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CHEMICAL WARFARE

A quarterly magazine devoted to the activities of the Chemical Warfare Service, of interest to all arms---

Edited by Staff, The Chemical Warfare School,
Edgewood Arsenal, Maryland

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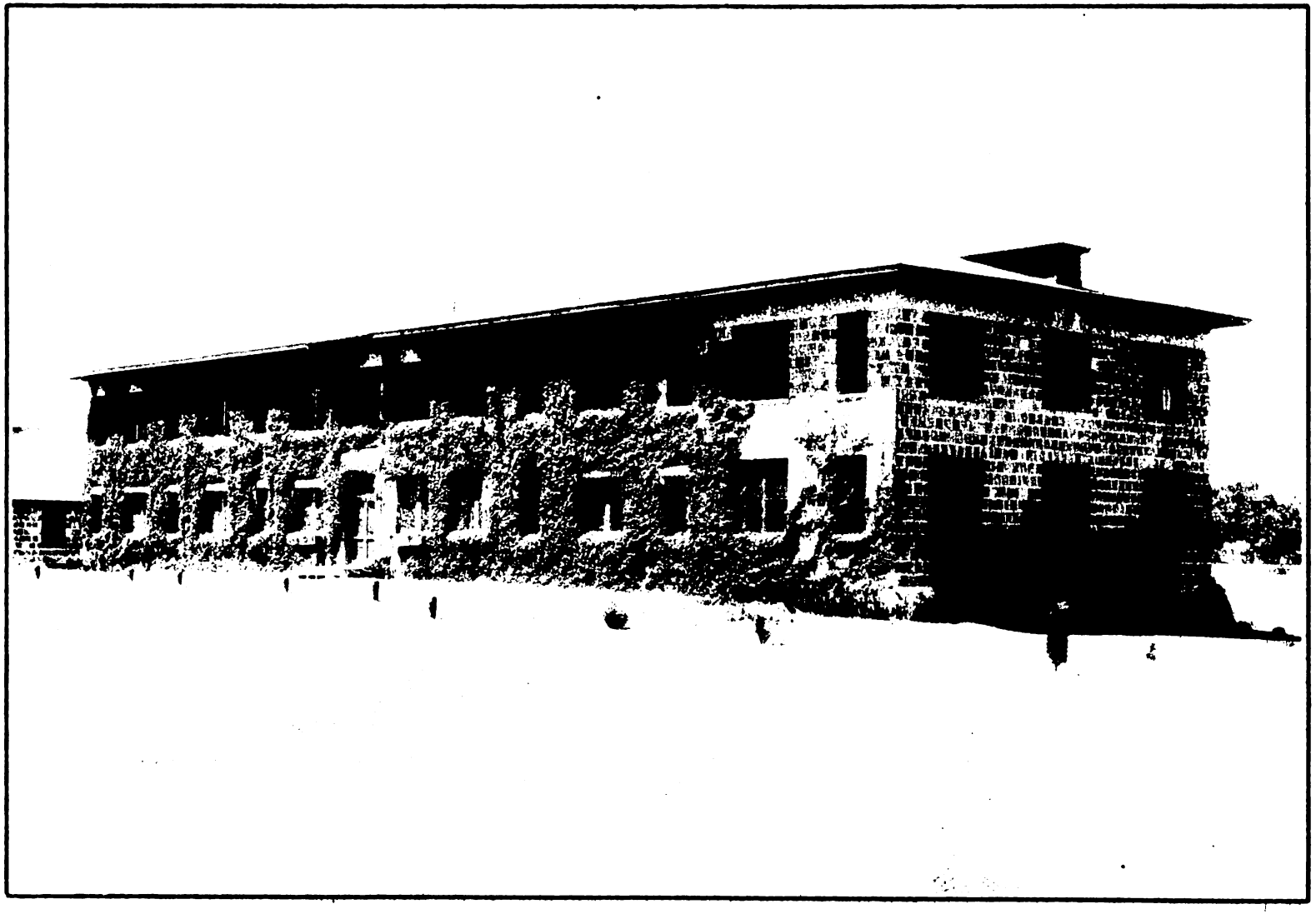

The Chemical Warfare School
Adminstration Building

CHEMICAL WARFARE

VOL. 18 JULY, 1932 NO. 3

THE 5TH FIELD OFFICERS' COURSE, 1932

The 5th Field Officers' Course, The Chemical Warfare School, commenced on July 5th and will end on July 30th. The following officers are in attendance:

Lt. Colonels

Gunner, Edwin, Inf.
McKinney, Garfield L., M.C.
Spalding, Merrill E., Inf.
Barrows, Frederick M., F.A.

Majors

Waterman, John J., F.A.
Sloan, John E., F.A.
Creed, John E., Inf.
Armstrong, Francis T., F.A.
Stiness, Henry W., Inf.
Dabney, Albert S., M.C.
Bull, Harold R., Inf.
Freehoff, William F., Inf.
Smith, Truman, Inf.
Daniels, Robert W., Ord. Dept.
Johnston, Edward S., Inf.
Woods, Samuel A., Jr., U.S.M.C.
Hammond, Claude G., Inf.

Captains

Marshall, William M., U.S.M.C.
Douglas, John N., Q.M.C.
Gibbon, James I., Cav.
During, Fred, Inf.
Booth, Charles J., Cav.
Herrington, Russell M., C.E.
Ballard, James L., Inf.
Foss, Elmer T., Q.M.C.
Muir, James B., Jr., C.A.C.
Coghlan, James J., Inf.
Wynne, Andrew J., Cav.
Anderson, Sam W., C.A.C.
Tallant, Richard E., Cav.
Atwell, Richard N., Cav.
Ulsaker, Carl M., Inf.
Steiger, Wallace C., Cav.
O'Keefe, Cornelius, Cav.
Bone, Bert A., U.S.M.C.
Storms, Harry E., Sig. C.
Prime, Charles P., A.C.
Raley, Edward W., A.C.

1st Lieutenants

Ackerman, Stephen W., Inf.
De Armond, James K., A.C.

TACTICAL PROTECTION

By: Captain John C. MacArthur, C.W.S.

The measures of protection against chemical warfare, individual and collective, are generally of a passive nature. They alone do not suffice. Active security provisions are required to supplement them. These include chemical combat intelligence and reconnaissance, posting of gas sentries, advance selection of alternate positions to occupy in case of an attack with persistent agents; offensive action to forestall enemy gas operations; in general, the tactical handling of troops to avoid excessive gas casualties in carrying out their assigned mission. All such measures may be classed as tactical protection.

It is of primary importance that troop commanders realize the time required to deal with gas situations and that they make allowances accordingly. One of the outstanding advantages in the employment of chemical agents is that they subject the enemy to serious delays due to the necessity of his wearing gas masks, to changing route of march to avoid gassed areas or to preparing such areas for reasonably safe passage through them.

For men not habituated to wearing gas masks at hard work for long periods wearing of masks reduces their efficiency by one-third for the first hour and by two-thirds for subsequent periods. This applies to rates of march as well as to other activities. Hence, in planning troop movements of any kind the probability of encountering gas - where, when, what kind and for how long a time - should be estimated and allowed for.

