

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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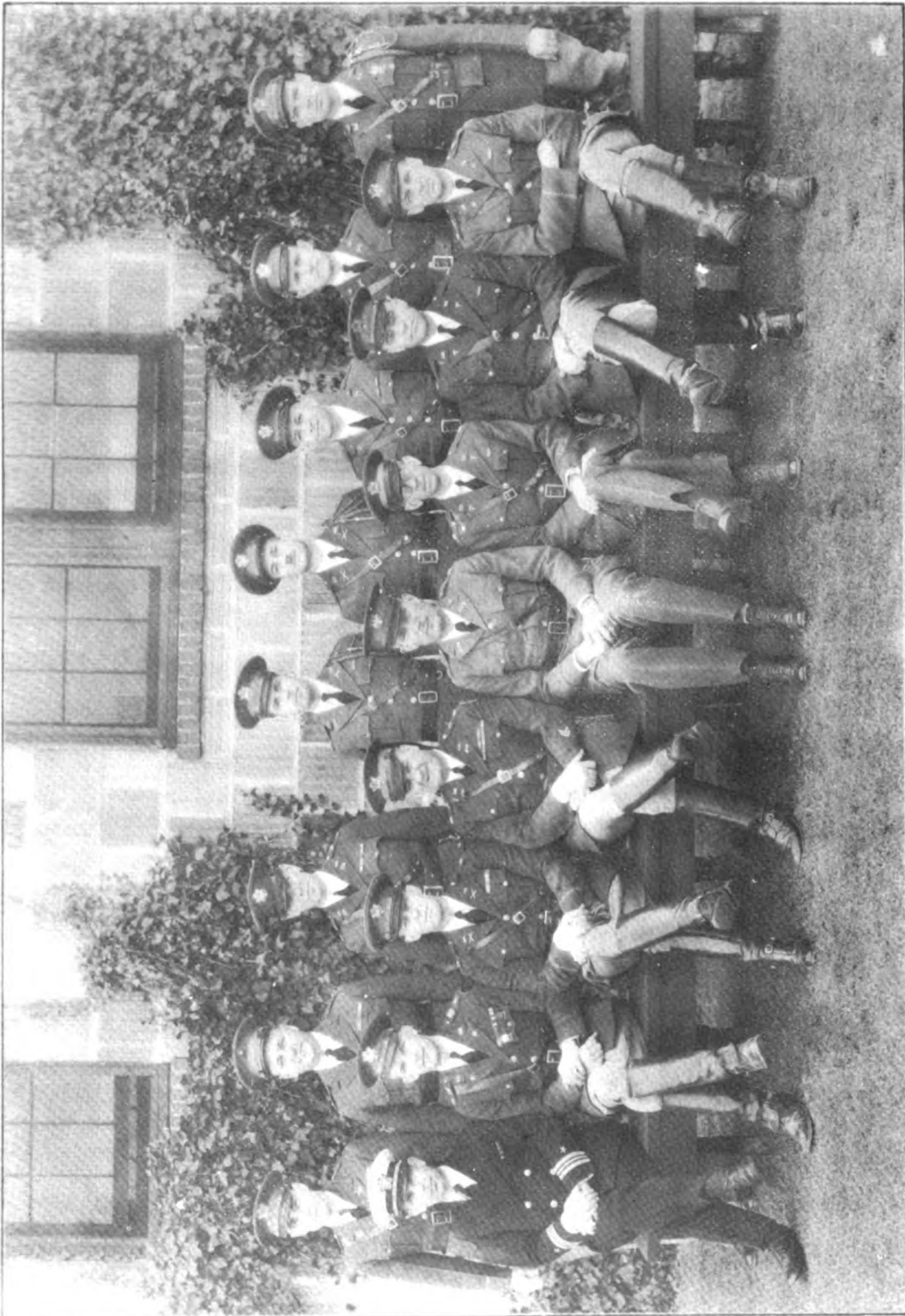
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LINE AND STAFF OFFICERS' CLASS, 1933.

Back Row: Hood, Linsert, van der Stempel, Heiner, Quarterman, Williams, Gruenther, Purcell.
Front Row: Brewster, Reutershan, Eager, Feigenspan, Padgett, White, Dildine, Brewer.

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CHEMICAL WARFARE

VOL. 19

APRIL, 1933

NO. 2

LINE AND STAFF OFFICERS' CLASS

The 16th Line and Staff Officers' Class entered upon its twelve-weeks course of instruction on February 6, 1933. The following officers are students:

Lieutenant Colonels

Padgett, Heber R., C.W.S., S.C.N.G.
Feigenspan, Edwin C., C.W.S., N.J.N.G.

Majors

White, Samuel A., M.C.
Eager, John M., F.A.
Dildine, Seth C., V.C.
Reutershan, Alfred D., Inf., N.Y.N.G.
Brewer, Robert M., Inf., Ind. N.G.

Lieut. Commander, U.S.N.

Brewster, George P.

Captains

Quarterman, William H., Jr., F.A.
Heiner, Gordon G., Jr., F.A.
Williams, Walter R., D.C., Ohio N.G.
van der Stempel, Theodore M., CW-Res.

1st Lieutenants

Gruenther, Alfred M., F.A.
Linsert, Ernest E., U.S.M.C.
Purcell, Frank X.A., C.E.

2nd Lieutenant

Hood, Reuben C., A.C.

CHEMICAL WARFARE EQUIPMENT AND SUPPLY IN THE INFANTRY REGIMENT

By: Major Harold R. Bull, Infantry

The critical period for which the American Army should especially prepare is the initial stage of the first campaign of any major war. If we can successfully weather the storm during that stage of the conflict, we may reasonably expect ultimate success with our vast resources in men and materials. The all important elements of time and experience thus gained will then permit us to modify organization and equipment as the type of warfare may dictate. If these suppositions are true we must expect our first severe test to be in highly mobile open warfare. So we must train, organize, equip and plan for that most difficult type of operations.

Realizing the great premium on mobility, it is my desire to call attention to the tendency since the World War to over burden the infantry battalion with useful but bulky equipment and supplies to such an extent that the individual and smaller units are most assuredly losing their ability to maneuver freely and rapidly. This discussion will be confined almost wholly to the chemical warfare equipment provided the infantry regiment but the same line of reasoning should be applied to all other articles now provided for. Each must be made to prove its worth or be abandoned.

In addition to the gas mask to be carried by the individual, the present Tables of Basic Allowances for Infantry provides for the issuance of infantry units, upon mobilization, of the following Chemical Warfare Service organizational equipment:

<u>Item</u>	<u>Quantity</u>
Horn alarms	5 per Co
Dugout blankets	6 per Co.
Protective boots	10 pairs per Co.
Gas Mask Canisters	5% additional for all masks issued.
Anti-dim sets	20% additional for all masks issued.
Protective gloves	1 pair per lineman and 10% of strength of organization.

<u>Item</u>	<u>Quantity</u>
Gas Mask repair kits	1 per Hq. Co. Detachment or separate battalion.
Chloride of lime	100 lbs. per Company.
Horse masks	1 per animal.
Protective suits	10 per company.
Smoke candles	100 per regiment.
Tear gas candles	40 per regiment.

This equipment must of necessity be carried either by the individual or on the company trains, combat trains or field trains if issued to infantry organizations.

