

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

THE CHEMICAL WARFARE SCHOOL

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CONTENTS FOR OCTOBER, 1932

	Page
The Unit Gas Officers' Course, 1932	1170
Address by General Perry Miles, to the Graduating Class, Field Officers' Course, The Chemical Warfare School, Edgewood Arsenal, July 30, 1932	1171
Some Interesting Smoke Bombs	1175
The Summer Training for Chemical Warfare Reserve Officers at the Massachusetts Institute of Technology	1181
Employment of Chemical Troops in the Attack of the American 1st Division, During the Second Phase of the Meuse-Argonne Offensive, 1918	1185
The Tactical Employment of Chemicals by a Cavalry (Mechanized) Force	1193
Use of Smoke by The Coast Artillery	1198
Changes of Address - Regular Officers, C.W.S.	1204

CHEMICAL WARFARE

VOL. 18

OCTOBER, 1932

NO. 4

UNIT GAS OFFICERS' COURSE, 1932

The Unit Gas Officers' Course, The Chemical Warfare School, commenced on October 16th and will end on November 23rd. The following officers are in attendance:

Captains

Griffin, Ashley J., Ord.Dept., Conn.N.G.
Johnston, Edward G., Inf., Ill. N.G.
Livingston, Walter, Cav., Iowa N.G.

1st Lieutenants

Smyser, Harold E., Inf.
Gillespie, Reginald R., A.C.
Pheris, William E., Jr., Inf.
Burns, John R., Inf.
Grace, William P., Jr., Inf.
Rick, Edwin M., C.A.C., N.Y.N.G.
Smith, Harold M., CW-Res.
Adair, James T., Jr., CW-Res.
Wilson, Alfred J.P., CW-Res.

2nd Lieutenants

Sink, Robert F., Inf.
Cole, George M., F.A.
Selby, Irving R., A.C.
Kunzig, Henry B., Inf.
Lermond, George W., Inf.
Wertz, George M., F.A.
Hackett, Robert, F.A.
Dick, William W., Jr., F.A.
Lehrfeld, Irving, Inf.
Ray, George G., Inf., Miss. N.G.
Bertolet, John H., C.A.C., Pa.N.G.
Crossley, Arthur W., CW-Res.

**ADDRESS BY GENERAL PERRY MILES,*
TO THE GRADUATING CLASS, FIELD OFFICERS' COURSE,
THE CHEMICAL WARFARE SCHOOL, EDGEWOOD ARSENAL,
July 30, 1932**

In your many lectures and conferences and in your studies and researches during your course here, I suspect that you gentlemen of the graduating class have been pretty well saturated with gas, some of it from this platform. I do not propose to aggravate your condition.

In inviting me, who knows so little about the interesting and important work you have been doing here, to make this address, I suspect that the school authorities have sought an antibody against the concentrations of technical instructions you have been subjected to.

I believe it to be unfortunate that chemical warfare has had to be in a defensive attitude for so long a time.

Because chemical warfare in the World War was initiated by our enemies, because this initiation was contrary to the agreement the Allies had made amongst themselves in the Hague Conventions, and because the Allies were caught defenseless at the beginning of this species of warfare and thereby suffered severely and almost decisively from what they affected to believe was an illegal method of warfare, there grew up a sentiment of antipathy against the use of this new weapon.

It is unfortunate that we as a nation have subscribed to a perpetuation of this sentiment so hostile to our national interests.

There used to be a considerable number of officers in our Army who were influenced by this sentiment and as a result of this situation and its emasculation by treaty agreements, the Chemical Warfare Service was engaged for several years in selling itself to the other arms and services and to the Navy. This should never have had to be necessary. I suspect that officers of the Chemical Warfare Service in some cases have overdone the matter of convincing skeptics of the services that chemical war-

*Read by General H. L. Gilchrist in the absence of General Miles who was unable to be present.

fare might be decisively important. They have fired the civilian mind which has not only accepted the feasibility of this weapon but has in many cases been influenced in its conceptions of it only by the hazy bounds of imagination.

Whenever the subject and effects of imagination are mentioned, I think of the little darky's experience with a grenade: My regiment was one of those orphaned units turned over to the French for incorporation in their divisions. We had French organization, French rations, French arms and equipment. We had been having a considerable amount of drill with dummy grenades. At length it came time to drill with live ones. Many of you are probably familiar with the French citron hand grenade. It operates by means of a plunger extending from one end. Drill by the numbers is executed like this:- At the command "One" the plunger is struck on the ground; at "Two" the arm is drawn back and at "Three" the grenade is hurled with a full arm movement. On the day we began the drill with live grenades there was a little darky, who was called by the other men "Sugar Foot", waiting with bulging eyes for his turn to be called out. At length his squad was called to the firing line. The command "One" had no sooner been given than Sugar Foot struck his grenade on the ground and hurled it as far as he could - almost with a single movement. After the other men of the squad had executed the drill correctly the instructor went up to Sugar Foot and said, "What do you mean by throwing your grenade at the command 'One'? Haven't you had drill enough yet to know that you don't do that until the command 'Three'?" "Yes suh, yes suh, I knows de drill Lieutenant suh, but dis time ah just had to thow it 'cause ah could feel dat thing a-swellin' in my hand".

I believe that one of the important duties that you graduates who have had these four weeks of training owe to the country is to educate our people and to dispel the surprising misconceptions of the use, purposes, powers and limitations of gas in warfare infesting so large a number of our people.

Gas, like every other new weapon, appeals to the imagination. The lay mind leaps over practical obstacles and disregards the possibilities of limitations. Do not misunderstand me. The world progresses only because men dream dreams. But you men who have been working with this new weapon practically realize that to obtain usable results, one who has his head in the clouds has to perform the difficult feat of simultaneously

keeping his feet on the ground.

Last winter, I attended a luncheon of the West Los Angeles Rotary Club where a judge of a superior court, naturally supposed to be a learned judge, spoke upon disarmament.

During his speech, he drew a lurid word picture of the future war. Swarms of death-dealing airplanes would fly over defenseless cities, hurling lethal gasses of many times more deadly effect than possible from any gasses used before. Thus the animal life, including men, women and children, would be entirely wiped out and whole cities thus fearsomely destroyed. The impression left - and undoubtedly intended to be left - upon the hearers was that there could be no defense against this terrible thing. Each military-minded country, according to this speaker, had developed and was keeping secret for future use a new gas against which the defense prepared by possible enemies could not prevail.

There was no suggestion that nations would refrain from employing an unrestrained force against which they themselves could not be protected. The picture was that of a devastating uncontrolled force that would negate all the experience of history and warfare - the experience that teaches that against every weapon devised by the ingenuity of man, there is of necessity soon developed an adequate defense.

This man, with his label of "learned judge", actually spoke in pitiful ignorance. He apparently never heard of any practical limitations, such as weights of materials, kinds of containers, need for concentrations, effects of wind, controllability, self protection, etc.

If such statements as these, which are continually being made throughout the country, go unchallenged, we need not be surprised that sentiment against the use of gas in war increases.

Whenever you have the opportunity, it is the duty of you gentlemen of the graduating class to refute, from the funds of exact knowledge obtained here, the vaporings of ignorance of this subject so prevalent in our land.

There is one other thought I wish to leave with you as

you depart for your various assignments.

I believe that the possibilities of the use of gas in domestic disturbances are frequently lost sight of.

I was interested to learn that in 1928 a device was developed by the Chemical Warfare Service, Ordnance Department and using service to lay down smoke and gas from a tank. The device proved to be mechanically satisfactory, but the whole matter was abandoned when it was decided that the laying down of smoke and gas from a tank was impracticable from a tactical point of view.

I suspect that no thought whatever was given to the practicability of the employment of this device in domestic disturbances, where the weapons ordinarily available to the mob and the tactics employed by it are altogether different from those of organized armies.

We have just begun a resurrection of this device. There are several questions in connection with it we would like to have answered:- Can tear gas be discharged from it as effectively as were smoke and lethal gasses? The apparatus is now on the outside of the tank, unprotected. Can it be effectively and simply protected where it is or must it be placed inside the tank? If it is inside, what will be sacrificed to afford the required space? In operations against a crowd or a mob, where in the formation should the tank with gas equipment be placed, etc.?

I believe that there is a field for chemical warfare officers in the use of gas in domestic disturbances that has not been thoroughly examined. There is a field, too, for you officers of other services and arms in your various capacities as command and staff officers to influence study and experimentation in the use of gas by methods suitable to the peculiar conditions of domestic disturbances.

We have thus far been more fortunate than most other countries in avoiding serious domestic disturbances, but however much we dislike the contemplation, the possibilities in the present and future condition of the country make it more and more important that we do not neglect the study and preparation of means that will assure decisive results with a minimum of blood-

shed.