INTELLIGENCE AND RECONNAISSANCE

As a basis for estimate of the probable gas situation, all possible information of the enemy's chemical activities, intentions and preparations should be obtained. For this the general intelligence system of the Army supplemented by continual "gas reconnaissance" is relied upon. Each combat unit down to the battalion has one or more officers charged with supervision of chemical warfare protective measures in his unit, including chemical intelligence and reconnaissance.

Gas reconnaissance begins upon entry of troops into the gas danger zone, increases in importance as they approach the enemy's position and continues throughout their subsequent en-

gagement. The depth of the gas danger zone, is limited only by the radius of action of enemy aircraft.

On the march gas reconnaissance prevents surprise encounter of gassed areas and enables commanders to select routes of approach and camp sites which are the least favorable to the enemy's employment of chemicals.

In battle, such reconnaissance develops information of the enemy's intentions, lessens the chance of surprise, and may make possible the destruction of the enemy's gas installations before he is able to launch his attack.

Reconnaissance is of no value, however, unless the information obtained by it is reasonably accurate and unless it is communicated to commanders in time for them to use it. Thus, as circumstances dictate, all means of communication in the field from airplane radio to runner should be employed for transmiting chemical intelligence.

While all information of chemical activities is important, two classes are especially so and should be emphasized, viz:

(1) The location and extent of areas contaminated with persistent agents, such as mustard gas. Timely warning of such areas not only enables advancing units to avoid them, but when the facts are corelated at the headquarters of the higher echelons, the location of these areas may give important indication of the enemy's intentions. In attack he will invariably avoid such areas sending his assaulting elements around or between them.

(2) Speedy identification of the chemical agents employed by the enemy. In every gas attack which causes numerous casualties,or whenever there is any question as to the exact nature of the chemical agent used, a dud shell, piece of contaminated earth or other sample of the agent, should be forwarded to the rear without delay for analysis by the Chemical Field Laboratory. If the agent is some compound against which our gas masks are not designed to protect, it is of vital importance that this fact be promptly determined and that the necessary additional protective measures be devised without delay. Failure to protect against a powerful new agent might well result in defeat if not

annihilation.

GAS SITUATIONS AT A DISTANCE FROM THE ENEMY

Beyond the range of artillery fire the gas protection problem resolves itself into a question of the enemy's air operations.

The radius of action of military aircraft, while great, is not unlimited and in stabilized warfare it will be comparatively easy to establish relative danger-zone limits. Since enemy airdromes will probably be not less than fifty (50) miles in rear of his front line, the zone in rear of our own front subject to bombing aviation will be about three hundred and fifty (350) miles deep. Included in this zone an area or zone about one hundred and twenty (120) miles deep will be subject to both bombing and attack aviation operations.

In mobile warfare, areas entirely out of range of enemy air activity will be more difficult to determine. Their vulnerability from the air will vary perhaps from day to day as the situation of the ground forces changes.

In either case, an efficient intelligence and gas alarm system will be essential.

Superiority of the air by friendly air forces cannot be relied upon to immobilize enemy aircraft. While friendly aircraft and anti-aircraft activities constitute the first line of defense, they cannot be expected to entirely prevent enemy air attacks.

In areas far to the rear, i.e., beyond the 120-mile zone the danger of aero-chemical attack, although much less than near the front, will necessitate provisions for Individual and Collective Protection. It does not appear however that within these areas any tactical measure of gas defense other than anti-aircraft provisions in general will be either possible or necessary. Distant air operations by the enemy will be conducted primarily for destruction of important military activities and works such as supply depots, munition factories, etc., the moral and casualty effect of such attacks being of secondary consideration. It therefore appears that chemical agents will be used in such operations principally in conjunction with high explo-

sives to prevent or delay the repair of damage caused by demolition bombs. It should nevertheless be kept in mind that future developments in chemical warfare and aviation may result in a much wider application of chemicals against distant targets than is now generally foreseen.

Within the 120-mile zone troops and military installations will be in constant danger of chemical attack from the air. High speed attack airplanes while of comparatively short cruising radius are designed for operating at very low altitudes against ground targets. Flying barely over the tops of trees and making use of all available cover,such planes, especially in wooded or hilly country, descend upon their targets with little or no warning. They launch their attack and are gone from view in a matter of seconds. Of the various weapons which such airplanes can employ chemical agents are their most serious menace. Consequently in this zone the approach of hostile aircraft should invariably be regarded as a probable chemical attack and protective measures should be devised from this point of view.

Troops in column or bivouac and convoys are especially vulnerable to this form of attack. Even where sufficient warning is given deployment offers little chance of escape from a well executed chemical attack under favorable conditions. Morever, the necessity for adjustment and wearing of gas masks and such other protective equipment as may be provided will interfere considerably with anti-aircraft fire. In view of these considerations concealment is the best protection and measures to this end whenever practicable should be adopted for safeguarding movement of troops and supply columns. Such measures will not only lessen the chance of excessive casualties but will insure against disruption of marches and consequent delays, to cause which is perhaps the chief mission of attack aviation. Night marches, avoiding roads easily seen from the air,should prevail. For large movements of either troops or supplies by road, use of covered transport vehicles, possibly rendered gas proof, will also greatly reduce the danger of chemical attacks. Judicious use of the road-net, splitting the convoys into separated sections and avoiding routine-scheduled traffic over main highways will likewise aid in protection. For long movements which cannot be completed in one night, layover points such as woods or villages, where the convoy can remain concealed during the daylight hours should be selected in advance.

The danger of gas attacks against movements by rail will probably be slight except at loading and unloading points. Use of a number of such points to avoid large concentration of troops in any one area is most desirable.

The liklihood of frequent attacks against line of communication establishments particularly those near the front will materially influence the supply arrangements. It is probable that railheads will have to be placed farther back than heretofore and that greater dispersion of activities in general will be required thus imposing increased burden on road transportation.

GAS SITUATIONS IN CLOSE APPROACH TO THE ENEMY

As troops approach the enemy's position, especially after they come within range of artillery fire, the probability of chemical attack is further increased. Tactical Protection during this phase is of vital importance.

Each arm is charged with devising suitable tactics for the advance of its troops to positions preparatory to battle. The object is in each case the same, namely, to accomplish the movement with the minimum danger of casualties, though the particular means may differ among different classes of troops - infantry, cavalry, artillery, etc.

It is not possible to lay down hard and fast rules for gas protection applicable to the same extent to all arms and all situations. Certain general principles which each arm can apply and adapt as circumstances permit are however set forth in the following discussion.

(1) Tasks which are impossible to accomplish without excessive losses due to chemical agents should not be assigned. It must be understood that if troops are required to remain in a heavily contaminated vesicant gas area for any considerable time, they will all be casualties; similarly if such troops are required to traverse an area where liquid vesicant gas will be splashed on their clothing, they will suffer severe casualty burns unless elaborate preventive measures are taken immediately after leaving the area.

(2) Alternate routes of approach should be selected in

advance. - In addition to the route selected for a movement one or more alternate routes for use in case the route first selected in gassed should be reconnoitered in advance. If not easily distinguishable at night the alternate routes should be suitably marked. Selection of alternate routes is particularly applicable in the case of unit advancing to assembly positions preparatory to battle or to take over a part of the front. It should be realized that while the zone of advance may be clear of gas when it is reconnoitered it is likely to be gassed later on. The enemy will seek to lay down gas at a time calculated to obtain maximum effect and if possible when it is too late for any material change to be made in the plan of advance to avoid gassed areas.