Considering one possible distribution of this load the total approximate weights involved (less gas masks carried by individuals) are as follows:

Rifle company	254 lbs.
Machine gun company	367 lbs.
Battalion headquarters company	291 lbs.
Howitzer company	313 lbs.
Regimental headquarters company	633 lbs.
Service company	1148 lbs.

All of this equipment is of undoubted value during certain types of warfare just as all of the special weapons adopted or proposed can serve a useful purpose in special operations. Can the infantry carry them all and still preserve its mobility? It is quite apparent that the tendency is to take each new piece of equipment or each new weapon and give it a place in our organization in the hope that it will help the infantry to move forward and yet preserve its combat strength. To keep this tendency within reasonable limits we must keep in mind the need for the maximum mobility in the opening days of mobile warfare. To preserve that mobility we must compromise. The attainment of more fire power calls for more transport for weapons and ammunition. This in turn increases our trains, adds to our road space and hampers our power to move freely and quickly. Increases which are apparently insignificant in the smaller infantry units become greatly magnified as battalions are multiplied in the divisions and larger units. We must therefore ruthlessly cut to the essentials only. The smaller units cannot always have readily available in the field those things which

it would like to have for the solution of each special problem.

Before we consider the necessity for Chemical Warfare equipment within the infantry regiment we should examine the function of the infantry trains in our supply system. The trains of course are to enable the commander to make available to his men all supplies when and where needed and in the quantity which the situation demands. Certain equipment is so uniformly essential to the individual that he carries it with him constantly when in the combat zone. On the company trains we should find only that equipment which is essential for the men and animals of machine gun, headquarters and howitzer companies to permit them to engage in combat instantly and to carry on the fight for a brief period. On the battalion combat train wagons should carry only equipment and ammunition necessary to initiate combat and to carry on till replenishment can be started. The field train carries other equipment needed by the regiment in the field which is not needed to initiate combat. Since the infantry combat train wagons must move to the division distributing point to replenish ammunition and then return to the battalion distributing point to transfer their loads to men or carts and since they continue this operation throughout the battle, it seems evident that they should not carry a dead load of any materials not needed to initiate combat. Such cargo, if present, merely takes up invaluable and very limited space and tonnage and requires what might be called a continuous back-haul which in open warfare cannot be avoided since the formation of small dumps means loss of equipment. For use in combat, all equipment must eventually be transferred to the soldier and thus add to his already too heavy burden.

With the foregoing facts in mind let us see what necessity exists for the Chemical Warfare equipment now provided by Tables of Basic Allowances. Due to the very nature of the agents and weapons used, chemical warfare finds its greatest role in stabilized warfare. It is most effective and pays the greatest dividends in defensive situations. Any extensive chemical warfare operations require time which would seldom be available in open warfare situations. This does not mean that chemicals of all kinds may not be used occasionally in mobile warfare but merely indicates that heavy concentrations of persistent agents over extensive areas which might threaten the success of our operations is most unlikely in war of rapid movement. However, since it appears quite probable that casualty producing chemi-

cals may be used in future wars, even in the earliest stages, no nation can safely send its army in the field without giving it the essential equipment for its reasonable protection. If and when the forces become stabilized or whenever the gas situation requires we must then add to the equipment and supplies necessary to meet that situation. Those supplies must be procured in advance, echeloned in rear to meet the needs of the troops and forwarded only when needed.

To draw conclusions from this discussion the Table of Basic Allowances is again presented with a recommendation of the disposition to be made of each item and its proper place in the infantry supply chain:

Horn alarms)	
Dugout blankets)	To be procured and stored in army
Protective boots)	
Protective gloves)	depots in quantities now provided for
Chloride of lime)	
Protective suits)	in Tables of Basic Allowances
Horse masks	-	To be carried on individual animal or vehicle
Smoke candles)	To be carried on the headquarters
Tear gas candles)	wagon of each battalion combat train
Gas mask canisters)	for units of the battalion and on the
Anti-dim sets)	regimental headquarters company
Gas mask repair kits)	transportation for other units of the
)	regiment.

Such disposition would give a load of approximately 230 pounds of essential chemical warfare equipment to be carried on the combat train wagon of each battalion headquarters company with no such equipment on the individual wagons of the companies engaged in ammunition replenishment. This equipment would thus be directly under the supervision of the battalion gas officer.

The load to be carried on the regimental headquarters transportation for the headquarters, nowitzer and service companies would amount to only 180 lbs. and would be directly under the supervision of the regimental gas officer.

By rearranging loads in the infantry trains, these articles can be carried without adding vehicles to the present

combat trains or adding to the load of the individual soldier.

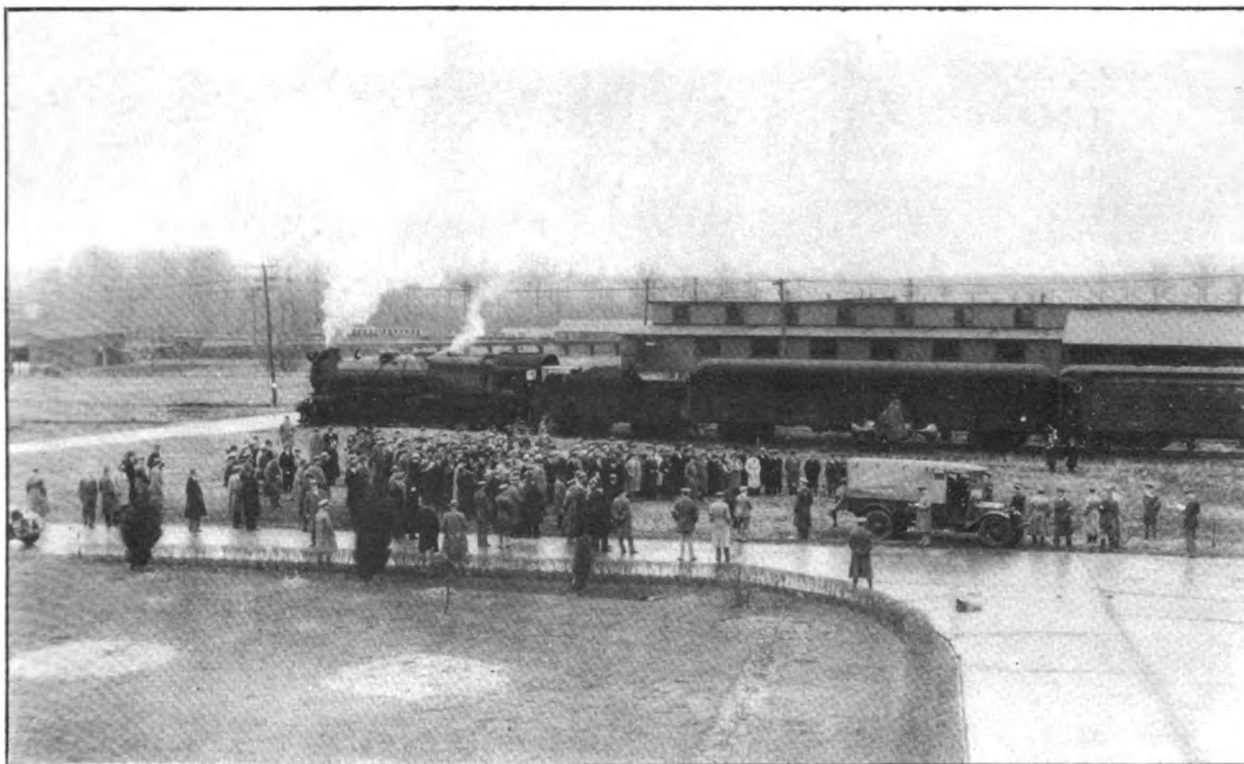
By holding the additional protective equipment in army depots it can be made readily available when chemical warfare agents may be used on an extensive scale. When this additional equipment is issued an additional wagon should be added to each battalion combat train and either a wagon or truck, preferably the latter, to each regimental headquarters company combat train. The truck would be of great assistance to the regimental gas officer also in arranging for protective operations throughout the area.

