To be sure, this disinterest has not been shared by chemical officers, but they have usually been shunted aside from key decision-making bodies. In comparison with the main-line military branches and services, chemical warfare services have afforded poor career opportunities for the most talented and dynamic officers.

In the past, disinterest and disuse have kept most, if not all, armies unprepared to use chemical weapons. Even where the weapons have been procured and stockpiled, they have been poorly integrated into combat forces and war plans. A few nations which possess chemical weapons have tended to regard them much more as a deterrent against the initiation of chemical warfare by the enemy than as dependable war-fighting weapons. Fear of retaliation and escalation, with unpredictable consequences, reduces the incentive to initiate

chemical warfare when the opportunity occurs. Unpopularity and unfamiliarity, causing lack of preparedness or planning, have tended to keep such opportunities from occurring and from being seriously considered. Thus, psychological aversion, military disinterest, and fear of retaliation have acted and interacted to prevent chemical warfare. (In the same category and in many ways not clearly distinguished is the use of germs in war—biological warfare.) The traditional restraints against chemical—and biological—warfare are embodied in one of the oldest arms control treaties now in force, the Geneva Protocol of 1925. Its prohibition of CBW under international law adds to the moral and political forces of restraint. In addition, the Protocol places gas and germs in a distinct category, offering an explicit standard upon which nations can base their conduct.

U.S. Interest in Preventing the Proliferation of CB Weapons

In the context of both tactical and strategic war, it is very much in U.S. interest to preserve and strengthen the restraints that prevent chemical warfare and the proliferation of chemical weapons. Today, "limited" wars are fought with conventional weapons which individually have limited area effect. Although such wars can be exceedingly destructive, they become so only when great quantities of weapons are used. The wealth of the United States allows it to expend enormous quantities of conventional munitions in tactical combat. Very few countries even approach this capability. However, the proliferation of lethal chemical weapons would greatly enhance the destructive and disruptive capability of smaller and less wealthy nations. This is because these weapons have the potential of large area coverage at relatively low cost. Many of the types of munitions used in limited war could be filled with lethal chemicals. In that case, the "kill area" of light weight munitions such as mortar shells and rockets would be increased by a large factor. Even though troops can be provided with protective masks and suits, such weapons would be devastating to military units caught off guard and to the civil-

ian population. In many situations lethal chemical weapons would favor guerrilla forces. Such forces generally have no shortage of targets. They know the locations of military installations such as base camps and support facilities. Their problem is their great inferiority in fire power. For anti-guerrilla forces, the reverse is usually true, their main tactical problem being location of the enemy. In this situation, any major enhancement of the area coverage of light weight weapons disproportionately favors less sophisticated forces operating in smaller units and capable of dispersing or mingling with the civilian population. Moreover, the proliferation of lethal chemical weapons would create greatly expanded opportunities for terror attacks on urban centers by small groups of men firing chemical rockets or mortars from the outskirts. Thus, the proliferation of chemical weapons would seriously reduce the military advantage that great wealth confers, while at the same time threatening a major increase in the violence of war and its toll among civilians.

At the strategic level, the hazard of proliferation of lethal gas weapons is also serious. Countries not possessing nuclear weapons might well be tempted to acquire a population-killing capability based on nerve gas. Under suitably chosen meteorological conditions, a small bomber force could deliver enough nerve agent to kill a large proportion of persons in a major city. Although it is unlikely that a poor nation could successfully deliver chemicals over a wide area of a country with modern air defenses, a surprise attack on one or a few coastal cities would be difficult to defend against.

Further, it should be noted that analysis and planning for the use of chemical weapons is likely to stimulate interest in the strategic possibilities of biological weapons and that the economics of anti-personnel and anti-crop biological weapons for threat or deterrence may seem particularly attractive to less wealthy nations.