(3) Routes of approach traversing high ground are preferable to those through valleys or ravines. - Each situation of course, will have to be met on its own terms. It may sometimes be the case that the cover and concealment against other weapons offered by low ground will outweigh the gas protection advantages of high ground.

(4) Routes of approach on the lee side of hills are preferable as regards gas protection to those on the windward side.

(5) Wooded defiles and ravines should be regarded with suspicion,avoided if possible, and in any case reconnoitered for gas before marching into them. Such places contribute to the persistency of gas, make deployment off roads difficult or impossible and hence are likely positions for sudden chemical attack from the air or for contamination in advance of the arrival of troops which must pass through them.

(6) Advance guards should include a gas reconnaissance officer or party and a sufficient number of degassing troops. - Such troops provided with protective clothing, necessary tools and defense chemicals, will be able at least to deal with minor gas situations encountered on the march such as contaminated bridges, road junctions and obstacles on the road, thus obviating serious delays of the main body.

(7) Upon finding an area contaminated with persistent gas, its location and extent should be marked and reported immediately to higher authority. - If possible to decontaminate the

area this should be done. Otherwise the area should be marked with a sign indicating the gas danger and giving the date on which the gas was discovered. This will enable other troops encountering the area at some later date to determine whether the area is still likely to be dangerous. The location of the area should be reported immediately to the next higher headquarters for notation as the "gas situation map" and warning of all concerned.

(8) The primary rule of protection upon encountering a persistent gas area is to avoid it. - This is preferably done by passing the area upwind. If not possible such an area, for instance one containing mustard gas, may be passed downwind at 1000 yards distance with probable safety. When necessary to pass closer to the area, or, in any case, if the odor of gas is detected, gas masks should be worn. It should be realized that passing through the area involves risk of excessive losses in gas casualties.

(9) It is probable that troops wearing ordinary clothing and heavy-soled shoes can march over a hard road through a mustardized area for a period of thirty (30) minutes or less with reasonable safety. - Gas masks, of course, should be worn, and, if possible, the troops should shuffle their feet through a mixture of chloride of lime and earth before entering and upon leaving the area. Where practicable, badly contaminated patches of the road should be covered with earth, if possible, mixed with chloride of lime. Another expedient would be to have men tie gunny sacks or other such covering over their feet for passage of the area. Continuing the march over turf land after leaving the area will be helpful toward preventing foot casualties if no better means of protection are afforded.

(10) When necessary to traverse an area of high grass or underbrush contaminated with a persistent vesicant gas, the danger of casualties will be greatly reduced by cutting lanes across the area to facilitate passage of troops. - Men detailed for this work should be provided with protective clothing. The number of lanes cut and their width will depend on the time and means available, and the tactical situation. It should be understood that unless some such provisions are made to prevent liquid mustard gas from being brushed off into the men's clothes, they are all likely to be casualties.

(11) Long grass land contaminated with mustard gas or similar agents may sometimes be burned to render it safe for passage. - During such burning,troops,including adjacent friendly units,should be kept upwind of the area as the heat generated will cause a high concentration of gas to be given off.

(12) In selection of sites for camps and bivouacs, high ground sheltered from the wind presents the least danger from gas. - Scattered trees affording some degree of concealment from the air are of value but heavily wooded areas,especially ravines should be avoided. In such places even generally nonpersistent gases are likely to remain in dangerous concentration for some time. Water sources at camp sites should be carefully examined for gas contamination before use.

(13) Gas sentries should invariably be posted over sleeping men to awaken them in time to adjust masks in case of gas attack. - Where troops are halted for the night, alternate positions for them to occupy in case of attack with persistent agents should be selected by each unit.

(14) In pursuit of a retreating force gas reconnaissance is of special importance. - Chemical agents are of great value in covering a retirement. Airplanes,artillery and especially static means of contamination may be used to establish gas barriers in the path of a pursuing force. The tendency of troops in the excitement of pursuit to relax in vigilance will result in their blundering into such contaminated areas unless adequate gas reconnaissance is conducted throughout such operations.

(15) Protective measures against low flying aircraft should be invariably provided for chemical attack. - Schemes for rapid deployment on the approach of hostile aircraft offer more promise of protection against other types of airplane weapons than against chemicals but the utmost in gas protection should nevertheless be sought in devising these precautions. Every such attack should be regarded as a chemical attack and troops should adjust all gas protective equipment immediately. To delay adjusting masks until it is determined whether gas is being used may be disasterous. Troops should also be trained not to look up until after gas masks are adjusted as otherwise they may be blinded by a chemical spray which falls like rain. On roads lined with trees and in cuts and defiles the upwind side of the road will offer some cover in case of a lateral wind. Training

in anti-aircraft fire should include use of gas protective equipment.

GAS SITUATIONS IN BATTLE

In battle position. troops will be subject to attack with all types of chemical weapons. Tactical Protection during this phase depends largely upon the character of the chemical agents employed, whether nonpersistent or persistent,and are discussed under those headings here. There are a few fundamental rules, however, which apply to all forms of gas attack.

Offensive action coupled with movement offers the surest means of protection against chemical agents. Troops in stationary position are an ideal target for gas which penetrates all ordinary cover. Artillery can be used to advantage to forestall gas attacks or prevent the enemy from exploiting them. Whenever installations or preparations for the projection of gas by whatever means are located, they should be promptly bombarded with a view to their destruction. Airplane observation will aid in locating such targets. When occupying a defensive position barrage fires to protect against an assault in force following a gas attack should be provided for. These should particularly include the areas lying between positions in which the enemy has laid gas of the mustard type, since he will avoid such positions in his advance.

Large scale attacks with nonpersistent agents are especially applicable to stabilized warfare. However, the possibility of this form of attack in mobile warfare should not be overlooked. The enemy in operating against prepared defenses and wnenever it may otherwise be practicable for him to bring forward and install the large amounts of chemical munitions required for such attacks, may resort to them. Nonpersistent gas attacks depend for success primarily on surprise, consequently steps must be taken to prevent troops from being caught unawares. It should be understood that these attacks are generally made at night or in the early morning when troops are likely to be asleep. Alert gas sentries are of vital importance.

At the outset of such an attack, the alarm should be sounded, troops awakened, and gas masks adjusted. Gas shelters if provided, should be put in operation. Fire positions should be manned and all unnecessary movement should cease. Troops

should be prepared to meet an assault.

Following the attack, trenches and dugouts should be cleared of gas, shelters opened and ventilated, and inspection made of personnel,equipment, ammunition and food supplies to determine the damage caused by the gas, if any. Report of the attack including kind and approximate amount of gas used should be rendered to the next higher headquarters. Casualties should be evacuated. Troops should be on the alert for another gas attack. Artillery and machine gun fire to break up an assault immediately following such a gas attack should be prearranged.

Persistent agents of the vesicant type such as mustard gas are much more difficult to protect against.

In defensive situations prominent positions in the defended line offering especially favorable fields of fire, and which the enemy will otherwise have to take and occupy to carry through his attack, are likely to be neutralized by gas such as mustard. Positions which he will need to occupy himself he will not contaminate with such agents.