It is believed that with this re-arrangement of chemical warfare equipment in the infantry regiment we may avoid decreasing our mobility by avoiding the addition of non-essential equipment. We assure reasonable protection for our troops by giving them masks and means for repair and replacement readily available. We provide for the emergency, when extensive use of gas may come, by having adequate collective protection equipment stored close in rear. These provisions coupled with the issue of impregnated clothing and the ability of troops to quickly move out of or around restricted contaminated gassed areas in open warfare situations should be adequate for the critical early days of a major war. With adequate protective equipment in rear the transition to static warfare protection can be easily effected.

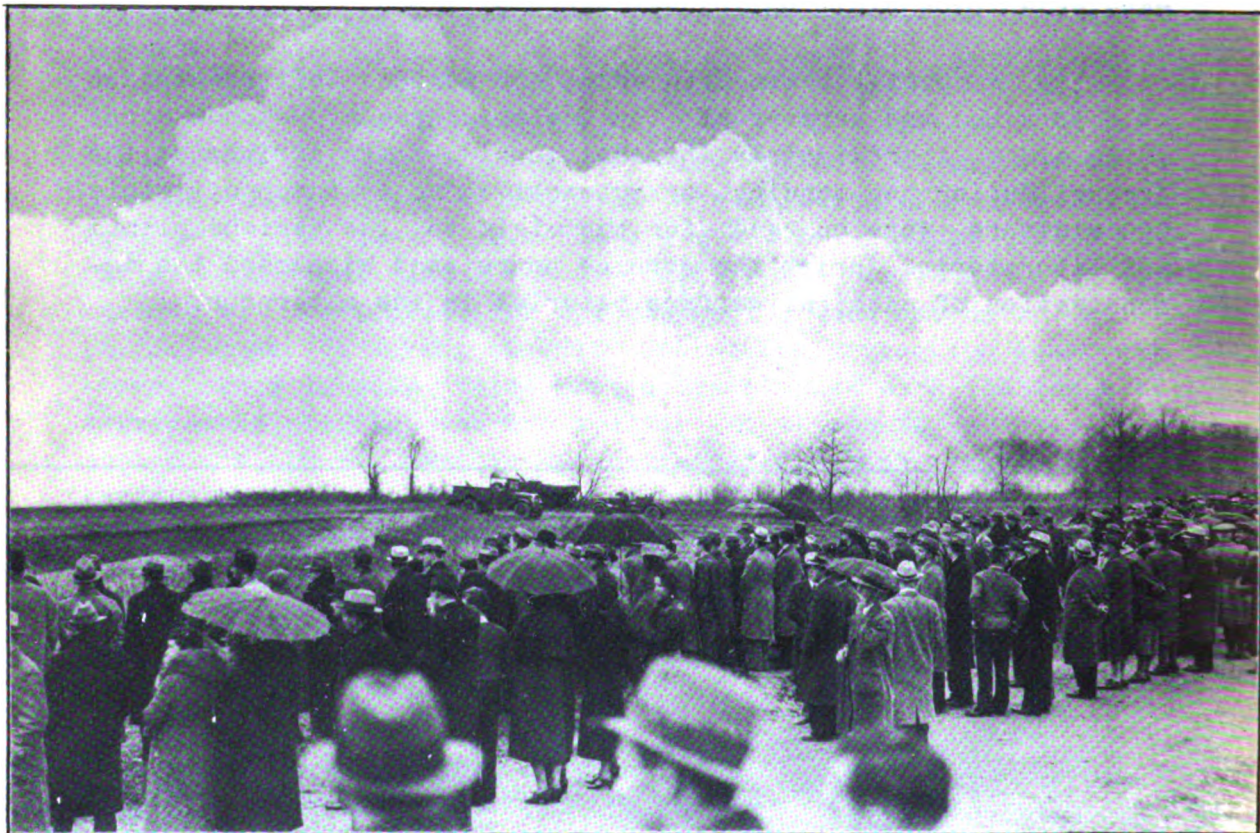
VISIT OF THE AMERICAN CHEMICAL SOCIETY TO EDGEWOOD ARSENAL

The American Chemical Society met in the City of Washington during the week beginning March 27, 1933. The Chief of the Chemical Warfare Service extended an invitation to the Society to visit Edgewood Arsenal at the conclusion of the Washington meeting. This invitation was accepted and arrangements were made for a visit on Friday, March 31, 1933.

A special train with about 150 members left Washington at 8:50 a.m., and arrived at the Edgewood Arsenal grounds about 10:20 a.m. Approximately 450 additional members arrived at the Arsenal during the morning by automobile, so that approximately 600 visitors were on hand for the visit to the various plants and laboratories during the morning hours and witnessed the demonstration of chemical warfare materiel in the afternoon.



Arrival of American Chemical Society



Airplane Smoke Screen



Candle Smoke Screen

Those arriving by train were welcomed by Colonel C. E. Brigham, Commanding Officer of Edgewood Arsenal, by a short address at 10:30 a.m., after which this group visited various Arsenal activities until 12:30, at which time the Officers' Club served a box lunch in the Brine Building of the Chlorine Plant. The laboratories and plants visited during the morning were as follows:

Physical Chemistry Research Laboratory.
White Phosphorus Shell Filling Plant.
Physical Laboratory.
Technical Museum.
The Plants of the Phosgene Group.
Gas Mask Factory.

The First Chemical Regiment furnished one company to mark the route and give out necessary information to the visitors during their tour through the plants and laboratories. The

class of The Chemical Warfare School acted as guides in the visit to the Arsenal installations.

During the afternoon the Technical Divisions, the First Chemical Regiment, and the Air Corps Detachment of Edgewood Arsenal cooperated in putting on a demonstration of chemical warfare materiel for the visitors on San Domingo Farm. The war-time Stokes mortar was shown in comparison with the present chemical mortar, both weapons being fired from the usual mounts and from mechanized mounts. Various types of candles were shown and later demonstrated. The concluding event of the afternoon's demonstration was a smoke screen laid by a three-plane formation. Due to a favorable wind, it was possible for the aviators to lay this screen directly in front of the visitors so that every detail of the operation could be plainly observed.

Many amusing anecdotes were told by the School class as mementos of their very pleasant day spent with the members of the American Chemical Society. Frequently questions were asked which were a little too much for members of the class, while upon other occasion questions were asked which required considerable ingenuity on the part of the guides who attempted to supply the required information. The prize question and answer of the day, as reported by the students, was the following:

Young Lady: "Suppose you make one of these smoke screens and then decide that you do not want it - what do you do about it then?"