I desire to congratulate each of you. You are certain to find the knowledge you have acquired here of advantage to yourself and the country wherever your future service may take you.

SOME INTERESTING SMOKE BOMBS

By: A.A. Gandy, F.B. Hale, A.V. Motsinger
and D.L. Woodberry

Since 1918, much has been accomplished toward the development and efficient use of aerial drop bombs. This rapid development and use of bombs is due largely to the perfection of the airplane engine and the correspondingly increased carrying capacity of the plane which permits extensive bombing operations.

There were only three general types of aerial drop bombs up to the summer of 1918. These were the high capacity (demolition), the fragmentation, and the incendiary. All these bombs were of the conventional streamlined shape with fin assemblies. At that time only one type of bomb was being produced in quantities in the United States. This was the high capacity bomb.

The only bombs that by any stretch of the imagination could be called smoke bombs were those of the incendiary type. The incendiary bombs were divided into two classes, the "scatter type" and the "intensive type". Of the former class, the Mark I weighed about 40 pounds of which 1-1/3 pounds was black powder and 19 pounds was cotton-waste balls soaked in turpentine, or solid-oil balls wrapped in burlap. Of the latter type, the Mark II weighed about 46 pounds of which 10 pounds was thermit and 16 pounds oil emulsion.

Since 1918 considerable experimental work has been done on bombs for use with smoke-producing fillings. The experimental bombs developed during the first part of this period were of the conventional streamline shape and were designed to function upon impact with the ground. An explosive charge was provided to disperse the smoke-producing filling at or near the surface of the ground. However, it is estimated that approxi-

mately 25% of the contents of this type of bomb is carried into the ground and is lost.

To prevent this loss a new type of bomb was designed. After the bomb penetrates the ground and comes to rest the filling material is forced to the surface of the ground through a tube or hose which projects from the tail of the bomb. If a tube is used, it could be either in one piece or a number of pieces designed to telescope within the tail of the bomb. If a hose is used, it could be coiled within the fins until the bomb functions. Both the hose and the telescoping tubes are designed to be extended as the bomb penetrates the ground, the open end of either the hose or tube remaining at approximately the surface of the ground. It has been found that a cylindrical-shaped burning-type bomb with a flat nose forms a kind of "chimney" as it penetrates the ground. Under these conditions a short tube set between and parallel with the fins has been adequate for venting the smoke.

Three different designs of bombs intended to produce smoke clouds at the surface of the ground have been developed. These designs are shown in Figures 1, 2, and 3.

The bomb shown in Figure 1 is intended to produce an effective smoke cloud at the surface of the ground without using an explosive charge to disperse the filling which may be either a liquid or a gas. This bomb is designed to function upon impact when dropped from any desired altitude. When the bomb comes to rest in the ground, the smoke-producing material is forced out through an ejection pipe which extends from inside the body at the nose to the end of the fin assembly. The necessary pressure is generated by a charge of liquid carbon dioxide which is released inside the bomb at the time of impact. The bomb has a capacity of approximately 2700 cc. and when filled and completely assembled ready to be dropped weighs about 30 pounds.

Referring to Fig. 1, a safety wire (1) holds the plunger assembly (2) in the safe position after the arming wire is withdrawn. Upon impact with the ground the safety wire (1) is sheared. This releases the plunger assembly (2) containing the charge of liquid carbon dioxide (14). The inertia of the plunger assembly (2) carries it forward and the large external point (6) of the plunger assembly (2) punctures the disc (3) which keeps

the liquid smoke-producing material (4) away from the plunger assembly (2). At the same time the small internal point (9) of the plunger assembly (2) shears a safety wire (8) and then punctures the diaphragm (10) which has been retaining the charge of carbon dioxide (14) in the plunger assembly (2). The plunger assembly (2) continues forward until its shoulder rests on the shoulder of the retaining nut used with the diaphragm (3) that seals the plunger assembly (2) away from the smoke-producing filling (4) in the bomb. The puncturing of the diaphragm (10) on the plunger assembly (2) releases the liquid carbon dioxide (14) from the cylinder (11) portion of the plunger assembly. The pressure caused by the gaseous carbon dioxide increases until it bursts the diaphragm (5) which has prevented the filling material running into the well (7) from which the eduction tube (12) leads. The pressure in the bomb then forces the smoke-producing liquid (4) out through the eduction tube (12) to or near the surface of the ground depending upon the type of soil into which the bomb penetrates.

This bomb is designed to contain no explosive charge and it is not believed that its handling or storing would constitute a fire or explosive hazard.

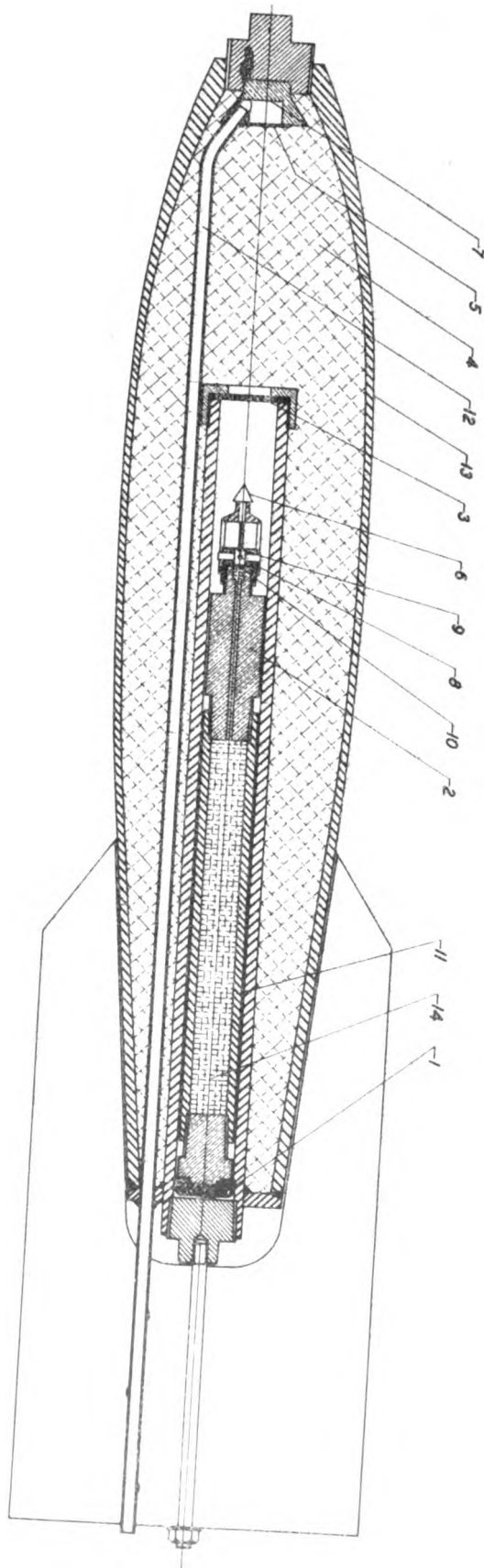
Bombs of this design have not been made.

An aerial smoke candle is shown in Fig. 2. It is designed to produce a smoke screen on the surface of the ground by dropping from a plane a large number of these candles in rapid succession at predetermined spacings. It is so designed that when dropped from a plane the candle impacts nose first.

The body of the candle is about four inches in diameter and is cylindrical in shape. It has a flat nose and is provided with fins or stabilizers to insure nose impact. When dropped from an altitude of 6000 feet the candle penetrates to a depth of from 12 to 24 inches leaving a crater of about 10 inches in diameter at the surface of the ground. The candle, being ignited by impact with the ground, emits an excellent smoke cloud for a period of four minutes.