To summarize, the proliferation of lethal chemical weapons would risk a major increase in the level of death and devastation in wars of all kinds. Proliferation would provide forces less wealthy and sophisticated than the United States with greatly enhanced capability for threat, harassment, and de-

struction. The acquisition of chemical weapons would stimulate interest in biological weapons, for the barriers against both are intertwined. The overriding objective of the United States in this area of policy should be to prevent the proliferation of chemical and biological weapons and to strengthen the barriers against their use.

Riot-Control Agents and Proliferation

The example of the world's most modern army deploying a whole panoply of newly developed gas munitions (even though labeled euphemistically "riot control munitions") cannot help but stimulate interest in the military establishments of other nations in the utility of similar weapons. It seems almost inevitable that analysis and planning for chemical warfare will increase on a worldwide basis unless an effective plan to abort such interest is developed.

Furthermore, the danger of a shift in interest from non-lethal to lethal chemical weapons is very real. The procurement of gas masks and the commencement of chemical training, which many nations might well feel forced to undertake if CS comes into general military use, would offset a considerable part of the cost of obtaining an offensive lethal chemical capability. As more military forces become accustomed to training in a chemical environment and as chemical cadres are upgraded and careers become dependent on an important role for gas, the next step leading to acquisition of lethal chemicals becomes smaller and harder to resist. Many of the techniques for the dispersal of riot control agents are similar to those employed for lethal chemicals, so that the procurement of an offensive lethal capability would be facilitated. The rapid expansion of the scale of use of CS once it was introduced in Vietnam is a good example of how a limited capability can be readily enlarged once the political barriers to the use of chemicals have been breached. Tactics are quickly developed for their use in a variety of military situations far beyond those originally envisaged.

The use of harassing gas in war provides experience and

establishes defensive preparations and logistic arrangements that can facilitate the transition to other, more toxic, gases. Once the enemy has acquired gas masks, CS and similar harassing agents lose most of their effectiveness. An obvious response in that case would be to employ skin irritants. The move to even more effective skin irritants such as mustard may not seem as great as the step of introducing harassing agents in the first place. Another source of pressure to move upward in the scale of toxic weapons could be born of desperation to retrieve a deteriorating battlefield situation where defeat would have serious political repercussions. If the use of a certain chemical weapon appeared to offer relief, political leadership might accept that onus in order to stave off worse difficulties. This decision might be much easier once the use of harassing agents had been generally accepted. It should be pointed out that even if both sides in a conflict tacitly agree to limit themselves to nonlethal agents, there may be serious difficulty in finding a mutually agreeable and workable standard, particularly as more agents with novel effects become available.

Since in some circumstances chemical weapons possess much greater persistency and area coverage capability than an equivalent weight of conventional weapons, nations not now militarily significant may be tempted to acquire chemical weapons in an attempt to raise their military strength in a single jump. Large industrial nations might be willing to supply such weapons to their smaller allies and to dissident forces that begin to see the possibilities for retaliation, threat, and harassment. Once these nations become accustomed to using riot control agents, they may be less inhibited than the United States in progressing on to lethal chemicals. The experience in Yemen, where tear gas is reported to have been the first agent employed, appears to be an example of such escalation, which occurred even though the United Arab Republic was a party to the Geneva Protocol. Indeed, the use of tear gas apparently preceded the escalation to lethal agents in every case where lethal agents have been used—in Manchuria, in Ethiopia, and in Europe during World War I.⁹

It should also be noted that the decision to employ a pre-

viously unused weapon can be preconditioned by earlier procurement practices. The large-scale use of CS in Vietnam in 1966 and since may have been made substantially more difficult to avert by the U.S. Army's purchase of 367,000 pounds of CS for Southeast Asia in fiscal 1964, almost two years before it had been generally approved for uses other than riot control. If proliferation of lethal gas weaponry occurs, political leaders may find it difficult to hold to a "no first use" policy, if there is any military pressure to use gas. This may be particularly true as the boundary line between riot control agents and lethal agents becomes blurred. The force of public opinion supporting conformance with international law, as exemplified by the Geneva Protocol, will be weakened.