Student Officer Guide: "We send the airplanes out, roll it up, take it home and use it some other day."

THE USE OF CHEMICAL AGENTS BY THE FIELD ARTILLERY IN FUTURE WARS

By: Major H.L.C. Jones, F.A.

The effort in this study is to come to some reasonable conclusion as to the amount or percentage of chemical shell we may expect to use in future war.

To this end the endeavor has been made to get data on the actual use of artillery gas shell in the last part of the World War, the effectiveness of this shell and the plans of the various powers for the expected campaign of 1919. This data, together with the predictions of military writers on future wars, give a reasonably good insight into the future use of chemicals in the early stages of any future war.

The instructional matter bearing on the subject issued by The Chemical Warfare School has been considered but is not quoted. Certain extracts from other sources, considered in arriving at the conclusion, are quoted, as follows:

Ludendorff's Own Story

Speaking of the situation in 1917, Ludendorff states:

"Gas production had to keep pace with the increased output of ammunition. The discharge of gas from cylinders was used less and less, the troops being opposed to it from first to last, and the use of gas shell increased accordingly. Our yellow cross shell was greatly feared by the enemy. The fear of injury from their own gas still remained very strong with our men and did not abate until much later.

Smoke shells, too, were now manufactured." - - -

* * * * *

"The French attack of October 22, 1917 was successful. One division succumbed to the effects of an exceptionally heavy gas bombardment and gave way before the hostile assault."

In speaking of the situation in 1918, he states:

"General Headquarters intended that after a short ar-

tillery bombardment (March 21, 1918), lasting only a few hours, the infantry, which was to be held in readiness in forward positions, should advance to the assault.

"The short storm of fire was expected to neutralize the enemy's artillery by means of gas, which spread over great areas and kept his infantry in dugouts.

"Our artillery relied on gas for its effect and that was dependent on the direction and strength of the wind."

In commenting on the Allied attacks of August and September 1918, Ludendorff states:

"The characteristics of their tactics was narrow but deep penetration by tanks after short but extremely violent artillery preparation, combined with artificial fog. Mass attacks by tanks and artificial fog remained hereafter our most dangerous enemies."

J.B.S. Haldane in "A Defense of Chemical Warfare"

"The most interesting thing about mustard gas is that, though it caused 150,000 casualties in the British Army alone, less than 4,000 of these (or 1 in 40 died), while only about 700 (or 1 in every 200) became permanently unfit."

* * * * *

"It is, therefore, somewhat unlikely though not, of course impossible, that any very poisonous vapor will ever be found which will go through a mask impermeable to mustard gas or chlorine. It is to my mind, far more probable that skin irritants may be discovered which are even more unpleasant than mustard gas."

"The question of smokes is more serious. It was the hope of the producers of irritant smokes that they would penetrate the gas mask * * * *. This was the German view when they introduced the "Blue Cross" shell in July 1917. * * * * * It is not however, at all unlikely that concentration of smoke will be produced in the future which will penetrate our present masks." * * * * * "This group, which included chlorine and phosgene, are probably as obsolete as muzzle-loading cannon."

The Riddle of the Rhine by Victor Lefebure

"Mustard gas was the war gas par excellence for the purpose of causing casualties. Indeed, it produced nearly eight times more allied casualties than all the various other kinds of German Gas."

Quoted from Die Technik in WeltKriege. "During the big German attacks in 1918, gas was used against artillery and infantry in quantities which had never been seen before, and even in open warfare the troops were soon asking for gas."

"For twelve days prior to their March assault (March 21, 1918) the Germans used mustard gas over certain areas, and non-persistent types for other localities. As an example of the first method, we can state that nearly 200,000 rounds of yellow cross shell were used on the 9th March, and caused us heavy casualties."

"Some idea of the importance which the Germans attached to their chemical ammunition, as distinct from explosives, can be gathered from the following extract from a captured order of the Seventh German Army, dated May 8th, 1918, giving the proportion of chemical shell to be used in the artillery preparation for the attack on the Aisne on 27th May, 1918.

a. COUNTER-BATTERY AND LONG RANGE BOMBARDMENTS.

For 7.7 c/m field guns, 10.5 c/m and 15 c/m howitzers and 10 c/m guns; Blue Cross, 70%; Green Cross 10%; H.E. 20%; long 15 c/m guns fire only H.E.

b. BOMBARDMENT OF INFANTRY POSITIONS.

(1) Creeping Barrage.

For 7.7 c/m field guns, 10.5 c/m and 15 c/m howitzers; Blue Cross 30%, Green Cross 10%, H.E. 60%, 21 c/m howitzers fire only H.E.

(2) Box Barrage.

For 7.7 c/m field guns, 10.5 c/m howitzers and 10 c/m guns; Blue Cross 60%, Green Cross 10%, H.E. 30%.

No Yellow Cross shell were to be used in the bombardment, but, as mentioned above, there was a complete change of tactics in their retreat, during which they attempted to create a series of barriers by literally flooding the country with mustard gas. This defensive use of mustard gas was most important.

Quoting General Hartley, speaking of the German retreat in 1918:

"Yellow Cross shell were used much farther forward than previously, bombardments of the front line system and of forward posts were frequent and possible assembly positions were also shelled with gas. * * * * * In Yellow Cross they had an extremely fine defensive weapon, which they did not use to the best advantage, for instance they neglected to use it on roads and did not hamper our communications nearly as much as might have been done. As our offensive progressed their gas shelling became less organized, and one saw very clearly the superior value of a big gas bombardment as compared with a number of small ones. In the latter case it was usually possible to evacuate contaminated ground and take up alternate positions, while in the case of a bombardment of a larger area such as the Cambrai salient, the difficulty of doing so was greatly increased, and consequently casualties were higher. During our offensive it was not possible to exercise the same precautions against gas as during stationary warfare, and the casualties were increased on this account."

In speaking of the percentage of gas shells used by the German Artillery, Lefebure states:

"The normal establishment of a German divisional dump in July 1918, contained 50 percent of gas shell. The dumps captured later in the year contained from 30 to 40 percent.* * *

* * * * * Examining the case less superficially (reduction of gas shells in dumps), however, we soon see that this lower percentage has an entirely different meaning. In the first place, we know that the German factories were still pressing on to their maximum output at the time of the Armistice. New units were being brought into operation. Secondly, we have seen how huge quantities of mustard gas were diverted to those particular German armies which were most threatened by the final Allied offensive and that they had expended these stocks at a greater

rate than their factories could replace them."

According to Schwartz: "Although the production of Yellow Cross almost reached 1000 tons a month, yet finally the possibilities of use and the amount required were so great that only a much increased monthly output would have been sufficient."

Lefebure states: "Between November 1917 and November 1918, France produced more than 5,000,000 of her latest type of respirator. The British figure was probably higher. From April to November 1918, the French filled nearly 2,500,000 shell with mustard gas. From the 1st of July 1915, to November 1918 more than 17,000,000 gas shell were completed by the French. * * * * The total French production of chlorine and poison gas for chemical warfare approached 500,000 tons, a larger proportion of which production occurred during 1917 and 1918. The British was of the same order, but German production was at least more than twice as high, showing what great use they made of gas shell. The huge American programme might have reduced the margin, but no limits can be placed on German possibilities and elasticity of production."