Referring to Fig. 2, the body (9) is cylindrical and is made of sheet steel. The nose or head (10) is welded into one end. Approximately 6 pounds 3 ounces of HC smoke mixture (11) is pressed into the body (9) and a layer of starter mixture

FIGURE 1



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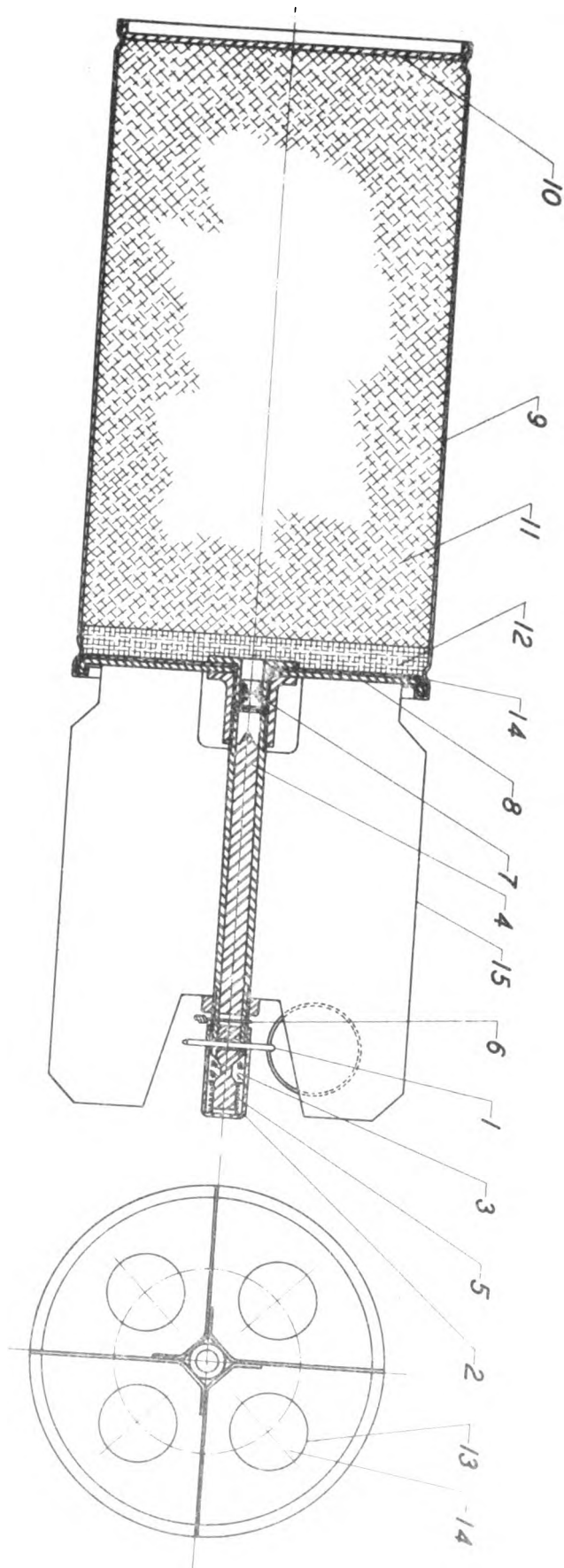


FIGURE 2

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(12) is placed on top of the HC smoke mixture (11) to act as a primer. Then the candle body is closed by crimping a cover (8) to the open end. This cover (8) has four holes (13) spaced 90 degrees apart. These holes are sealed by a thin disc of zinc (14) which is attached to the under side of the cover (8). To the center of the cover (8) is attached a stud which carries the firing mechanism (1,2,3,4,5,6,7) and the fin assembly (15).

To prepare the candle for use, it is placed in the release rack of the plane and then the safety pin (1) is removed. The striker pin (4) is held in the safe position by the two safety spacers (3) in a retaining cup (2). While the candle is in the release rack of the plane the retaining cup (2) cannot be forced off by the spring (5) around the end of the striker pin (4). When the candle is released from the rack and falls from the plane, the retaining cup (2) is forced off the end of the striker pin (4) by the spring (5) just mentioned. The removal of this cup allows the two safety spacers (3) to drop out of the groove in the striker pin (4). This leaves only a safety wire (6) to hold the striker pin (4) away from the primer (7). Upon impact the safety wire (6) is sheared and the striker pin (4) moves forward, due to its inertia, and fires the primer (7) which ignites the starter mixture (12). The heat generated melts the zinc disc (14) used to close the holes (13) in the cover (8) and also ignites the HC smoke mixture (11). The smoke generated by the combustion of the HC smoke mixture (11) escapes through the four holes (13) in the cover (8) of the candle.

Candles of this design have been made and tested. It is very cheap in construction and is considered to be an excellent means of producing and maintaining an effective smoke screen on the ground.

The bomb shown in Figure 3 is designed for use by planes to lay an effective smoke screen along the surface of the ground. This bomb is designed for burning-type fillings. It has a flat nose and is not streamline but by changing the firing mechanism it can be dropped from very low as well as from higher altitudes. When dropped from very low altitudes the fin assembly (10) and firing mechanism (4) are to be disassembled from the tail cap (9) of the bomb and replaced with a fuze (or firing mechanism) of the "Allways" type. This insures functioning of the bomb even if nose impact is not obtained. When filled, completely assembled and ready to be dropped this bomb weighs about

40 pounds. It holds approximately 22 pounds of HC smoke mixture which on burning gives an effective smoke screen for about 12 minutes.

Referring to Fig. 3, the body (13) of the bomb is made of commercial tubing. The head (14) is flat and is welded to one end of the body (13). The required weight of dry burning-type smoke mixture (8), in this case HC, is pressed into the bomb body (13) and then the bomb is closed by screwing the tail cap (9) into the open end of the body (13). The tail cap (9) is provided with a zinc cup which contains a starter mixture (7). The fins (10) are welded to a central tube (12) and this assembly is attached to the tail cap (9) by screws which are not shown. The striker pin (3) is supported in the central tube (12) by the circular disc (15) which is provided with four holes (16) through which the smoke, generated by the burning mixture, escapes after passing up the central tube (12). The fuze (4) contains the primer (5) and the ignition mixture (6) and is assembled into the tail cap (9) and extends up the central tube (12). The striker pin (3) is held in the safe position by a cotter pin (1) and is protected from external blows by a shield (11) which is assembled over the protruding end of the striker pin (3).

When the bomb is released from a plane, the cotter pin (1) is automatically removed. A safety wire (2) supports the striker pin (3) keeping it away from the primer (5). On impact the safety wire (2) is sheared by the inertia of the striker pin (3), which continues forward until it fires the primer (5) which starts the ignition mixture (6). This sets fire to the starter mixture (7) which burns and generates sufficient heat to melt the zinc cup and ignite the smoke mixture. In the meantime the bomb has come to rest in the ground. The smoke evolved escapes from the bomb out through the central tube (12) and the holes (16) in the circular disc (15) and thence to the surface of the ground. If desired the central tube (12) may be provided with a metal hose or telescopic-tube extension to provide free passage of the smoke to the surface of the ground in case the bomb penetrates the ground to a distance greater than the overall length of the bomb. When the bomb penetrates to a depth greater than its overall length, the smoke ordinarily escapes to the surface through the hole in the ground made by the bomb. It has been found that the hole made by the bomb does not close in sufficiently to interfere greatly with the escape of the smoke to the surface of the ground unless the bomb landed in mud or ex-

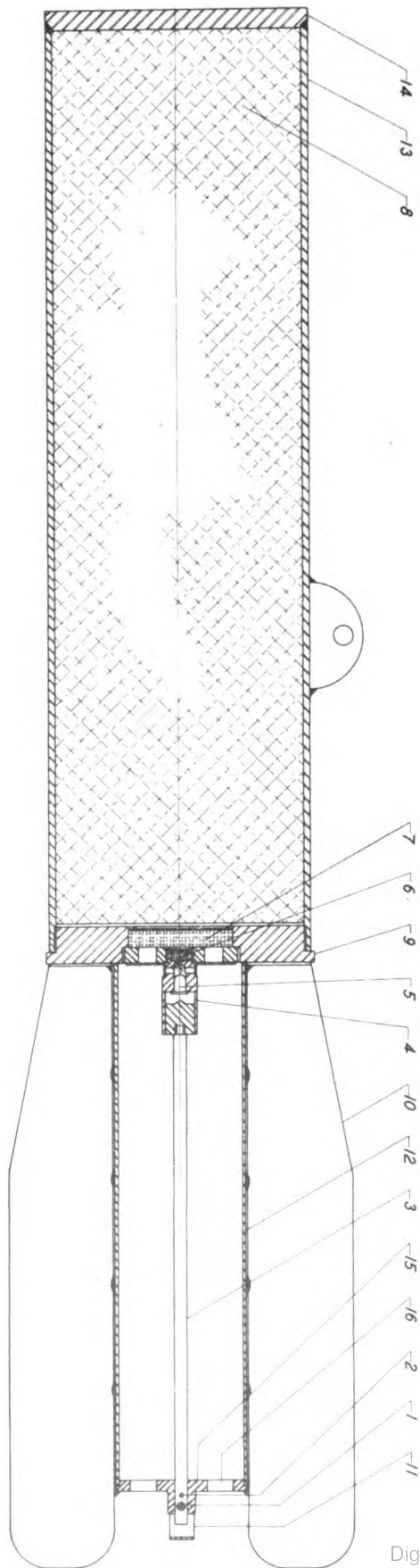


FIGURE 3

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ceptionally soft ground.