The extensive use of riot control agents has had a serious effect on the U.S. ability to take international action to discourage lethal chemical warfare. When it was confirmed that numerous gas attacks had been made against the royalist side in the Yemen civil war, the United States made no move to bring public pressure against the apparent attacker, the United Arab Republic. Although there were certainly other factors involved, the use of chemicals in Vietnam was a potent influence in inhibiting the United States from urging in the United Nations a strong stand against such use. Despite President Nixon's strong, unilateral decision to forgo the use of biological warfare and most chemical warfare, the use of riot control agents in Vietnam has hindered the United States in assuming a role of world leadership in controlling CBW. Instead the United States is continually forced to adopt a defensive posture in world forums.

During the past year the Conference of the Committee on Disarmament (CCD) at Geneva has paid increasing attention to methods of controlling chemical and biological warfare.¹⁰ The Soviet bloc has introduced a treaty that would ban the use, production, and stockpiling of both chemical and biological weapons. This has presented the United States with a difficult problem, since most nations involved believe that harassing chemical agents would be included in the category of chemical weapons. The United States has made clear that it does not agree with this definition. Probably in part because

it recognized the problems which the control of chemical warfare presented the United States while it was using CS in Vietnam, the United Kingdom has put forth a draft treaty that deals only with biological warfare. While the United States and the United Kingdom are behind this proposal, many others are in favor of the more inclusive Soviet approach. Thus, instead of providing leadership in attempting to achieve President Nixon's stated objectives of eliminating both chemical and biological warfare, the United States has given the appearance of dragging its feet.

Finally, the use of riot control agents has presented the United States with serious problems in connection with the Geneva Protocol.¹¹ In December 1969, the United Nations General Assembly held, by a vote of 80 to 3, with 36 abstentions, that the Protocol prohibits the use in war of all toxic chemicals, without exception. In view of this, there is no likelihood in the foreseeable future of getting widespread agreement to exempt CS. On the other hand, if the United States were to relinquish the use of harassing agents in warfare, it would almost certainly obtain general agreement on the applicability of the Protocol to all anti-personnel chemicals.

The United Kingdom, under the pressure resulting from its use of CS in Northern Ireland, recently changed its position to the view that CS, but surprisingly not other riot control agents such as CN, is not included in the Protocol. However, the Cabinet was seriously divided and most of the numerous ensuing commentaries in the British press were unfavorable. Therefore the United Kingdom, particularly with a new government in charge, may well be willing to accept a uniform standard if it is reemphasized that the Protocol in no way restricts the domestic use of riot control agents for preserving order. This distinction between use in warfare and in riot control has been understood and practiced by many nations since the Protocol came into being. During World War II, United States military police were well supplied with tear gas grenades and used them on soldiers and on allied civilians in certain circumstances to quell disturbances. However, these munitions were not employed in combat against the enemy. Riot control chemicals are used for civil purposes in France, but the French

government has held their use in war to be prohibited and their military manuals state this. There are many similar examples. Even Sweden, a nation that is very energetically promoting international action against the use of tear gas in war, uses CS for maintaining domestic order. Indeed, a possible threat to the freedom of police to use tear gas in the democratic countries probably comes from the risk that it will be misused in war and cause serious injury or that its massive and undisciplined employment will lead to reaction against it. These consequences can be made more, not less, likely by habituation to the large-scale use of CS in war and by the gradual transition of its image from a police aid to a war weapon.

The Geneva Protocol is an important factor in maintaining the expectation that gas will not be used. This, in turn, dampens interest and pressure for chemical weapons in many countries, especially ones where funds and facilities for military programs are sharply limited. Thus, the Protocol helps to avert proliferation of chemical weapons, benefiting the United States at least as much as any other country. Beyond that, the Protocol can provide a clear standard upon which belligerents can base their conduct in war. Creating dissension regarding the interpretation of the Protocol weakens its psychological effectiveness and calls attention to gas weapons. Furthermore, it reduces the effectiveness of the Protocol as a clear standard for agreement during war. When the simplest focus for agreement is "no gas," much of the benefit of the Protocol is lost by attempting to create exceptions.