General Fries states: "The battle-field of the future will be covered with smoke * * * * * with dots and patches, big and little, here and there and everywhere."

General Debeney states: "Should war begin now, aviation, and especially gas would play one of the most important parts."

"The Australian Victories in France in 1918"

by

Lieutenant-General Sir John Monash

In speaking of the capture of Hamel on July 4th, Monash states:

"My practice was therefore, during ordinary harassing fire in periods between offensive activities, always to fire both classes (gas and smoke) of shell together, so that the enemy became accustomed to the belief at the least that our smoke shells were invariably accompanied by gas shell, even if he did not be-

lieve that it was the smoke shell which alone gave out the warning smell. The effect on him of either belief was, however, the same; for it compelled him in any case to put on his gas mask in order to protect himself from gas poisoning.

On the actual battle day, we fired smoke shell, as we dared not vitiate the air through which our own men would shortly pass. But the enemy had no rapid means of becoming aware that we were firing only harmless smoke shell. He would therefore promptly don his gas mask, which would obscure his vision, hamper his freedom of action, and reduce his powers of resistance. On July 4th, both the 4th and 11th Brigades accordingly took prisoner large numbers of men who were actually wearing their gas masks. The stratagem worked out exactly as planned."

Speaking of the period preceding the battle of August 8th, 1918, when the Australian Corps were improving their position by repeated raids and local attacks, Monash states:

"The enemy attempted nothing in the way of infantry retaliation. But whenever he had been thoroughly angered, he treated my front to a liberal drenching of mustard gas, fired by his artillery. His supplies of mustard gas seemed inexhaustible, and he would frequently expend as many as 10,000 of them in a single night * * * * * .

"These gas attacks were annoying and troublesome in extreme. During the actual bombardments, troops wore gas masks as a matter of course, but doffed them when the characteristic smell of the gas had disappeared. But it was warm weather, and as the sun rose, the poisonous liquid, which had spattered the ground over immense areas, would volatilize, and rise in sufficient volume still to attack all whose business took them to and fro across this ground. In this way hundreds of our men became incapacitated; although there were few serious cases, most of the men would be fit to rejoin in two or three weeks. But this form of attack, and the constant dread of it, made life in forward areas anything but endurable."

Concerning plans for the battle of August 8th, Monash states: "These - the guns (artillery) and the machine guns - were the only things that troubled us * * * * * ."

"Very special care was, therefore, devoted to the whole

of the arrangements, first for carefully ascertaining beforehand the actual or probable position of every enemy gun that could be brought to bear on our Infantry, and then for allocating as many heavy guns as could be spared. * * * * * to the destruction or suppression of the selected target. For it served the immediate purpose of eliminating the causes of molestation to our advancing Infantry equally well, whether the enemy gun was merely silenced by the sustained fire of shrapnel or high explosive which drove off the gun detachment, or by a flood of gas which compelled them to put on their gas masks, or whether it was actually destroyed by a direct hit and rendered permanently useless."

Monash makes the following comments on the attack on the Hindenburg Line in September, 1918:

"The programme began on the night of September 26th. There was an intense artillery action, extending over some sixty hours, with every gun that could be brought to bear * * * * *."

"The first phase of this bombardment was of novel character. For over two years the enemy had been using a shell containing an irritant and poisonous gas known as "mustard gas" * * *. For a long time we had been promised that the British Artillery would shortly be supplied with a gas shell, of similar character, but even more potent. It was, moreover, anticipated that the German gas mask would prove no adequate protection against this kind of gas.

"At last the new shell was forthcoming, and the first shipment from England, amounting to some fifty thousand rounds, was placed at the disposal of the Australian Corps. My artillery action, therefore, opened with a concentrated gas bombardment for twelve hours, attacking probable living quarters, occupied defenses, and all known or suspected approaches to them. Apart from being the first occasion, I believe that it was also the only occasion during the war when our "mustard gas" shell was used. No suitable opportunity for further use occurred before the close of hostilities.

"The gas bombardment was followed by forty eight hours destructive bombardment with high explosive shell."

The following appears in the order for the very successful attack of the Australian Corps, of the Fourth British

Army, on August 8th, 1918:

SMOKE

a. Artillery smoke will be as follows:

(1) 3 rds per gun will be fired during the first three minutes of the artillery barrage.

(2) 3 rds per gun will be fired in quick succession on the arrival of the field artillery barrage at the artillery halt line covering the first objective.

(3) In the event of wet weather a small proportion of smoke will be used in the barrage to replace the smoke and dust caused by the burst of shells in dry weather. This will not be sufficient to confuse the effect with that of smoke shells prescribed in paragraph a. (1) and (2).

General Paul B. Malone

In letter of June 25th, 1918 to C.G. 2d Div., General Paul B. Malone, then Colonel commanding the 23d Inf., gives the following data regarding the enemy's artillery fire and the casualties produced.

Total casualties, June 1st to 25th - - -	855
Produced by gas shell - - - - -	344
All other causes - - - - -	511

Estimated rounds fired by enemy -

Gas - - - - -	4,000
Other shell - - - - -	116,000

Considering that all casualties were produced by artillery fire, the gas shell was approximately nineteen times as effective as high explosive. As a considerable proportion of casualties were produced by other weapons, machine guns, etc., it is evident that, from General Malone's data the relative efficiency of gas as compared to high explosive as a casualty producing agent was well over 20 to 1.

Brig. Gen. Hartley, one of the best informed British

authorities states:

"It was always possible to silence German batteries by firing gas shell."

"The normal establishment of a German Divisional Ammunition Dump, in July 1918, contained about 50 percent gas shell. The dumps captured later in the year contained from 30 to 40 percent."

The War of the Future

By
General Von Bernhardt

"In many cases gas-shell will be the best weapon in dealing with artillery. A surprise gas bombardment will certainly cause losses, and in any case it will compel the enemy to wear gas masks and thus make it extremely difficult for them to serve their guns or bring up ammunition * * * * *. Thus, if the gas shelling begins before the infantry attack and the gas-cloud is kept thick as long as possible, the hostile artillery will frequently be silenced or compelled to withdraw.

"In certain circumstances high explosive can be used as well as gas-shell * * * * *.

"The barrage will consist of high explosive or gas-shell from the largest possible number of field guns and heavy howitzers.

"The defense will make full use of gas bombardment. As the area of the enemy's battery emplacements will not be entered by the defender's own troops, he can saturate it with gas and thus compel the attacker's artillery to evacuate it."

Discussion

1. Effect of Agreements to Restrict the Use of Gas.

The effort to prohibit the use of gas seems so futile that it deserves little consideration. In the preparation for war, we should not be moved from the only logical position by any agreements signed by foreign powers. We should plan to use

gas because it is an effective weapon of war and one which we are well disposed to use. The question of the relative humanity as compared with high explosive is of little moment. If we really desire to be logical on that score, we should propose an agreement whereby the powers agree to use gas only, abolishing all other forms of attack.

2. Summary of Use in World War.

The following facts appear to be evident:

a. There was no lessening in the manufacture of artillery gas shell prior to the Armistice.

b. The allied powers planned to increase their gas shell production for the expected campaign of 1919.

c. Germany expected to use, not less than the percentages used in 1918.

d. The percentages of gas shell used by the major powers in 1919, if the war had extended to that year, would probably have ranged between 30 to 50 percent of all shell fired.