It follows that the safest procedure in such a case is to withdraw all troops from the contaminated area. Troops so withdrawn should occupy some previously selected position free from gas. It is obvious,however, that disastrous confusion will result unless such changes of position are definitely controlled and coordinated throughout the command. Alternate positions masked by the fire of other friendly units cannot be used unless these other units themselves change position accordingly. Hence, for forces in a position which they expect to occupy for as much as twelve (12) hours, it is essential that a definite "Plan of Protection against Persistent Agents" be formulated. This plan should be drawn up when the position is taken. To insure maintenance of fire power and prevent loss of control, the plan of each unit from company up should be coordinated and approved by the headquarters of the next higher unit, i.e., company plans by the battalion, battalion plans by the regiment,and so on. Under such a scheme, if,the position of a certain battalion is contaminated, the plan of the regiment to which the affected battalion belongs is immediately put in force. If a greater degree of adjustment is required, the brigade plan is executed, etc.

The plans of protection of higher units such as the

division will be broad in scope. They will cover the several more likely contingencies and may involve material changes in disposition of subordinate units which these units would not be justified in making on their own initiative. For instance, such plans may call for the withdrawal of a unit from its sector entirely giving it some new mission.

In some cases it may be of vital necessity to maintain fire from a position contaminated with mustard gas. The length of time that men can remain in such an area before succumbing to the gas will depend primarily upon the concentration and their protective equipment. If the concentration is high the period of usefulness of troops in ordinary clothing, remaining in the area, will probably not be more than a few hours. It would, therefore, be foolhardy to consider manning the area with any considerable number.

When the concentration in such an area is not so high as to produce casualties within a very short time, and it is deemed imperative to utilize the position only as few men as are absolutely essential should be left in the area and they should be provided with all possible means of protection. Such gas decontamination as may be practicable, for instance about machine gun positions, should be undertaken and the men in the area should be relieved every hour,or oftener if practicable. It may sometimes be feasible to withdraw initially all men from the area, sending a small number back into it only when fire from this position is required.

The flanks or rear of a mustardized area in a defensive line may offer suitable positions for the organization of counter-attacks, since it is likely that the enemy's artillery fire will have been shifted to other positions after the mustard gas has been laid.

Artillery will be subject to counter-battery fire with gas of all sorts. In a sudden heavy bombardment of an artillery position with persistent gas, it may sometimes be expedient to withdraw all personnel temporarily,leaving the guns in position. After the bombardment ceases the area must be decontaminated or else new firing positions selected. As a general rule,artillery as well as infantry should prepare in advance for occupying alternate positions in case of persistent gas attack.

The enemy on the defensive may be expected to employ persistent gas on areas to his front and flanks through which attacking troops will most likely have to pass. In the selection of routes of approach, obvious points of danger should be avoided. In any case, efficient gas reconnaissance will determine their location in time for provisions for dealing with them to be made.

THE SIGNAL CORPS AND THE CHEMICAL WARFARE SERVICE

By: 1st Lieut. Milton T. Hankins, S. C.

The closest liaison must be maintained between the Division Chemical Officer and the Division Signal Officer when in contact with the enemy. The interdependence of the Signal Corps and the Chemical Warfare Service is more important than casual observance would indicate.

There are six important considerations in connection with these two branches, viz:

1. The influence or weather upon chemical warfare operations.

2. The necessity of communication between the division chemical officer and the unit gas officers of the division.

3. The influence of chemical agents upon the selection of command posts.

4. The protection of the command posts.

5. The laying of field lines as influenced by chemicals.

6. The protection of signal communication personnel and equipment.

The greatest single factor in the use of chemicals is the effect of weather; heavy rains may wash out chemicals, cold may prevent the use of certain agents, wind may take the gas cloud in the wrong direction and high winds break up gas clouds. It is part of the duties of the Signal Corps to furnish meteorological data and weather forecasts to the army. As most chemical

operations are planned in advance,the weather forecast is of vital importance and must be in the hands of those making the plans. Weather conditions are often not only the deciding factor in the success or failure of an undertaking but may also indicate the plan of the enemy in increasing the probability of a gas attack. The Signal Corps personnel will make and issue forecasts at 8:00 AM and 8:00 PM daily which should be in the hands of the Chemical Warfare Officer as soon as possible so that he can make his plans.

Provision should be made for efficient communication between the unit gas officers and the division chemical officer. Whenever gas is used by the enemy, the unit gas officer should notify the division chemical officer of the time of fire, kind of gas and the place where used, as soon as fired. Special consideration must be given this communication in order that gassed areas may be avoided, preventing many casualties. This data may also indicate to the division chemical officer what action the enemy is going to take.

In the selection of positions for command posts the use of chemicals by the enemy should be given serious thought. In active service each unit of our army down to and including the company has its headquarters divided into a forward and rear echelon. The forward echelon of the headquarters is known as the command post. Here the commander has personnel and equipment for assistance in tactical operations. To insure continuous command in action, especially when movement is anticipated, successive locations for the command posts are selected in advance. These successive locations are known as the axis of signal communication.

There are five people at the division command post who are interested in the selection of its position. The division commander is responsible to his superior for all the division does or omits to do. True, he has a staff which may or may not be capable of performing the functions of relieving the commander of details but no matter how good a staff may be, it does not relieve him of his responsibility for policies, plans and decisions. He must have a plan of command which includes the axis of signal communication for the brigades as well as the division when the division is acting alone.

The axis of signal communication with the selection of

command posts naturally falls under the duties of the division signal officer. He is a special staff officer provided to make recommendations relative to the most suitable locations for the command posts. Since communication is essential in the command and control of troops the selection comes under the duties of G-3. The Chief of Staff is vitally interested in the chain of command. The division chemical officer who is interested in the protection of the command post is the fifth staff officer who should know the factors influencing the selection of command posts.

In considering these factors Training Regulations 160-5 on the selection of command posts are as follows:

"6.c(1) The neighboring terrain should afford covered routes to the front,rear and flanks, suitable for wire lines and messenger routes.

(2) The command posts should be located so as to afford most favorable signal communication to the unit making the main effort.

(3) The command posts should be sheltered from hostile observation and fire."

I believe the following paragraph should be added:

6.d When the enemy is using chemical agents, location in valleys,stream beds or in heavy woods should be avoided whenever possible. A location higher up on the side of the valley or in a less thickly wooded place is preferable. Thick rank vegetation should be avoided and the chemical or gas officer of the unit should be consulted.

Valleys, ravines and stream beds should be avoided because gas is heavier than air. It is heavier than the surrounding air, first, because all war gases have higher specific gravities than air and, second, because air around the gas is colder than the neighboring air. Cold air is heavier than warm air. Upon release from the containers gas expands enormously, thereby taking heat from the surrounding air leaving it at a lower temperature. The heavier gas cloud behaves much like a liquid flowing over the ground. It has a tendency to seek the lowest spots and of its own accord flows down hill even against light cur-

rents of air. This causes gases to flow into trenches, shell holes and dugouts making them intolerable. On the other hand gas flows around rather than over high areas leaving gas free places on the terrain.

Woods and places with thick vegetation should be avoided as gas is more effective in woods than in the open. In wooded areas we have air bursts of shells leaving all the gas in the air instead of some being forced into the ground as in a surface burst. The weather conditions in a wooded area are the same as would exist on a clam, cloudy day in the open, very favorable for the use of gas. The trees prevent most of the sun's rays from reaching the ground, thereby not allowing convection currents to lift the cloud from the surface. Likewise the trees break the wind speed so that the gases are not blown away. Tne persistency of a gas may be several times as great in a wooded area as in the open. Again in wooded areas with thick vegetation mustard gas is more effective due to the fact that the liquid mustard clings to the leaves and vegetation and men in the area will brush up against this mustard with many casualties resulting.