Summary and Conclusions

President Nixon in November 1969 made it clear that the basic objective of U.S. chemical-biological warfare policy was to eliminate these forms of weapons from the arsenals of the world. Nevertheless, riot control or harassing chemical agents have in the last few years found considerable utility as normal military weapons in the conflict in Vietnam, where logistical problems complicate the ability of the enemy to provide its

forces with gas masks. Riot control agents also provide the potential for reducing civilian casualties in situations where military and civilians are intermingled, although this has not occurred nearly as frequently in Vietnam as originally anticipated. On the other hand, the use of harassing agents for military purposes erodes the fire break between conventional weapons and so-called weapons of mass destruction. It increases the likelihood that other nations will not only use these weapons but more lethal ones as well. Such worldwide use not only is contrary to the President's basic political objective of banning CBW, but also could lead in the long run to decreased U.S. security.

The key issue that must be faced by U.S. policy-makers is whether the military gain from continuing use of riot control agents in military operations in Vietnam overrides the longer-range harm that such use may cause our basic CBW policy. As the United States continues to use CS, the forces of opposing nations will develop defensive tactics and will seek to acquire gas masks and gas weapons of their own. As a result, the military utility of CS to U.S. forces will decline. In contrast, U.S. interest in averting the proliferation of chemical weapons will continue and intensify with the capability of progressively more countries to produce weapons once considered the monopoly of the most advanced nations, and as future discoveries in chemistry and biology open up new avenues for possible military exploitation. If the long-term disadvantages are deemed sufficiently serious, then means must be devised for halting the use of these agents in Vietnam in such a manner as to minimize the danger to U.S. military operations. It is the authors' view that the limited military value of CS in Vietnam, the gradual decrease in U.S. involvement in Vietnam, and the need for the United States to provide leadership in eliminating CBW all dictate a U.S. policy that would lead to the phasing out of the use of riot control agents and to a return to the traditional U.S. stance of not using gas weapons of any kind in war.

REFERENCES

1. See pp. 4, 8-14.
2. The conceptual distinction between "lethal" and "nonlethal" chemical agents requires some explanation. No agent, and certainly not one intended to produce an irritating physiological reaction, is nonlethal in absolute terms. For military purposes, a nonlethal agent is one which has a sufficiently wide spread between its effective dose (the dose at which it elicits the desired symptom) and its minimum lethal dose as to permit it to be employed in a given situation with only a very slight lethal danger to the target population. As an example, the lethal toxicity of chlorine, which was successfully employed as a lethal agent in World War I, is not much different from that of the nonlethal agents CN, CS, and DM. The difference is that the latter agents are significantly harassing at airborne concentrations approximately one hundred times smaller than chlorine. It should be pointed out that both effective dose and lethal dose vary from one recipient to the next. Thus, it is possible that a dose of a given agent that is merely harassing for a reasonably healthy adult might be sufficient to aggravate a serious preexisting condition in another person, or pose a threat to the very young or aged. The best nonlethal agents minimize these complications by virtue of their large safety factors (i.e., the spread between effective dose and lethal dose).
3. A. A. Fries and C. J. West, *Chemical Warfare* (New York: McGraw Hill, 1921), pp. 15-16.
4. Albert Speer, *Inside the Third Reich* (New York: Macmillan, 1970), pp. 489-490.
5. U.S. Department of State *Bulletin*, Vol. LII, No. 1346 (12 Apr. 1965), pp. 529, 531.
6. The specific examples in this section of the use of CS in military operations in Vietnam were supplied informally by the U.S. Army.
7. U.S. Dept. of the Army, Training Circular TC 3-16, Apr. 1969.
8. For a detailed analysis of the restraints against chemical warfare, see Maj. Frederic J. Brown, *Chemical Warfare, A Study in Restraints* (Princeton, N. J.: Princeton Univ. Press, 1968).
9. See Stockholm International Peace Research Institute, *The Problem of Chemical and Biological Warfare* (Provisional ed., 1970), Part I: History.
10. See pp. 97-108.
11. See pp. 2-14.