3. Casualties.

The gas casualties show conclusively that, under the conditions of the World War, mustard was the most efficient casualty producer possessed by the artillery.

Two characteristics of these casualties, however, are worthy of note, a. the low percentages of deaths, approximately 1 to 12 as compared to H.E. and b. the shorter stay in the hospital, approximately one-half as long as H.E. casualties.

Considering one battle only, these factors are not important as the essential thing is to produce casualties and thereby reduce the enemy effective combat strength and at the same time further handicap him by the burden of caring for these casualties.

It is necessary, however, to consider more than the immediate effect as single battles may last several weeks and campaigns many months. The early return of casualties will be a

decided advantage. For example, if an belligerent used a preponderance of H.E. and the opposing force a preponderance of mustard and each produced an equal number of casualties, the force using mustard would need, initially, a considerably larger percentage of replacements to keep up an effective strength equal to the proportionate enemy strength.

For a long campaign, it is also evident that the return of casualties would stabilize and the final result would be that the force using less H.E. would always have a comparatively larger percentage of ineffectives providing, as assumed, the total number of casualties on each side were equal.

The larger percentage of casualties produced by mustard under the World War condition more than offset the quicker return to duty. An accurate study showing the percentage needed to be more effective than H.E. in an extended campaign would be of considerable value.

The other consideration, the deaths produced, becomes of vital importance in a war of several years duration, when the man power becomes the deciding factor. The advantage is distinctly with a death producing agent and also one which leaves the higher percentage permanently disabled. The tremendous losses in the World War and the decline in available man power in all of the European armies indicate very clearly the need for a high percentage of deaths and permanent injuries, providing the belligerent is not reasonably certain of gaining a quick decision.

4. Mass of Artillery Necessary to be Effective.

It is clear that gas used sporadically in small quantities is not effective. Therefore, to be effective, great masses, of artillery, such as the World War developed, must be available.

It is also evident that gas cannot be spread evenly throughout all artillery on all fronts but must be concentrated in the particular army or front where it may be used most effectively, as determined by the character of operations, terrain, etc.

5. Influence of Character of Operations.

Position warfare is particularly suitable for the use of gas. The great masses of artillery, the ease of supply, the known disposition and close proximity of the enemy and the fact that an advance over ground held by the enemy is less frequent tend to make the situation ideal for the use of gas. This difference is not so apparent in the use of smoke, and it seems that warfare of movement will call for greater quantities of smoke.

In open warfare, gas is without doubt of more value to the defense. The persistent characteristic of mustard limits the value of this most important gas in offensive operations.

6. Agents, Other Than Smoke.

In chemical warfare every possible effort will be made to produce new agents and the continued success will depend somewhat upon the success in the development of new agents. With any agent used, it is a matter of time only until defense measures will limit the effectiveness of that agent. Therefore, the greatest success may be expected during the early use of some new chemical or some new method of using a known agent for which the enemy is unprepared.

It would seem, from the predictions of chemists, that we may expect the development of a gas similar to mustard but more powerful and quicker acting. This would obviously add greatly to the effective use by artillery. An agent of this character, with considerably less persistency than mustard, would be a distinct advantage to the attacker.

Authorities also agree that new irritant smokes, which will make the construction of a suitable gas mask a difficult undertaking is reasonably probable of manufacture.

The effectiveness of any new agent will depend largely upon the flexibility of the gas manufacturing industry and the speed with which large quantities of this agent may be produced.

It is difficult enough to predict the amount of gas shell which may be used most effectively in the beginning of any future war and quite impossible to foresee the results of the developments during a war of several years.

7. Counter Battery.

The success of gas for counter battery during the World War is an admitted fact. Mustard was highly effective and remains an excellent weapon when no advance is expected through the area of the enemy's battery emplacement. The use of impregnated clothing will reduce the effectiveness of mustard and it remains to be seen whether or not such protective measures will reduce the effectiveness to the degree which makes it less efficient than high explosive.

In any case the defense will make full use of persistent gas for the combination of casualties produced and the lowering of the effectiveness of the batteries. In either offense or defense it will be desirable to force the enemy's artillery into masks and therefore CNS, or some similar gas, should be used when the persistency of mustard makes its use undesirable.

The development of a satisfactory time shell for mustard will add materially to its value as a counter battery agent.

8. Smoke.

Ludendorff characterizes the combination of massed tank action and artificial fog as the most dangerous Allied threat during the World War. This is worthy of serious consideration.

All factors which led to the success of the massed tank attacks must be evaluated in order to know what may be expected of tanks in the future. Their success in the World War was due in part to the lack of proper anti-tank weapons in the German Army. Ludendorff indicates that smoke was also an essential. The records of the successful tank attacks show that strong artillery support was habitual.

It is inconceivable that any properly trained and equipped army would fear a tank attack, no matter what speed tanks attain, providing the tanks were not obscured by smoke or that the anti-tank weapons were put out of action prior to the actual tank attack. The tank is vulnerable to aimed fire and therefore there must be cover from view or the anti-tank weapons

must be put out of action.

If the tank attack is supported by powerful artillery fire sufficient to destroy the bulk of the anti-tank weapons the tanks may well succeed without cover. The attack then becomes a limited objective attack and we are back to the statement of the western front.

Without almost complete smoke cover there seems to be little chance of success of the tank attack in the future in open warfare situations with the expected moderate artillery support.

It is worthy of note that the two most successful attacks made on The Western Front, were made in fog, the German attack of March 21, 1918 and the attack of the British Fourth Army on August 8, 1918. If nature does not assist by obscuring the attacker we must do so by an artificial fog. The handicap to the attacker is much less than to the defense.

Military students are now groping for some new tactical methods which will once again give the offensive the supremacy of the past. The success of the Allies in 1918 must be allied with the full realization that the morale of the German Army made many things possible which would have had no chance of success of few months before.

The most obvious solution, too, is increased mobility, through mechanized forces, which give the attacker the opportunity to strike the enemy when he is so disposed that he cannot bring the tremendous fire power, now common to all armies, into play. Even with the added mobility, it is recognized that surprise is necessary to insure the success of the attack. The fast moving, hard-hitting, maneuvering force must therefore be covered from enemy observation, both air and terrestrial. Artificial fog seems to be the answer and the only way that reasonably complete surprise may be attained.

The World War indicated that many phases of warfare may be waged on an unpremeditated scale far beyond anything contemplated in peace time preparation. The next war may well bring about the use of prodigious smoke screens immeasurably beyond our present anticipation. It would seem that the slowly crystallizing principles for future tactical employment point to

this use of smoke as one of the outstanding changes in future war.

9. Conclusions.

There seems to be nothing to indicate that gas shell will not be effective in future wars and generally with an effectiveness equal to that of the World War under similar conditions.

The only power able to use chemicals to what approached the maximum effective degree was Germany, with approximately fifty percent. The lag in manufacture by the other powers led to an amount which did not represent the percentage desired.

As we look forward to open warfare, it would appear that the percent used by Germany is in excess of the probable requirements. The added need for smoke will tend to lessen the disparity between the two figures.

The percentage needed by any particular force will depend upon the nature of the operations contemplated.