The persistent gases cause the most trouble at command posts. They could be put down by shell fire from the enemy artillery or from bombs or spray from enemy aircraft. An area that has been subjected to mustard or other vesicants could not be considered for the location of a command post. Even though part of the area might be neutralized, some gas casualties would result, and the time and material needed would make it advisable to select another location. However,if the command post is subjected to a vesicant gas the area could be used if sufficient protective clothing and neutralizing material are available but continued operations in the area would not be practicable.

In the protection of a command post there are many possibilities for future development. At a command post there will be offices for the various staff officers, sleeping quarters, message center, radio station and a telephone switchboard, in the last three of which the Signal Corps is particularly interested in the matter of protection.

At the message center there will be clerks,messengers, motorcyclists, tables, chairs, stationery, books,cypher devices, telephones and, in some cases, pigeons. It is set up and goes

into operation as soon as the division commander halts. It would be hard to protect a message center even though a gas proof shelter were provided as there are so many messengers and other people moving in and out that the place would soon be contaminated. When working in gas the best protection would be masks and protective clothing with frequent shifts and a minimum number of men to keep the message center in operation.

The telephone centrals for the larger units could be protected. The switchboard could be worked in a gas proof truck or it could be placed in a tent that could be made gas proof; the switchboard being inside with the cable from it to the terminal strips long enough for the latter to be placed on the outside.

The radio station could be protected in much the same manner. One thing to be considered is the length of time required to make a tent gas proof. It is believed that a GMC truck could be made to serve each purpose.

For the smaller unit a rolling command post could be designed which could be made gas proof and in it the various offices could be contained. For example, a GMC with curtain rolls which would be extended to the sides and front and a pump to pass air through a purifier could be rigged up to the motor of the truck.

In the laying of lines contaminated areas and areas expected to be contaminated should be avoided if possible. The closest liaison must be maintained with the division chemical officer so that mustardized areas may be made known to the construction personnel. When the enemy is using gas,the bottoms of valleys, ravines and thickly wooded areas should be avoided.

Protective measures must be taken for the signal personnel when gas is being used. Tactical considerations may make is necessary to route wire lines through gas, also broken wire lines must be repaired even in a mustardized area. Linemen should be equipped with masks, impregnated clothing and impervious shoes and gloves. The gloves should be of a soft pliable material so as to permit the man wearing them to splice wire and do other lineman's duties. Signal personnel should be given protective training in the operation of communications under gas conditions.

When gas is used it will require more men to perform a task. Men working in masks with thick gloves and protective clothing will require more time to put in a line and more time to make tests and repairs after the line is in. The telephone switchboard operator will not be able to work as fast with a mask on. The speed of the radio operator will also be lowered. The Chemical Warfare Service has developed the diaphragm mask which works fairly well. However, the hand set of our present type telephone is not long enough to talk into the transmitter and listen in the receiver at the same time. It is necessary to move the hand set back and forth when using it while wearing a mask. In addition the diaphragm mask prevents clear transmission through the telephone. The result will be that it will require more operators, clerks and linemen to do the work when gas is being used.

Much opportunity is left for the development of protective equipment for the Signal Corps. A gas mask with the transmitter inside the facepiece or a hood containing ear-phones and a transmitter would be a welcome addition to the present equipment. The rolling command post mentioned above would do much to cut down the number of gas casualties as would the impervious lineman's glove. Methods for the protection of equipment such as switchboards, radio sets, telephone wire and projector lamps should be considered. Some of the war gases and smokes are corrosive while others such as mustard are absorbed by wood and may give casualties for weeks after being contaminated.

In closing, while methods for the protection of equipment should be considered, the important thing is the protection of personnel. The Signal Corps is not concerned with the offensive use of gas, with the possible exception of screening smokes in the establishment of advance observation posts. The big problem is the protection of signal personnel and the closer the liaison between the division signal officer and the division chemical warfare officer, the greater the protection that can be furnished.

THE EFFECT OF CHEMICAL AGENTS ON BRIDGE OPERATIONS

By: Captian F.H. Kohloss, Corps of Engineers

CLASSIFICATION OF BRIDGE OPERATIONS. - Military bridge operations may be classified as follows:

a. Footbridge construction.
b. Ferrying.
c. Light ponton bridge construction.
d. Heavy ponton bridge construction.
e. Fixed bridge construction.

Footbridge construction and ferrying operations in general are preliminary to a forced river crossing, and are necessary for the passage of an infantry covering force under the protection of which a light ponton bridge is built to enable the main attacking force of the division,its combat trains,and light artillery to cross.

Heavy ponton bridges and fixed bridges are for the passage of the heaviest divisional, corps, and army loads. They are erected much farther to the rear than the light ponton bridge, and are restricted as to location by the main roads upon which the heavy loads as a rule must travel. For the latter reason, these bridges are targets for long range artillery and airplane bombs and the use of chemical agents in such a manner by the enemy is a problem that must be faced. And, in the case of a retreating enemy,these bridge sites very likely will be heavily gassed with mustard or Lewisite or some new and equally persistent casualty producing chemical agent. This will make it necessary that we be prepared for "de-gassing" these sites or for extensive road and abutment construction so as to avoid them.

Due to the lack of time and space, this paper will now be limited to a more detailed discussion of footbridge,ferrying, and light bridge operations. However, in the case of the other three bridges listed in the initial paragraph, a real problem is indicated,and it is hoped that further consideration of the general subject will go more into detail concerning it.

DETAILED DISCUSSION OF BRIDGE OPERATIONS. - Footbridges: The standard model M-II Kapok footbridge consists of a number of rafts, lashed end to end, forming a floating roadway.

The rafts are lashed together on a line normal to the stream with the stream end of the bridge as near the water as conditions permit. Technical considerations require that the bank from which the bridge is launched be not excessively steep. Tactical considerations require that our shore end of the bridge be easily accessible for the infantry, and that the enemy bank at the opposite side be suitable for prompt deployment of the covering force.

Footbridge sites, although in some instances limited to the vicinity of the site of the light ponton bridge which is to follow, generally may be located at numerous points along the stream. Since the footbridge is limited as a rule to streams of less than 100 yards in width, close support from the friendly bank may be furnished the crossing operation.

The use of chemical agents in support of the crossing will likely be confined to smoke (not WP except in favorable wind). And if smoke be used generally at several suitable points, the element of surprise will be maintained. The employment of chemical agents to oppose the crossing operation will depend upon the future intentions of the enemy, the direction of the wind, etc. A favorable wind from our point of view may permit the use of nonpersistent casualty agents; while conversely, a favorable wind for the enemy will permit him to use the same agent. If he has no intention of eventually forcing us back across the stream, the enemy may use persistent casualty agents. In any case, the effect of chemical agents upon footbridge operations exclusively will be negligible due to the small amount of preparation and engineering work involved. Gas masks may be worn by the bridge launching detail without serious loss of effectiveness or time. On the other hand, the success of a footbridge operation may depend upon the wind direction. An unfavorable wind probable would result in the postponement of the operation against an enemy well supplied with chemical munitions.