If bombs are streamline greater accuracy in aiming can be obtained but there is an increase in the depth to which the bombs penetrate. The greater the depth to which a bomb penetrates the ground the greater the probability that the "chimney" which the bomb makes in the ground will be sufficiently filled by the surrounding dirt so that smoke from the bomb will not reach the surface of the ground. This probability is not nearly so great with the flat-nosed bomb as it does not penetrate the ground as far as does the streamline bomb. Also the flat-nosed bomb has a tendency to form more of a crater than a "chimney" in the ground. As accuracy in aiming smoke bombs is not as important as it is with demolition and fragmentation bombs the cylindrical-shaped flat-nosed form for smoke bombs is considered to be satisfactory. With smoke bombs it is necessary to register only on an area and not a definite target as is required with demolition and fragmentation bombs.

If it is desired to decrease the distance to which a streamline bomb penetrates the ground it is believed that a bomb modified as described below might accomplish this purpose. An outer shell having the same contour as the nose end of the bomb may be fastened to the body of the bomb at the point of its greatest circumference. This outer shell may be divided into longitudinal sections intended to open like an orange peel and flatten out at right angles to the longitudinal axis of the bomb when it penetrates the ground. The sections at the nose end of this outer shell may be partly opened or separated so that the flattening or peeling action will be positive. On the other hand, if the nose of the bomb is flat and it is desired to improve its trajectory, the streamline effect may be obtained by the addition of a false nose or ogive of very thin, weak material. On impact this false ogive should collapse and the consequent spreading out or mushrooming should prevent excessive penetration of the ground.

**THE SUMMER TRAINING FOR
CHEMICAL WARFARE RESERVE OFFICERS
AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY**

By: Captain M. E. Barker, C.W.S.

The second session of The Chemical Warfare Training Center, Massachusetts Institute of Technology, Cambridge, Massachusetts, was conducted for Chemical Warfare Reserve Officers from August 28th to September 10th, 1932.

Four courses were given. Lecture and conference periods began at 8:00 a.m., Daylight Saving Time, and ended at 12:00 N. Afternoons and nights were devoted to study on assigned topics and the solution of assigned problems. The instructors in each course were allowed fifty minutes to present their material each day.

A resume of the courses follows:

COURSE NO. 1
Military Chemistry

Captain M. E. Barker, C.W.S.
Instructor .

Eleven conference and lecture periods, together with two sets of problems and an examination solved by the students and handed in to the instructor, constituted this course. It covered the general field of Chemical Agents, Defensive Chemicals, Chemical Warfare Research procedure, and a discussion of the manufacturing problems dealing with mustard gas, phosgene, soda lime, and activated charcoal.

COURSE NO. 2
Chemical Engineering

Thomas K. Sherwood, Consultant, C.W.S.
Instructor ;

Twelve lecture and conference periods were devoted to this subject. A few periods were lectures dealing with absorption and extraction, heat transfer, and flow of fluids. The course also included plant design and ~~three~~ practical problems in Chemical Engineering. These problems, handed out at the be-

ginning of the course, required about fifteen hours work on the part of each student.

COURSE NO. 3
Organization and Tactics

Major R. F. Maddux, C.W.S.
Instructor

This course consisted of a series of seven lectures covering -

- a. The organization of the United States Army, The Chemical Warfare Service, and Edgewood Arsenal.
- b. Organization of procurement districts and the problem of procurement planning.
- c. General principles of chemical warfare tactics.

COURSE NO. 4
Physical Chemistry

Lt. Col. Frederick G. Keyes, CW-Reserve
Instructor

Twelve periods were devoted to this subject, and in addition, about fifteen problems taken from Millard's Physical Chemistry were solved by the students during outside study periods. The course embodied a rapid review of the fundamental principles of physical chemistry. The perfect gas laws and the application of these laws to problems of chemical warfare were then considered. The entropy changes of pure and mixed gases were also studied and the formulas governing these relations were derived, assuming the perfect gas laws to hold. The application of thermodynamics to the problems of physical chemistry was emphasized throughout the course.

Through the courtesy of The Massachusetts Institute of Technology, students in this course were allowed to occupy Dormitory rooms. A charge for this room service was made at the rate of five dollars (\$5.00) per week. Meals were available most of the time on the campus at Walker Memorial and at nearby restaurants at other times. Living conditions were thus very satis-

factory as well as quite economical.

The following Reserve Officers were students in the course:

<u>Lieutenant Colonel:</u>	Byers, H.G.
<u>Majors:</u>	Herrick, Horace T. Racicot, Phileas A. Rupert, Frank E.
<u>Captain:</u>	Mottern, Albert J.
<u>First Lieutenants:</u>	Butz, Richard J. Berne-Allen, Allan, Jr. Borglin, Joseph N. Cummings, John L. Cummings, Leland W.T. Donovan, James Gilliland, Elias W. Haggerty, Cecil J. Hilberg, Frank C. Mendum, Willis C. Sayre, Clifford L.
<u>Second Lieutenants:</u>	Gold, Kenneth M. Lewis, Frederick B.

The course closed at 11:00 a.m., Saturday morning, September 10th, 1932. All the students, as well as the instructors, were enthusiastic about the work accomplished during this course. Courses of this kind offer a very effective means of keeping Chemical Warfare Reserve Officers interested and instructed in the technical problems concerning The Chemical Warfare Service.

A few problems solved by the students during their home study periods follow for the information of those who may be interested:

The following problems in Military Chemistry were given for solution:

I. A single 155 mm. mustard filled shell explodes in

a destroyer containing 100,000 cubic feet of air space. The ventilating system changes the air every 10 minutes. Air at 68 degrees F., leaving this ship, is 1/20 saturated with mustard gas vapor. How long will it take to clear the ship of mustard gas under these conditions?

ANSWER: 10.3 hours.

II. The vapor pressure of ethyldichlorarsine is 5 mm. of Hg. at 20 degrees C. Calculate the volatility. (Weight ED per unit volume of saturated air.)

ANSWER: 47.9 oz./1000 cu.ft. ✓

III. The probable error in range of the 4.2" Chemical Mortar is 20 yards. In firing a problem the center of impact is placed 20 yards short of the near edge of a target which is 20 yards wide. The target is longer than the lateral dispersion of the gun. How many shells must be fired in order to hit the target 16 times?

ANSWER: 100 rounds.

EMPLOYMENT OF CHEMICAL TROOPS IN THE ATTACK OF THE AMERICAN 1ST DIVISION, DURING THE SECOND PHASE OF THE MEUSE-ARGONNE OFFENSIVE, 1918

By: Major E. S. Johnston, Infantry

SUBJECT OF THE STUDY PRESENTED. - As stated above, together with a study of the results which might have been obtained had the chemical troops been employed as contemplated in present (1932) doctrine.

FACTS BEARING ON THE STUDY. - a. Mission of American First Army: The American First Army, attacking between the Meuse River and the Argonne Forest (inclusive), in conjunction with a general Allied advance on other fronts, was to cut the principal German lines of communication connecting the western front in France with the area near Metz. These communications were in the main the railways passing generally through Sedan. Success would deprive the German mass in France and Flanders of its principal lines of communication south of the difficult Ardennes region. It would at least force a withdrawal of the German armies to the line of the Meuse. It might even prevent a successful withdrawal and so lead to a decision. The importance of the First Army's offensive is thus manifest.

b. Operations of First Army: (1) Plan of first Army. The army plan contemplated an advance with three corps abreast. In general the critical area of Montfaucon would be reduced by flanking action of the flank corps, respectively on the east and west. The mission of the right corps was rendered difficult by flanking fires from across the Meuse to the east. The logical zone for the main effort therefore lay to the west between Montfaucon and the Argonne Forest; this therefore becomes the critical area. An analogous situation is presented in the Command and General Staff School text on "General Tactical Functions of Larger Units", wherein an army, advancing to the north, outflanks from the east and west the dominating terrain near Gettysburg, its right flank being restricted by other troops, and its left flank by South Mountain.

(2) Actual Operations. (a) The initial attack of the First Army occurred on September 26, 1918. Launched mainly by new divisions in their first fight, it gained a little ground, largely by surprise; but after desperate fighting the line crystallized somewhat to the south of the initial army objective.

On the left, in the critical area of the Aire Valley, the 35th Division advanced some ten miles, then recoiled under counter-attack, and when spent, had established a somewhat indeterminate line generally south of Exermont. (See attached sketch, based on map accompanying the History of the 1st Division.)