In considering the War Reserves, which should express the average used by all forces in the field in the initial operations, it is recommended that chemical shell constitute approximately thirty percent of all artillery shell and in about the following proportion:

Smoke - - - - -	10%
Mustard - - - - -	10%
CNS, DM and CG - - - - -	10%

A more concrete development of the tactical employment and the use of large mechanized forces will naturally influence the proportion of chemical shell and especially smoke.

In addition to establishing chemical shell as a part of the War Reserve, all plans should be made for the manufacture of great quantities of these shell to keep the percentage up to the approximate figures given and to take full advantage of the enemy's probable lack of experience and adequate training in protective measures.

PROBLEMS IN LOCATION OF GASSED AREAS

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

Officers making reconnaissance of routes to be used by troops may find it necessary to locate gassed areas, sketch such areas on their map and actually place signs around such areas on the ground, especially when persistent vesicant type agents are used by the enemy. The manner in which such areas should be approached and the reconnaissance conducted is extremely important when time is a factor. Rapid location of such areas is of vital importance to horse cavalry and mechanized units. Gases may be placed on areas by means of gas shell, by static firing or by spray. It is highly desirable that the reconnaissance indicate not only the area covered and the agent used, but the manner in which the agent has been fired, the quantity used, and the probable time the agent was put down. All these factors govern the length of time which such areas are dangerous to the passage of personnel.

For instance, if mustard gas has been fired by means of 155 mm. shell or 4.2" chemical mortar, its persistency will be considerably greater than when placed by 75 mm. shell and will be far greater than the persistency to be expected by agents laid down by airplane spray. The quantity of agent per unit area (usually taken as artillery square, 100 yards by 100 yards) will also affect the persistency, and will be especially important in estimating the probable vapor concentration and the danger distance downwind from the area.

In sketching-in a gassed area on a map the area on which the agent is used should be sketched in in a solid color or other similar method of designation and the downwind area which is dangerous for occupation by personnel should be sketched in by a suitable method. Generally, such areas will be found to be woods, cross-roads, or likely observation and command posts, although such gassed areas may be found at any place.

On a reconnaissance to locate routes for troops, the principal object is to select those routes which are free of gas, both liquid and vapor. After such routes are found, little or no time need be wasted in accurately locating the gassed area, but the area on which the gas has been detected should be marked and the proper location of the area sketched. In case routes selected pass through areas covered by vapor concentra-

tions, signs should be posted or orders given so that troops can wear the gas mask at the proper time. Of course, no halts are to be permitted in such areas.

The Chemical Warfare School has now had considerable experience in laying out problems of this type for its students and in suggesting methods of approach by means of which the problem can be solved most expeditiously. Such problems should be introduced at all chemical training centers and should be made a part of all field exercises and maneuvers, even though such maneuvers and exercises are slowed down.

In approaching a gassed area, the reconnaissance detail should approach it at a direction of 90 degrees to the wind direction until they locate the edge of the area. They should then turn upwind, locating the upwind edge and then the edge parallel to the wind on the opposite side from that first located. It may or may not be necessary to locate the downwind edge, which is the most difficult part of the problem, if necessary. While carrying out this reconnaissance the gas mask and mustard-proof gloves should be worn. The student should observe shell or bomb craters in order to get some idea of the amount of chemical agent that has been used. When it is desired to test the air for odor, the left hand should be removed from the glove and inserted under the facepiece and the air tested by sniffing, not by breathing. The number of such sniff tests should be reduced to the absolute minimum necessary on the reconnaissance, as continual sniffing greatly reduces the accuracy of detecting odors. Every effort should be made to keep the left hand absolutely free of gas, otherwise the introduction of gas underneath the facepiece may entirely invalidate the whole reconnaissance. At one time a student wearing woolen gloves inserted his left hand, glove and all, underneath the gas mask facepiece. Chlorpicrin had been used on the area and this student had gotten his glove well soaked with this agent. The result to this student was instantaneous, and he was unable to continue with the problem. It may on occasion be necessary for the officer conducting the reconnaissance to remove his gas mask in order to positively make certain tests (especially when testing earth from shell holes). It is unnecessary in this case to remove the gas mask for more than a minute or two and it is advisable to take a deep breath previous to removing the mask and hold the breath while the mask is off. If a small amount of earth is collected from the side and bottom of the shell hole on a stick or piece of board, this

earth can be examined for remaining odors of gases and the agent present identified quite accurately by a skilled observer.

Students frequently expect to see standing pools of mustard gas on an area following the bombardment. Such is far from the case, and it is frequently impossible to find even small drops on dry vegetation or dry ground. However, such drops do stand out quite clearly on green vegetation.

In preparing problems of this type for the instruction of students, a variety of chemical agents may be used. Crude pyridine, known as dark colored, high boiling denaturing pyridine, has a powerful clinging and persistent odor which may be used to represent mustard gas. Pyridine is a comparatively cheap material (\$0.80 per gallon in 50 gallon drums) and can be purchased almost anywhere. It is nontoxic. Pyridine dissolved in crude oil and filled in quart tin cans may be statically detonated on the area desired. This is the best agent to use for instruction purposes. In some cases, it is desirable to dig out a place to simulate a shell hole; at others, the cans are hung on trees and bushes. As a detonator a 6" glass test tube filled with tetryl, giving about 20 grams of tetryl, which is fired by a commercial electric detonator is very satisfactory. Such an explosive charge tears the can to pieces and gives a wide scattering of the liquid contents. On an area approximately 200 by 200 yards, 20 gallons of a mixture of 50% pyridine and 50% crude oil filled in 80 quart cans is about the right quantity to use. In addition to this mixture, real mustard gas dissolved in pyridine is detonated on three or four spots in the area. The introduction of actual mustard gas on the area adds reality to the problem and forces the students to take precaution such as they would under field conditions. In addition, eight or ten tear gas candles can be fired upwind from the area during the course of the reconnaissance for harassing purposes.

The class is divided into groups of approximately four students to the group with one umpire (senior officers of the class) attached to each group. The umpire is furnished a sketch of the location of all the danger spots on the area and if he finds the group blundering into danger, they are called casualties at once and removed from the problem.

At the end of the exercise a critique is held. The senior officer of each group reports his results and makes his

recommendations. The umpire with each group then presents his criticisms of the operation of that group. The instructor makes such comments as appear necessary at any time. The critique is conducted from a point where the entire area can be observed so that actual ground features can be pointed out by all concerned. Problems of this type are difficult to conduct and require careful preparation, but such problems are extremely effective in pointing out the difficulties of gas situations, especially at night and on unknown terrain.

DEVELOPMENT OF MECHANIZED CAVALRY

By: Captain Rhey T. Holt, Cavalry

NOTE: This is the first of a series of articles on mechanized cavalry. Subsequent installments will include the organization, tactical employment, and examples of such employment, including the use of chemicals.