Ferrying Operations: Ferrying may be employed in conjunction with footbridge operations in the case of a narrow stream. For the purpose of this paper, we will confine the discussion to a stream too wide for footbridges and yet narrow enough for ponton bridges - say around 500 yards. There is no definite limit to the length of a ponton bridge. The character of the stream; the activity of the enemy; etc., are more important restrictions than the width of the stream.

If a stream crossing is to be successful provision must be made for the prompt and effective support of the covering force. This is usually effected by the construction of a light ponton bridge under the protection of the covering force that has been transported across by ferrying.

Ferrying sites are restricted in general by the site of the ponton bridge that is to follow. Since there are never enough pontons to carry out the ferrying operation independently of the bridge construction, and since the bridge must be constructed as soon as possible after the covering force has been landed, it follows that the ferrying sites (particularly on our bank) must not be so far from the bridge site as to cause undue loss of time in reassembling the pontons at the proper point for bridge construction. The debarkation site in a ferrying operation is subject to the same tactical considerations as in the case of the footbridge. The covering force must land at a point suitable for prompt deployment,and in addition,it must cover the enemy end of the ponton bridge to follow.

The technical considerations involved in a ferrying operation are the necessity for some cover for the pontons if brought up before the night of the operation; or much greater preparation for the prompt arrival of the pontons at the bank by dusk of the night of the operation. The ponton,model 1925 Light Ponton,is launched by hand,and may be propelled across by a crew or by an outboard motor. The use of smoke for covering the actual ferrying operation even at night is clearly indicated particularly since the use of flares may afford sufficient illumination for aimed small arms fire. Again the use of smoke,WP smoke since the opposite bank is far enough for the safe use thereof, at several locations may preserve the element of surprise particularly if outboard motors are used at sites not selected for the actual crossing. And in a favorable wind harassing and non-persistent casualty agents will be of immeasurable benefit; conversely, an unfavorable wimd may permit the enemy to deny the crossing through the use of these same agents.

Again it appears that the direction of the wind will exert a controlling influence upon the probable result of this operation, but this is from a tactical rather than a technical viewpoint. The engineers can conduct their part of the ferrying operation almost as easily with gas masks as without if outboard motors are used as medium of ponton propulsion.

Light Ponton Bridge Construction: While the sites of light ponton bridges are not restricted to the actual road crossings of streams, nevertheless they cannot be very far therefrom due to the probable necessity for extensive approach and abutment construction which is well nigh impossible within the time usually available.

The general scheme for light ponton bridge construction presupposes the landing of a covering force on the opposite bank (by footbridge or ferrying); the driving back of enemy lines so as to eliminate or minimize aimed small arms fire on the bridge-erecting crew; and the passage of additional infantry with infantry weapons all between dusk and daylight. Time, therefore, is at a premium.

The construction of the ponton bridge requires not only familiarity with the equipment, but much exhaustive labor as well. To require the bridge force to don their gas masks will immeasurably reduce the efficiency of the crew, and this means greater time required for construction, as well as more delay in placing additional infantry with its machine guns, one-pounders, trench mortars, and mules across, (as well as combat wagons).

When the actual construction of the bridge has begun it may well be anticipated that the enemy will use harassing and casualty agents all along the river at the probable ponton bridge sites. It does not appear that we will be able to do anything about this except to wear gas masks. If the enemy is able effectively to use mustard (or another persistent casualty agent) on the site of the bridge, the engineers must be prepared for heavy casualties, much more loss of time, and in addition must be prepared to demustardize the bridge and approaches.

If ponton bridge sites are few, and if the enemy does not intend eventually to cross the stream, he will be able to so fully mustardize the bridge sites on our bank as to practically preclude the construction of a light bridge except with impermeable clothing.

CONCLUSIONS. - In the case of footbridge and ferrying operations, the use of chemical agents appears to be advantageous to the force attempting the crossing, particularly if the wind is favorable. In the case of light bridge construction, the use of chemical agents appears more advantageous to the defender.

Bridge operations are generally confined to the period from dusk to dawn - the time most favorable for the use of gas. Likewise, ponton bridge sites are at low points with generally level approaches on each bank - also a condition favoring enemy use of gas.

River crossings in the face of an alert and well-equipped enemy have always depended upon the element of surprise for their success. With the advent of chemical agents, it appears that the element of surprise can largely be eliminated by the use of persistent agents at probable sites, provided that their number does not make necessary the use of a prohibitive amount of the agent.

On the other hand, if the engineers are well equipped with impermeable clothing, and if ample equipment, degassing agents, and numbers are available for clearing and construction, it is believed that forced river crossings will be possible in the future.

RECOMMENDATIONS. - Note: These recommendations are based on a rather superficial knowledge of the measures discussed, but are included in this paper in order that they may receive consideration, if only to be thrown out.

a. Combat engineers should be thoroughly trained in the use of chemical agents. Accordingly, a portion of each annual training period for combat engineer units, should be devoted to engineering operations under simulated field conditions in which chemical agents are used. For instance, we say that a ponton bridge can be constructed so many yards long in so many minutes. This is without the use of gas masks or impermeable clothing. To what degree will the speed of construction be influenced by the wearing of masks and impermeable clothing?

b. Combat engineers should add to their field equipment a sufficient number of bush hooks or other tools suitable for clearing mustard areas sufficiently to permit the passage of the infantry. This equipment may well be added to the infantry tools now carried by the divisional engineer regiment, and also may well be used by the infantry under the direction of the unit engineer officer.

c. Impermeable clothing should be available for engi-

neer troops in the construction of light ponton bridges. If the bridge must be built, and if mustard is used by the enemy, impermeable clothing is absolutely essential, otherwise the entire bridge building crew may become casualties. In addition, if mustard is used on both banks, the engineers will need this clothing in order to make the approaches safe for the infantry.

d. Detailed and explicit consideration should be given to chemical agents and equipment in our training manuals.

SUGGESTIONS FOR INSTRUCTORS IN REGIMENTAL OR POST CHEMICAL WARFARE SCHOOLS

(Fro[illegible] C.W.S., while Chemical Warfare Officer Philippine Dep[illegible]ce of officers carrying on chemical warfare instruction).

PURPOSE OF SUGGESTIONS. - These suggestions are intended to serve as a guide for instructors in the preparation, coordination and effective conduct of instruction. In it are laid down some broad, general principles which may be applied to any subject taught, and which, if carefully studied and intelligently used, should assist materially in perfecting instruction in chemical warfare.

MISSION. - The Chemical Warfare Service, among other missions, was given the following mission by the National Defense Act creating it:

"The supervision of the training of the Army in Chemical Warfare, both offensive and defensive, including the necessary schools of instruction."

This involves carrying on schools to train post, regimental and battalion chemical officers and regimental and battalion chemical noncommissioned officers. This mission also involves the supervision of the tactical training of organizations in chemical warfare.

The instruction of officers should not only cover the technique of training their respective organizations in chemical warfare, but should be broad in scope so as to cause them to think and act intelligently in terms of chemical warfare with

reference to the functioning of each arm and of the combined arms. A foundation should be laid to enable them to meet probable future developments in chemical warfare intelligently and effectively.