(b) It was now necessary to mount a new coordinated attack on a wide front. To give the principal impulse in the critical theater, the high command now brought up from reserve the 1st Division, and put it in up the east side of the Aire Valley, to break the German defense and drag the army forward. The 1st Division attacked early on October 4, and during the ensuing week it carried out that sustained, dogged, and grueling offensive, dragging the army with it, which broke the deadlock and evoked the thankful appreciation of the GHQ. Before relief, the division had established its line in front of the next main German position, south of Landres St. Georges: the Kriemhilde Stellung. The relieving division, after hard fighting and heavy loss, was unable to carry this position. For the third phase, then, the high command brought in the 2nd Division, backed by the 1st in reserve, to pierce the German line and drag the army on again. In the general attack which initiated the third phase, the 2nd Division broke the German defense, and, advancing generally on the critical railway area near Sedan, had by November 11 established a bridgehead across the Meuse.

c. Plan of 1st Division: (1) Opposing Forces. The 1st Division, on relieving the 35th during the night of September 30 - October 1, was disposed with the 1st Brigade on the right, the 2nd on the left. It was opposed by the German 5th Guards Division (west) and 52nd Division (east); both classed as fresh and first-class, though not at full strength. During the ensuing battle, elements of six other German divisions appeared in the 1st Division's zone. The 1st Division was reinforced by the following:

French 219th Field Artillery (9 batteries; 75-mm gun)

Three Companies, American 1st Tank Brigade

Three Troops, Cavalry

One Observation Squadron

One Balloon Company

Company C, American 1st Gas Regiment.

The artillery support, including corps artillery's mounted to one battery per 15 yards of frontage.

(2) Terrain. The ground in the division zone included the following dominant hills, from south to north:

Hill 224 (Montrebeau woods)

Hill 240 (Montrefagne)(west) and hill 212
(east)

Hill 272.

The ridges extended generally east and west, and were separated by deep ravines. The most difficult terrain in the area was the approach to the Exermont ravine, hill 240 and hill 272 being particularly dense. The ground was very rough. Hills 240 and 272 were particularly well disposed, by nature, to cover the natural approaches in the right portion of the zone. On the east flank the dominatory hills in the neighboring zone provided means for hostile enfilade fire, particularly from hill 269. From the west, the German positions across the Aire similarly enfiladed the west flank. The comparatively bare slopes west of hill 240 made it undesirable to employ any considerable bodies in that region. The Germans had, in general, organized the ground as a delaying area.

(3) Scheme of Maneuver. (a) Approach purely as a map problem, then, the situation confronting the 1st Division will be found to be fascinating, but difficult of solution. Corps could much have reduced the inherent difficulties of the ground by shifting the division boundaries to the east so that the division would not be subjected to flanking fires from areas over which it exercised no authority. On the east the boundary should have included the crests in the Bois de la Morine and on hill 269 and 263. On the west the boundary should have included the crests of hills 224 and 240.

(b) To avoid the bare slopes west of hills 224 and 240, the main effort must be made initially on the right. Once hill 240 was captured, it should shift to the west in order to outflank hill 272 from the left. Such a plan would direct the main effort over the most favorable ground, avoiding a direct approach against the most formidable hills. In outflanking hill 240, however, provision must be made to neutralize observation and flanking fires from hill 272, the lower reaches of which are within effective machine-gun range of hill 240.

(4) Weather. It does not appear that the weather constituted a major factor in the plan of the division, this notwithstanding that the experience of the 35th Division had shown

there was usually an early morning fog lasting for some hours, and that advances were easily made during the period of fog, but were brought to a prompt and bloody stop when the fog lifted.

(5) Decision. The actual scheme of maneuver of the division was based on an initial main effort on the right to outflank hill 240 to be followed by flanking action by the left against hill 272.

d. Actual Attack: (a) The attack was launched at 5:30 A.M., October 4, in a dense fog, with regiments abreast from east to west in order 26th, 28th (2nd Brigade), 18th, and 16th (1st Brigade). At H minus 5 minutes the artillery started a brief preparation. The attack was preceded by a rolling barrage. The flanks (about 50) were employed in depth in each brigade zone. Company C, 1st Gas Regiment had lost all its officers by reason of a mustard-gas shell on October 2; this necessitated withdrawal for reorganization until October 7, so that the company was not employed in the early stages. It had supported the 35th Division with a "shoot" of about 50 projectors, and had been prepared to render that division close support with mortars. Later, another company of the regiment was to render effective support to the 2nd Division by a "shoot" of about 150 projectors and by its mortars. .

(b) Favored by fog, the 16th Infantry plunged forward to the ridge south of Fleville. In spite of the expectation that it would drag behind, it was the only unit in the first army to reach its set objective that day. The 18th Infantry, with somewhat greater difficulty, reached hill 240, but did not capture the crest. The 28th and 26th, from west to east, on the right, were involved in extremely serious fighting and had heavy losses due to enfilade fire from the ridges close in to the east. After furious combat they crossed the Exermont ravine, and by dark on October 4, the line was as shown by the attached sketch. The contrast between expectation, as shown by the 3rd phase line (objective at dark of the first day) and the line reached, is notable. Instead of gaining ground rapidly on the right, it was the left that pushed forward and the right that dragged. Many of the tanks failed to reach the line of departure by reason of heavy fire from hill 224, they were evidently late in completing their approach. Only a few tanks survived the day; tank personnel losses were 80%. Units on the flanks of the 1st Division were unable to keep abreast.

(c) The assault battalion, 28th Infantry, owing to a misunderstanding, preceded its barrage, but thanks to the fog, reached its objective (see sketch line at 7:50 A.M.) with little loss. The second-line battalion, on passing through, was pushing on to the Exermont ravine when the fog lifted; its losses were severe.

(d) For October 5, the Division continued with its original plan, but all available artillery concentrated successively on the front of the 18th, 28th and 26th Infantry, till they were abreast of the 16th, when all advanced together. H-hour was at 6:30 A.M. with the usual heavy fog. The 18th and 28th carried hill 240. The 2nd Battalion, 28th Infantry, advancing from brigade reserve, was moving toward hill 272 when it was caught at the base of hill 240 by enfilade fires which opened on the lifting fog, and experienced heavy loss. These enfilade fires came from the west, hill 240 not yet having been captured in toto. The 26th Infantry, hampered by enfilade fires from the crests to the east, finally reached the base of hill 272; an attack to the north against that hill failed with severe losses. At dark on October 5, the line ran east and west just north of hill 240 (see sketch).

(e) On October 6, the 82nd Division, attacked to the west from the zone of the 1st Division, relieving the 28th Division (west) and so disposing of the galling enfilade fires from across the Aire. A battalion of the 1st Engineers and a detachment of the 26th Infantry, captured hill 269, and so eased the situation in the neighboring zone on the east.

(f) One platoon, Company C, 1st Gas Regiment, on October 7, fired 20 rounds of thermite each, against three targets north of hill 240. This was the only actual use of the chemical troops. The Division was now allotted additional ground to the east, including hill 203, in order to insure effective prevention of flanking fires from that area during the remainder of the attack.

(g) During October 8, the artillery hammered hill 272.

(h) On October 9, the division reserve (one battalion, 16th Infantry), supported by practically all the artillery, seized hill 272 by H plus 22 minutes. The 2nd Brigade,

with maximum artillery support, then captured hill 263. The 1st Brigade then advanced in turn behind a rolling barrage, carrying the line forward on the left. By dark of October 9, the line was as shown on the sketch. The critical phase of the day's operation had been the capture of hill 272.

(i) During October 10, the line was advanced by exploitation, as noted (sketch).

OPINIONS OF THE AUTHOR. - a. Division Plan: The 1st Division plan was sound, the maneuver of artillery fire constituting probably the outstanding American example during the war. The Germans, of course, had also correctly estimated the situation, and consequently opposed strength to strength, east of hill 240. Accordingly, the plan for October 5, should have contemplated seizing the crest of hill 240 under cover of the usual fog, after which a fresh attack should have been launched from cover in rear of that hill towards the northeast to outflank the resistance in front of the 26th Infantry. This attack, if not covered by natural fog, should have been screened by smoke. Thereafter the main effort should have shifted to the west, to outflank hill 272 from the left.

b. Influence of Fog: It is evident that the initial daily advances were attended with success by reason of the fog. The real difficulties began only after the fog lifted. The initial great advance of the 16th Infantry across the relatively open western slopes of hill 240 is to be attributed to the presence of fog. On this flank the dominatory hill to the west was relatively distant. On the right flank, while the ground afforded more cover, the flanking hills were closer to the Division's actual fight, and the fog afforded less protection.

c. Employment of Chemical Troops in Initial Stage: Putting aside all questions of detail, it is evident that the principal threats to the main effort in the initial stage lay in fires from the ridges on the right and from hill 224. All available projectors of Company C, 1st Gas Regiment, if concentrated at H minus 5 minutes on hill 224 (Montrebeau woods) with HE and CG (both authorized fillings, available at the time) would have facilitated the advance of the 18th Infantry and would also have much reduced the losses of the tanks. Of the three platoons of mortars available (only three of the four platoons actually having mortars available at the time), one should have been emplaced

on the right to lay a WP screen near Tronsol farm in case the fog was insufficient, and the two remaining should have been prepared to support respectively the 26th and 28th Infantry, displacing forward early to the crests overlooking the Exermont ravine. On arrival here, one platoon should have screened the right flank with WP, while one supported the advance of the 28th Infantry (main effort) with smoke; the remaining platoon, on displacing forward from initial emplacements, should have supported the advance of the 26th Infantry with smoke.

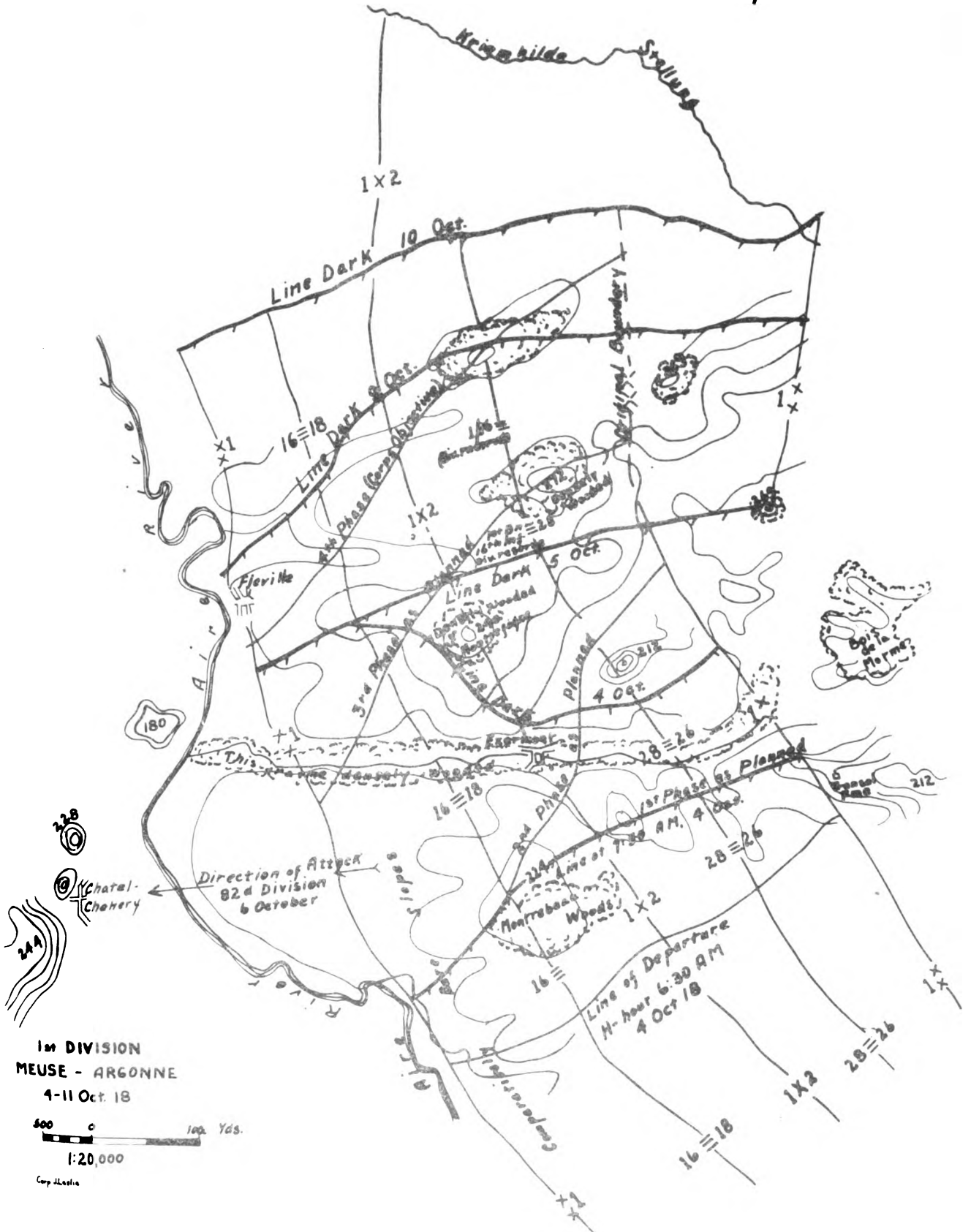
d. Employment in the Attack of October 5: For October 5, one platoon should initially have smoked the crest of hill 240, and then displaced forward to cover the advance to the north, west of hill 272. Another platoon, advancing to the crest of hill 240 with the infantry, should then have laid a screen to the east to cover the flanking attack to be launched from south of hill 240 to the northeast. Simultaneously with this latter mission, the third platoon would have been prepared, should the fog be unduly thin, to thicken it with smoke on the right flank of the 26th Infantry. Displacement of these two latter platoons would then have been made to the south and southeast portions of hill 272.

e. Chemical Troops on October 9: (1) For the attack of October 9, the three chemical platoons, if present, should have blown the top off hill 272 with projectors, and laid a screen on a front of about 1800 yards generally across hill 272. On displacement, two should have smoked hill 263, and one should have supported the further advance of the 28th Infantry and of the division reserve.

(2) With only one platoon present on October 9, as was actually the case, all mortars should have been employed successively with smoke against hills 272 and 263.

f. General Comment of Employment of Chemical Troops: The failure to make full use of chemical troops was not due to the failure of the division commander to appreciate the powers of chemical agents properly employed; a reading of the records of the division from the St. Mihiel period onward indicates, on the contrary, a lively appreciation of the possibilities of such employment, especially as to smoke.

CONCLUSIONS. - a. The fact that the sudden gassing of



1st DIVISION
 MEUSE - ARGONNE
 4-11 Oct. 18



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all the officers of a chemical company deprived the main effort of the army of the support of chemical troops is a commentary on the incomplete training of the army at large in chemical warfare. Whether the situation is much improved today is a question.

b. Other chemical troops were available in the army but they were not promptly made available to the division making the main effort in the critical zone.

c. The great effectiveness of the daily natural fog is a sufficient indication of what might have been accomplished with smoke. The daily advances as made were short; the displacements suggested herein were well within the powers of troops even under the difficult conditions of such a battle; and the screening missions as outlined would have required only reasonable expenditures of ammunition even under the most unfavorable conditions as to wind direction.

d. Had the chemical troop-complement originally contemplated been actually available to the 1st Division, it is evident, in fact, that the advance could have proceeded more rapidly with the same loss, or at the same speed with less loss, which fact is sufficient argument as to the effectiveness of support by chemical weapons.

THE TACTICAL EMPLOYMENT OF CHEMICALS BY A CAVALRY (MECHANIZED) FORCE

By: Captain R.E. Tallant, Cavalry

Mechanized cavalry is still in a state of flux as regards make-up and organization. However, it has been determined that, in general, its characteristics will be the same as that of horse cavalry; mobility, fire power, and shock. The tactical unit, however large it may become, will be built around the Christie combat car as a nucleus, and some observers believe that all vehicles in the force must be of the wheel-track type, possessing the same roadability as the Christie, as well as considerable cross country ability.

The force as now organized, exclusive of administrative and supply units, has vehicles which can be roughly placed in three main groups. First, the combat car group. These vehicles can maintain an average rate of march on good roads of from 30 to 40 miles per hour. Transition from wheels to tracks can be made in 15 minutes, whereupon the car can maintain a speed of from 20 to 25 miles per hour cross country over average terrain and can negotiate some swamps, steep slopes, small streams and trenches, and brushy areas at slower speeds. However, its ability to negotiate all sorts of terrain is not equal to that of the horse, although its ability to move rapidly on roads or over average terrain is much greater. This is the group which furnishes the shock characteristic in the cavalry role. It also has considerable fire power, although this fire power must be delivered when the car is moving, due to its extreme vulnerability when stationary. This group may be said to correspond to the "maneuvering force" in actions of horse cavalry.

The next group is the fire power element - vehicles carrying machine guns, mortars or light artillery. These vehicles with their respective weapons form the "pivot of maneuver" in the typical cavalry action, and, as at present designed, possess about the same road mobility as the combat car but very limited cross country ability. Due to this limited maneuverability the trend is to mount all weapons on vehicles of the wheel-track type which could move cross country equally as well as the Christie combat car. For purposes of this discussion we will consider that all weapon carriers are so mounted.

The third group consists of the armored cars and I

will not elaborate on their tactical uses except to say that they are primarily reconnaissance, and those of contact and covering. The armored cars also possess about the same mobility on roads as the combat cars, but, like the weapon carriers, are restricted in maneuver in that they have little cross country ability and it is thought that they also may be replaced with vehicles mounted on a wheel-track type of chassis.