DISCIPLINE. - Discipline is the fundamental basis of the training of the army. Chemical warfare schools are a part of military training. Discipline should be used as an aid toward accomplishing the results sought. Military precision, exactness and system should be used. Discipline should, however, be flexible and should not prevent that freedom of thought and action necessary to accomplish the training mission.

METHODS. - Three principles are important in good instruction. They are simplicity, graphic presentation and the learning by doing, i.e., by the applicatory system on the part of the student.

a. Simplicity: The essentials of chemical warfare are simple and can and should be presented in a simple manner. To present a subject with brevity and simplicity requires first a complete and thorough understanding of the subject on the part of the instructor and second a careful detailed preparation before each presentation. There is a very natural tendency on the part of an instructor generally familiar with a subject, to fail to make detailed preparation and to fail to review the subject before each presentation. This reduces instruction below the plane of maximum efficiency.

b. Short answer type examinations may be used as a good check on the instruction and on the student. By means of this type of questions a broad field may be covered in a short period of time. This is not practicable with the old essay type question. The results of these examinations will enable the instructor to check his own efficiency in putting across his subject. These questions also furnish a quick and easy method of self examination by students. Psychological tests at the University of Chicago show that the average student will obtain 50% more from the study of any subject if he has in mind taking an immediate short answer type of examination on what he is reading. He will unconsciously look for important points concerning which questions might be asked and will fix these points in his mind. His correction of his own examination paper will add also greatly to his understanding of the subject. Exact references

should be given where the answers may be found. An excellent small book on this subject is, "Preparation and Use of New Type Examinations" by Donald G. Paterson, published by World Book Co., Yonkers-on-Hudson, N.Y. - price 65¢.

c. Graphic Presentation: Individuals in general learn most easily what they can see with their eyes or what they attempt to do. They grasp with difficulty and remember but a short time things which they have been told. Reduce verbal explanation to a minimum. Use graphic presentation wherever practicable by means of the object itself, pictures, drawings, etc. Explanation, demonstration and application are important in the order shown but the explanation must be brief, concise and clear and cover but one point at a time.

d. Learning by Doing - The Applicatory Method: Students will be called upon whenever practicable to think and act. The instructor should not attempt to talk chemical warfare knowledge into students' minds. The instructor's ingenuity should be directed toward originating schemes of practical instruction involving the actual use of material both on the terrain and in the classroom, and the application of principles on the part of the student. The students will be furnished texts, material, problems in the field and on the map and methods of self examination. Each officer should first obtain knowledge of certain basic facts and principles. The actual handling of chemical warfare materiel and munitions and the use of the short answer type examination are important means to this end. This knowledge should then be applied and tested by map problems, terrain exercises or tactical walks. These can be made simple to suit the previous tactical training of the student. Problems used at The Chemical Warfare School may be simplified and modified to suit local needs.

PREPARATION BY THE INSTRUCTOR. - a. Good instruction may be given by officers with no special aptitude for instructing when they make careful preparation for each class. Preparation is essential, no matter what the subject or who the instructor. It should include an analysis of the instruction memorandum of the day and hour for points to be covered and points which must NOT be introduced. It is easy for an instructor interested in his subject to allow the introduction of extraneous matter, or to get far ahead of the schedule to the confusion and detriment of his class. Arrange the points to be covered in a

logical sequence and determine how one point is to lead up to the next. Put this outline in concrete form on charts to be referred to during the instruction period. Then build up the day's program around it. Check carefully the fact that you have on hand all material required. Coach each of your assistants on his duties in connection with the instruction and the field problems.'

b. The instructor should avoid the very common error of giving verbally in conference or lecture the subject matter of a text which the student can obtain nore readily and efficiently by reading the text. The instructor should supplement the text with his wider range of knowledge and experience and should direct the student as to the relative importance of the various subdivisions of the subject and as to how to obtain the essentials without wasting time on non-essentials. The instructor should be prepared to cover briefly only those outstanding facts and principles necessary to guide and stimulate the student in his own thinking and acting.

c. The success of the conduct of a course depends largely upon the careful, detailed, previous preparation by the instructor.

(1) For a regimental or post school we should have available at least two experienced chemical warfare noncommissioned officers to assist him,and a working detail of 1 corporal and 4 men during the period of the school.

(2) Several weeks previous to the opening date of the course,the schedule should be gone over carefully and revised, if necessary.

(3) All material of every sort required for the school should be carefully listed and should be obtained,checked and stored conveniently for use.

(4) All instructional matter should be reviewed, the noncommissioned officer assistants coached and arrangements made for the necessary work detail to be permanent throughout the course.

(5) The school building and the terrain suitable for the practical field work should be selected and all neces-

sary preparations in connection therewith made.

d. When the school is finally in operation, the instructor should:

(1) Review carefully (preceding each days instruction) all instructional matter, including the examinations.

(2) See that all required material is on hand preceding each day's work.

(3) See that all assistants understand their duties thoroughly with reference to the next day's work.

TRAINING OBJECTIVES. - a. A student completing the course successfully should have achieved the following:

(1) A general knowledge of the purpose, organization and functioning of the Chemical Warfare Service.

(2) A practical knowledge of methods of care and repair of gas masks and of the important features of construction of the same.

(3) Ability to train a company,or similar unit, in gas mask drill.

(4) A practical knowledge of gas chamber procedure.

(5) Knowledge of the limitations of the army gas mask.

(6) Knowledge of the construction and use of gas proof dugouts.

(7) A practical knowledge of the first aid treatment of gas casualties.

(8) Ability to detect by odor:

(a) Mustard.

(b) Chloracetophenone (tear gas).

(c) Phosgene.

(d) Chlorine.

(e) Toxic Smoke.

(9) A practical knowledge of the putting down of smoke in tactical field problems.

(10) A practical knowledge of the use of tear gas in various chemical munitions for mob control.

(11) A practical knowledge of the defensive measures to be taken against the chemical agents mentioned in (8) above.

(12) A general knowledge of the methods of using chemical warfare agents by each Arm and the defensive measures to be taken against this use.

TRAINING COURSES. - a. The officers' course should qualify all officers taking the same for the duties of regimental, battalion or post gas officers.

b. The noncommissioned officers' course should qualify all noncommissioned officers for the duties of regimental, battalion or post gas noncommissioned officers.

RECORDS. - a. Records should be kept showing the success of the schedule and making such recommendations as to changes therein as experience may indicate necessary.

b. A questionaire should be prepared for each student to fill out at the end of the course, giving his reactions and recommendations with reference to the course.

c. The experience gained in conducting each course should be used as a basis for improving the next course. Records should be kept showing these results and recommending improvements in the next course, so that whoever conducts the next course will have the benefit of all past experience.

EXAMPLES OF THE USE OF SMOKE IN BATTLE

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Captain George C. Sherman, Infantry
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During the early part of the World War smoke was not used, or if used, no report was made. In fact,one of the first, probably the first, use of smoke was the lighting of a hay stack north of LA BASSEE CANAL in October, 1914. This enabled the greater part of a company that would otherwise have been cut off to withdraw.

The reason that smoke was not used until much later in the war was due to the distrust of this weapon by the attacking troops. Smoke was put down on the enemy, and attacking troops encountered the smoke, causing loss of direction,disorganization and confusion.