All vehicles in the mechanized cavalry are armored on the side against 30 caliber fire and will also give protection from glancing blows of 50 caliber machine gun bullets and 37 mm shells. Not all of them, however, have top armor to protect personnel against shell splinters or grenades.

Having considered these characteristics it can be seen that the outstanding capabilities and limitations of the mechanized cavalry are as follows:

a. It has a great value to a commander as a very mobile, hard striking reserve, which can be quickly moved from one critical point to another as the situation demands. Due to its high mobility it can easily reach positions favorable for the attack of enemy flanks or rear areas.

b. It is extremely vulnerable, and due to progress in development of artillery and anti-tank weapons, and difficulty of concealment, must depend on mobility and the surprise factor for its protection.

c. It has little application in defense as, when stationary, vehicles will soon be destroyed. Although it can be used to neutralize enemy opposition or to overrun his positions, it cannot be used to hold ground and for this reason will always be an auxiliary arm which must, in the main, work with infantry or horse cavalry.

In general, actions of mechanized cavalry will follow in principle those of horse cavalry. The armored car group will find the enemy, the fire power group will fix him in place with their fire, while the combat cars will move to his flanks or rear to deliver the main and decisive attack. In actions of this sort the combat car group will furnish the reserve.

Since concealment and surprise have such an important

bearing on successful use of mechanized cavalry, I believe that a battery of 4.2 chemical mortars should be an integral part of such a force and that in the present tentative regimental organization this battery should consist of not less than 8 mortars. Carriers should be of the wheel-track type with a very flexible maneuverability. Moreover mortars should be so mounted in vehicles as to eliminate digging in of baseplates. These mortars would fire smoke only and should be small enough to be able to utilize a certain amount of cover when available. They should, to a high degree, possess the characteristic of being able to quickly reach the most favorable positions, go in action rapidly, and then get out. A vehicle resembling the present English Carden-Lloyd machine gun carrier may furnish the solution to this problem.

There would be considerable difficulty connected with supplying and transporting ammunition for this mortar battery. A unit of this type could not afford to sacrifice its mobility in order to carry large numbers of chemical shells. Although the toxic smokes, persistent and nonpersistent lethal agents, lacrimators and vesicants would undoubtedly have a somewhat limited use with the mechanized cavalry, it must be borne in mind that mechanized cavalry is an auxiliary arm, never used in position warfare, and generally working in conjunction with infantry or horse cavalry. These two arms are best equipped to transport and handle chemical munitions and their mobility would be affected to a lesser extent thereby.

The use of smoke, however, would be essential and would find its most effective use in the following situations:

a. Covering movements of the mechanized force into assault positions. After the enemy has been located it may be necessary for either the pivot (fire power elements) or the maneuvering force to cross areas exposed to fire of enemy artillery or anti-tank weapons in order to reach positions favorable for the launching of their attacks. Smoke laid by the mortar battery located in covered positions in rear might be used to screen these critical areas, or the movement could be made possible by smoking positions of enemy weapons, if located. If conditions were favorable both enemy flanks might be smoked thus assisting the maneuvering force by denying the enemy early information of the direction from which the main attack is to come.

b. Smoke might also be used in assisting either the mechanized units or forces of other arms in making successful withdrawals from action. Assuming that troops are withdrawing by echelon, mortar batteries emplaced in rear could lay a screen between last element of the rear guard and the enemy, and could maintain it for a sufficient length of time to cover the movement of unit withdrawing to next position to be held.

c. It could also be used to advantage in river crossings by smoking enemy positions which threaten the crossing or by laying a screen to front and flanks of troops making the crossing, and maintaining it until troops have actually landed and established a foothold on the other shore. It could be used in a similar manner to cover and protect troops passing through narrow defiles or passes.

Since smoke has such a wide application in practically all the operations of the mechanized cavalry, an attempt has been made to invent some sort of dropping device which would permit gunners, in combat cars or armored cars, to drop ordinary smoke candles at desired intervals along a route of march, thus restricting pursuit or covering movements of vehicles through zones known to contain anti-tank weapons. Such a device would permit combat cars to lay protective screens to cover any sort of troop movement, as due to their mobility these cars could quickly reach desired positions for the laying of the screens. Armored cars, so equipped, would find them very valuable in hampering enemy pursuit or to enable cars to make a successful getaway from an ambush or trap. One very serious disadvantage connected with this scheme however is the fact that a vehicle, when emerging from or outlined against a smoke cloud makes a clear and distinct target for anti-tank weapons. Fuses of candles so dropped must be so timed that vehicles can keep a considerable distance ahead of a rising cloud of smoke, so as to never be clearly outlined against it.

Some consideration has lately been given to the feasibility of equipping combat cars with some sort of weapon, which would project smoke munitions to the extent of effective range of small arms. Such a weapon would be very valuable when used by combat cars, in smoking machine guns located in pill-boxes, or emplacements which cannot be destroyed by small arms fire. These guns could be rendered ineffectual by the combat cars as they move into the enemy position, thus permitting the foot troops to

work into positions from which these guns could be out-flanked and destroyed, without possible delay attendant upon asking for artillery fire on these small targets, or waiting for a mortar battery to move into a position from which they can engage them. These proposed smoke projectors could be used to lay all sorts of protective screens, often from covered positions and would be a considerable protection to the combat cars themselves as it would enable them to neutralize areas from which anti-tank fire is coming, but in which enemy guns have not been definitely located. *

While such a weapon would be very desirable, difficulties incident to its design and successful operation have thus far prevented its development. It would have to fire a shell of considerable size to get a sufficient concentration of smoke material down to form an effective screen at the desired location. This would add weight to a vehicle which is already excessively heavy; it would necessitate redesigning of combat car gunners' turrets to provide space for additional munitions and the projector itself. It would have to be a flat trajectory weapons due to the fact that fire from a moving vehicle must be direct. Anything in the nature of a mortar would not be practical for this purpose, and lastly, it would make another job for an already over-burdened gunner.

USE OF SMOKE BY THE COAST ARTILLERY

By: Major William R. Nichols, Coast Artillery Corps

The history of war is replete with examples of the use of smoke for screening purposes. Even unto Moses was vouchsafed a knowledge of the value of smoke; for, did he not, upon the approach of the Egyptians, protect his rear and screen his movements by a pillar of smoke by day and a pillar of fire by night? A study of historical instances of the use of smoke would be interesting and valuable to every military student, but the brevity of this paper precludes more than the above brief historical reference, made merely as an indication that smoke is not a new untried agency of warfare, rather is it an ancient and oft tried one, and that its tactical value is a positive thing of long standing.

The obscurity of the early dawn has long been used advantageously to effect concealment, gain surprise, and reduce casualties. Fog and haze are natural phenomena which have proven of great value. These, however, cannot be counted upon in advance, are uncertain of duration, and cannot be controlled. Smoke, by which an artificial fog can be created, is one of the newest developments of modern war. Its value is augmented by the fact that its use may be planned and prepared in advance. It is subject to control as to time, and, within certain limits (principally atmospheric), as to place.

Smokes may be classified as follows:

Toxic Smokes. These are poisonous or irritating and used in warfare for casualty effect.

Screening Smokes. These are essentially non-poisonous and are used to interfere with visibility. Such smokes may be further classified, as follows:

Blanketing Smokes: So called when employed on or immediately in front of the enemy to interfere with his aimed or observed fire.

Obscuring Smokes: So called when employed in such manner as to conceal something from the enemy.

It is with screening smokes that we are particularly

interested in this paper.

All smokes on the battlefield have certain properties which must be carefully considered for each situation that may arise in warfare, for the reason that in some situations some or all of these properties may be an advantage while in other situations quite the reverse may be true. These properties are:

Smoke obscures vision, and:

- a. Prevents aimed fire and saves lives.
- b. Prevents us from seeing the enemy and the enemy from seeing us.
- c. Increases difficulty of maintaining direction.
- d. Makes communications more difficult.
- e. Demoralizes untrained troops.

Smoke drifts with the wind. It is obvious then from the above that wind direction is of vital importance in the use of smoke.

Smoke puts the enemy on the alert. This may result in an advantage to us when we are trying to learn the details of his defenses. On the other hand, it would be decidedly disadvantageous to alert the enemy if he is not already aware of our strength and dispositions.

Smoke draws enemy attention and fire to itself. This property of smoke makes it possible to employ it advantageously in ruses.

Since the World War the Coast Artillery has shown increasing interest in the value of chemical warfare in connection with Coast Defense. While some thought has been given to offensive use of chemical agents, the interest of the Coast Artillery has more or less naturally centered largely in defensive measures against gas, such as; proper types of gas masks, individual and collective protection of personnel, lectures on chemical warfare to officers and men, target practices held in gas concentrations, and the gas proofing of installations. So far as can be

ascertained, however, little has so far been done by the Coast Artillery in the way of experimenting with and developing the use of smoke. Record can be found of but one experiment with smoke; viz, at Battery Closson, Fort Kamehameha, T.H., in June 1929, the results of which were not very conclusive or helpful.