Very little mention of the use of smoke is made in any reports or documents until 1917. Three attempts without smoke had been made to sieze and hold OPPY WOOD and the "MAIZE", a strongpoint in front of the woods, all ending in failure. On June 23, 1917, the 15th Infantry Brigade (British) attacked with smoke from artillery and trench mortars. The 1st Bedfordshire Regiment had a fire fight 100 yards from the position; they used "P" bombs, which enabled them to take all their objectives and swing a flank to the left. On November 20, 1917, the British tanks attacked at CAMBRAI and were favored by a dense morning mist,which had been still further increased by an intensive fire of smoke shells by the English artillery. Three hundred and fifty tanks moved forward in several waves.

The use of smoke in river crossings is very effective, as the two following examples will show. In the German operations against REGA, a very strongly fortified position, on September 3, 1917, the infantry crossed the DUNA while batteries of heavy howitzers fired smoke shells. The operations were completely successful and the losses were insignificant. In the MEUSE-ARGONNE offensive,smoke and thermite were successfully used to decoy the enemy into believing that the MEUSE was to be crossed in two places near MOUZON, thus drawing his fire, while the actual crossings were made at other points.

In the battle of ARRAS in April, 1917, eighteen pound

shells (smoke) were included in the creeping barrage covering the infantry attack. This was done on the front of the 9th Division (Scottish) north of RIVER SCARPE. The attack was completely successful and due to the smoke screen casualties were few. There were two other interesting developments of smoke during this battle. The first was a distant eighteen pound smoke screen to prevent the enemy from seeing our creeping barrage from his observation posts and thus realizing that our attack had been launched. The second was the use of smoke to protect a flank. The 15th Division was attacking south of the SCARPE. Its attack was held up, thus exposing the right flank of the 9th Division to machine gun fire from across the river. A battery of the 9th Division blinded the enemy opposite the left flank of the 15th Division with smoke. This enabled the right of the 9th Division to press forward unscathed and by its advance to assist the 15th Division.

Smoke was used by the enemy to deceive observers. These devices, to simulate the firing of a gun or a group of guns or the burst of an enemy shell, was called "marron". They consisted of a cardboard box filled with seventy-five grams of nitro cellulose powder, to which was added a smoke composition and fired with a Bickford fuse. By properly grouping the "marrons" at an abandoned battery position, or a dummy one, enemy fire was drawn to these selected positions. These were also used to simulate burst of a shell and in this manner to confuse the observer. A smoke producer was also employed by the Germans at points under fire of destruction in order to simulate a conflagration for the purpose of causing enemy observers to regard the artillery mission as complete and therefore order a suspension of fire on the target. In the absence of wind the cloud produced lasted about an hour.

Several cases of very large smoke screens being employed were reported. At CAMBRAI on November 20, 1917, a smoke screen (British) was put down lasting four hours on the high ground which overlooked the right of the attack. Ten days later the Germans used smoke when they made their counter-stroke in this area. On that day the 12th Division (British) reported that owing to the enemy smoke the reserves could not see enough to enable a counter-attack to be formed. Some of the smoke was by bombs by airplanes. On the French front, a successful attack was made by the Germans, preceded by a heavy smoke shell bombardment of four hours and twenty minutes' duration on a twenty kilometer

front and to a depth of eight kilometers. The cloud was so dense that it was impossible to see men or objects in it.

During the last year of the war smoke appears to have been used much more frequently and to have obtained better results. During the battle of MATZ, according to a report by General Herr of the French Army, on the 10th of June,1918, the Genman center advanced and reached the valley of ARONDE only seven kilometers from CAMPIEGNE; to the left it took possession of the whole forest between DIVETTE and the MATZ; on the right it approached the PARIS-MONTDIDIER road on the level with TRICOT. At eleven AM on June 11th, when it was in the act of widening the breech, advancing to the south of MONTDIDIER, its right flank encountered a counter-attack by strong forces consisting of four divisions,twelve tank sections and two regiments of horse artillery. Favored by mist, they completely surprised the Germans, the right wing retreated in disorder and thus also made the center yield, and forced the retreat from ARONDE. Herr leaves the question open as to whether the mist was natural or artificial, but considering the time of day when the action took place it was probably the artificial kind. Another use of smoke in covering a counter-attack was employed by the French in their counter-attack on PORTE FARM and DES LOGES FARM on July 9, 1918; to conceal the approach and the entry into action of four battalions of Schneider tanks they blinded the German observation posts with smoke from flat trajectory fire while they gassed the batteries. The objectives ordered were reached without any trouble by the infantry and tanks.

At four-thirty PM August 6, 1918,the 1st Gas Regiment, near BOZOCHES, opened with five Stokes mortars, firing heavy smoke bombs, to screen the advancing infantry and to enable the engineers to throw bridges across the VESLE. The fire continued for one and one-quarter hours. Three hundred and thirty-two rounds were fired maintaining the screen which permitted the infantry on the right to cross the VESLE. Numerous fires were started by the bombs in the village of BOZOCHES. Another use of smoke by the 1st Gas Regiment occurred on August 31, 1918, when twelve Stokes mortars were set up and all ammunition prepared. The purpose of the operation was to establish a semi-circular screen of smoke to simulate the start of an infantry advance in order to draw the enemy fire and to disclose his intentions. At two AM one hundred and eighty-four rounds of heavy smoke were discharged. Not only were the intentions of the enemy revealed

but the lesson was taught us, without losses, that direct smoke screens only invite retaliation upon a conspicuous target and that flanking screens and fake screens were clearly to be more profitable tactics for the future. On September 12th,four Stokes mortars were carried behind the infantry and were set up three different times north of SEICHEPREY and were thus able to furnish a progressive smoke screen covering two kilometers.

The Canadians used smoke on August 30, 1918, on the VIS-en-ARTOIS SWITCH; the 3d Canadian Battalion attacked in a south-east direction, while the 1st and 2d Canadian Battalions in a north-east direction. The wind was mild and blowing in an easterly direction. Smoke was most effectively used,and by concealing movement, enabled the attack to develop from both sides. Three hundred prisoners were taken.

The British used smoke in their attack on the German bases at OSTEND and ZEEBRUGGE with excellent results as shown by an extract from a telegram sent by the German Kaiser to the General Staff, "Two small cruisers of the SIRIUS class fitted out as blocking ships were sunk on the coast eastward of OSTEND. Three other small cruisers of the same class were able to enter the harbor of ZEEBRUGGE in the dense artificial fog and were sunk there."

In the battle of CAMBRAI-ST. QUENTIN. the tanks of the 9th Tank Battalion took part in the attack of the 32d English Division on October 2, 1918, in the sector of the 1st British Army against FONSOMME-JONCOURT. In this attack the tanks engaged in the action, repeatedly make a successful use of smoke screens generated from the exhausts of their engines and thus prevented losses through the fire of the German close range guns.

In the battle of JUTLAND destroyer attacks were combined with a retiring movement on the part of the German Battle Fleet, the movement being covered with the aid of a heavy smoke screen. Although the retirement was not visible from the Iron Duke (Jellicoe's) owing to the smoke and was therefore not known to him until after the action, it was clearly seen from the rear of the line. The captain of the Valiant stated in his report "At 7:23 PM enemy's battle fleet now altered course together away from us and broke off action, sending out a low cloud of smoke which completely covered their retreat and obscured them from further view". At 8:22 the battle fleet (cruiser) engaged

the Germans but at 8:38 PM contact was lost through the smoke screens put down by destroyers and ships.