A coast defense must be prepared to deal with naval attack, aerial attack, and attack from the land. It is believed that the principles involved in the use of smoke against hostile forces which are being studied and developed by the Chemical Warfare Service and by students of chemical warfare, apply generally and sufficiently well to the case of land attacks against coast defenses to require no discussion here. Our chief interest, then, centers about the employment of smoke as an agency of defense for the Coast Artillery against naval and aerial attacks. Relative to these two types of attacks against coast defenses we are interested to know whether smoke can be used to real advantage by the defenders, the manner in which smoke can be most advantageously used, and the effect obtained by its use.

The role of a coast defense with regard to naval attack, is to keep the area within reach of its guns clear of hostile ships. This may mean repelling a naval attack in any one of the following forms:

Blockade.

Bombardment.

Attack of barriers, docks, utilities, etc.

Attack of naval craft, utilities, etc., inside of harbors.

Attack by landing parties.

To conduct an attack in any form a hostile naval force must see its objective, either by direct observation through means of its observing instruments or through means of its air observers. Can the coast defense attacked employ smoke, at least, to make the problem of the hostile naval force more difficult and at the same time not impose difficulties in the way of its own land armament (including antiaircraft) and attached or cooperating air force? This question must in time be settled definitely one way or the other. Better sooner than later. Therefore, through earnest study and well planned tests and experiments we should lose no time getting at the problem.

Consider now a blockading effort of a hostile naval force. In such action the hostile vessels do not ordinarily engage the coast defenses. When such vessels do engage the coast defenses the blockade assumes one of the other forms of attack. Therefore, in a blockade there is no occasion for the use of smoke directly against the blockading vessels. However, during a blockade the hostile navy, if strong in aviation, may attempt harassing missions against the shore defenses and harbor installations. It is conceivable in such cases that obscuring smokes may be used to advantage by the defenders provided timely warning is had of the approach of the hostile aircraft. Such smoke could, of course, be considered only as an auxiliary means to the primary elements of the defense; viz, the friendly air and antiair forces. If the coast defenses are provided with ample smoke producing agencies, and through training are on the alert for such an emergency, it should be possible to provide an obscuring smoke over the more vital elements of defense, which would greatly increase the difficulties of the attackers in locating their objectives, thus rendering them more vulnerable to the defending air and antiair forces.

A hostile naval bombardment would normally take place from positions just within the limiting range of the naval guns in order to remain at the greatest possible distance from whatever land artillery there may be in the coast defenses. Against such action the mission of the coast defenses is to prevent the bombardment and to cause the enemy vessels to withdraw. Failing the accomplishment of this mission through means of land artillery and aircraft, a smoke screen would add greatly to the difficulties of the bombarding ships through interference with the accuracy of their guns, perhaps even to the extent of rendering their fire ineffective. A blanketing screen would be effective unless the hostile air were able to push in close enough to observe for the ships, and maintain such observation. In which case an obscuring screen would become necessary in order to secure protection.

In case of a direct naval attack against coast defenses, it is more vital for the coast defenses to inflict such losses on the enemy as to compel him to withdraw. The land artillery and air force, with high explosive and gas, must be depended upon primarily to defeat the hostile naval attack rather than such negative means as smoke. However, should the hostile attack prove successful against the coast defenses an attempted

run by would probably follow. What of the mine field still to be negotiated? The hostile navy may have attempted sweeping the mine field, but such operations are rarely 100% successful. A mine field always remains a menace to an attacking naval force. Would not a mine field obscured, even partially, by smoke become a much more serious obstacle to successful navigation by the hostile ships? Certainly the answer is yes. This thought then suggests provisions for quickly creating obscuring smoke screens for mine fields. The less important mines on the edges of the field might be loaded with smoke, wholly or in part, and set off at will from shore. Or special electrically controlled smoke producing apparatus may be incorporated in each mine project. Still another possible means would be small fast boats held ready in the defenses with smoke apparatus ready to dash out and screen the mine field. Smoke may similarly be effectively used to hinder or defeat naval operations aimed at other defensive barriers.

Attacks against naval craft, docks and other utilities inside of harbors would probably be attempted by aircraft, fast light draft surface vessels, or by submarines. Against the first two smoke screens would serve a useful purpose provided the alarm could be given in time for a screen to be laid. Against submarines, however, smoke is likely to be less effective. The submarine can submerge and await the clearing of the smoke without becoming confused in navigating the harbor. In fact, a light smoke or haze would not prevent the submarine at periscope depth from feeling its way about a harbor relatively secure, for under such conditions the periscope would be very difficult to detect.

For landing operations we have seen that smoke is very valuable in effecting a landing, provided the point or points of landing are not obscured to the landing force. Therefore, smoke in the hands of the defenders, when so used as to obscure the probable landing beaches and to confuse the landing forces, should prove a valuable agency against the enemy.

It is realized that the above discussion, necessarily hurried, and along a line of thought about which little appears to have been written, is very general and inconclusive. It was not hoped to do more in this paper than touch on the value of the use of smoke in warfare, the principles that have been deduced from the use of smoke in the past in land warfare and through subsequent study, and to indicate, as is believed to be

true, that there is an important place in our scheme of coast defense for smoke, so real and pressing in fact as to warrant more serious thought and study of the subject.

The fundamental tactical principles for the use of smoke by the Coast Artillery must be developed through the study of the subject by Coast Artillery officers, and, in collaboration with the Chemical Warfare Service, through extensive tests and experiments.

Academic study only of the subject will lead nowhere. Tests and experimentation with various smokes and smoke producers must be had under all conditions of weather. Vast quantities of smoke would be required. Cheaper and more efficient smokes and smoke producers must be developed.

Local conditions, especially as to weather and terrain features, vary greatly and produce special problems for each locality where coast defense installations occur. Therefore, tests and experiments carried on in one locality cannot be accepted as criterions for other coast defense localities.

Finally, there is a real place in coast defense warfare for the employment of screening smokes. Just how, when, and under what circumstances screening smokes can be used to advantage must be determined. As stated before, this can be accomplished only through extensive tests and experiments, and in addition careful training.

For these tests and experiments considerable funds must be made available. Through cooperation with and support of the Chemical Warfare Service steps should be taken without delay to secure the necessary funds and smoke material and equipment, to the end that experimentation with smoke and the development of plans for the use thereof, be required as a part of the yearly training program of each of our actively manned coast defenses.

CHANGES OF ADDRESS - REGULAR OFFICERS, C.W.S.

1st Lt. Joseph F. Battley, - address changed from 3d C.W.S. Proc. Dist., Pittsburgh, Pa., to Army Industrial College, Washington, D.C.

Major Edward C. Wallington, - address changed from Army War College, Washington, D.C., to Hq. 7th Corps Area, Baird Bldg., Omaha, Neb.

Lt. Col. Ray L. Avery, - address changed from C. and G. S. School, Ft. Leavenworth, Kas., to Hq. 8th Corps Area, Ft. Sam Houston, Tex.

1st Lt. Harry A. Kuhn, - address changed from Army Industrial College, Washington, D.C., to Hq. 4th C.W.S. Procurement District, 35 E. Wacker Drive, Chicago, Ill.

1st Lt. Edward J. Sullivan, - address changed from Army Industrial College, Washington, D.C., to Hq. 3d C.W.S. Procurement District, 1010 Diamond Bank Bldg., Pittsburgh, Pa.

Major Paul X. English, - address changed from OC-CWS, Washington, D.C., to Army War College, Washington, D.C.

Captain Edward B. Blanchard, - address changed from Edgewood Arsenal, Md., to Army Industrial College, Washington, D.C.

Major William A. Copthorne, - address changed from Hq. 7th C.A., Omaha, Neb., to Command and General Staff School, Ft. Leavenworth, Kas.

Major Oliver J. Bond, - address changed from A.C.T. School, Maxwell Field, Ala., to Hq. 5th C.A., Fort Hayes, Ohio.

Captain Ralph C. Benner, - address changed from Hq. 5th C.A., Ft. Hayes, Ohio, to Edgewood Arsenal, Md.

Captain Thomas J. Johnston, - address changed from Edgewood Arsenal, Md., to R.O.T.C., Massachusetts Institute of Technology, Cambridge, Mass.

Major Theodore Barnes, - address changed from Edgewood Arsenal, Md. to Air Corps Tactical School, Maxwell Field, Mont-

gomery, Ala.

1st Lt. Maurice E. Jennings, - address changed from Edgewood Arsenal, Md., to Infantry School, Ft. Benning, Ga.