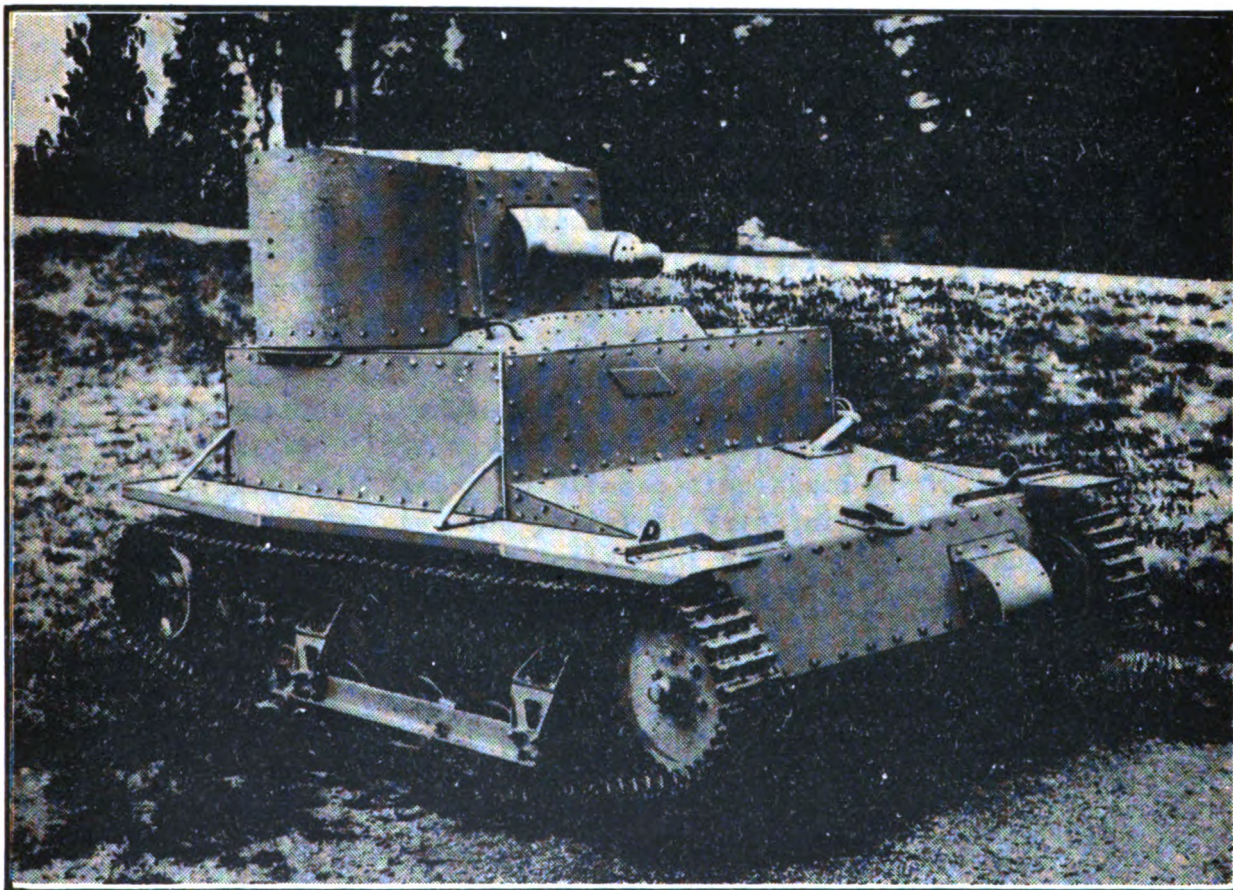
Experience gained during the World War demonstrated the potentialities of motor propelled ground vehicles for war purposes. Under suitable conditions, the advantages of such vehicles over former methods were apparent under three general uses: (1) for the movement of supplies and materiel; (2) for rapid transport of troops in rear of the battle lines, and (3) for crushing organized resistance on the battlefield. As examples of these respective employments might be cited: the increased motorization of supply and service trains; General Gallieni's use of commandeered motor transportation in the defense of Paris; and the decisive use of tanks by the British at Cambrai.

Post war experimentation and development have made great strides towards a solution of many of the vexing problems incident to the further utilization of motor vehicles in combat. In the United States, this subject is of major importance as this country is the World's largest producer of motor vehicles. The problem of transporting materiel and supplies by motor has been partially solved. Thought is becoming clarified regarding troop movement by truck in rear of the battlefield and for further motorization of certain organizations in order to facilitate their participation in combat. The problem of developing fighting vehicles, their types, organization and tactical employment is still subject to experimentation. However, the matter of detail is now of greatest concern, as certain principles regarding their uses and employment have been formulated. Tables of organization, although subject to further development, have been approved.

In the study and development of motor propelled vehicles for military purposes, two general divisions are made. These are strategical mechanization and tactical mechanization.

Strategical mechanization, commonly termed motorization, is here defined as "The use of motor propelled vehicles for

the transporting of men, animals, materiel, and supplies, generally over roads." This employment does not contemplate that the vehicle itself is used as a combat instrument, but may include its use for transport or traction of a combat group or of a weapon well forward to the proximity of the initial engagement position. The ability to so transport combat elements at faster rates than can be accomplished through marching, or by means of animals, greatly increases strategical mobility. Depending on the situation and unit there will also be an increase in tactical mobility, but with this use of motor vehicles we are not greatly concerned.



Vickers-Carden-Loyd Patrol Tank

Tactical mechanization, commonly termed mechanization, is defined as "The application of mechanically propelled vehicles to combat on the battlefield." The machine may constitute the main destructive instrument, or it may form the carrier or traction for a combat group or a weapon, whose tactical employment is dependent upon the vehicle. Built around machines capable of this tactical employment, units increase greatly their strategical and tactical mobility.

England has maintained the lead in tank development and continues to appropriate large sums of money for development and experimental purposes. She is committed to the tank idea and apparently intends to provide the army with the best mechanized combat vehicle that money can buy. Her outstanding development in this line is the "Vickers" tank, weighing 12 tons and capable of about 25 miles per hour. Additional development includes a one-man tank or "Tankette" weighing 2-1/2 tons, with a speed of 20 - 30 miles per hour; a two-men tank, weighing 5 tons, with a speed of 30 miles per hour; and a heavy tank weighing 40 - 50 tons, with a speed of 15 miles per hour.

England was the first power to conduct experiments with a mechanized force capable of independent action. These tests were initiated in 1927. The first thought contemplated the development of a large unit capable of independent action which could replace the infantry division, but was eventually proven impracticable. The present intentions are apparently to organize two general types of mechanized units, as follows:

A force built around the light and medium tanks, capable of independent action, but primarily for use in conjunction with infantry operations.

A force built around the armored car, designed to extend the roles of the Cavalry. Such a unit, in the form of a provisional armored car brigade, was organized some few years ago from the 11th Hussars and the 12th Lancers.

The French development includes the "N.C." Renault light tank, weighing 6 tons, with a speed of 12 miles per hour, and the "2-C" tank, weighing 70 tons, with a speed of 6 miles per hour, designed to carry either one 75mm or one 155mm cannon and four machine guns. Secret development is also being carried out on a very fast light tank and a super heavy tank weighing about

130 tons.

The French thought leaves the tank primarily to divisional functions with large tank elements for use by the Army. Mechanization and motorization are being carried out to a high degree in the Cavalry, mainly in the form of armored cars and motorized machine gun units as a part of the cavalry division.

Only in the last few years have the Italians given serious thought to these combat vehicles. Their tanks at present include the "Fiat" 3000 tank, weighing about 5-1/2 tons, with a speed of 13 miles per hour, and the "Fiat" 2000 tank, weighing 40 tons with a speed of 5 miles per hour.

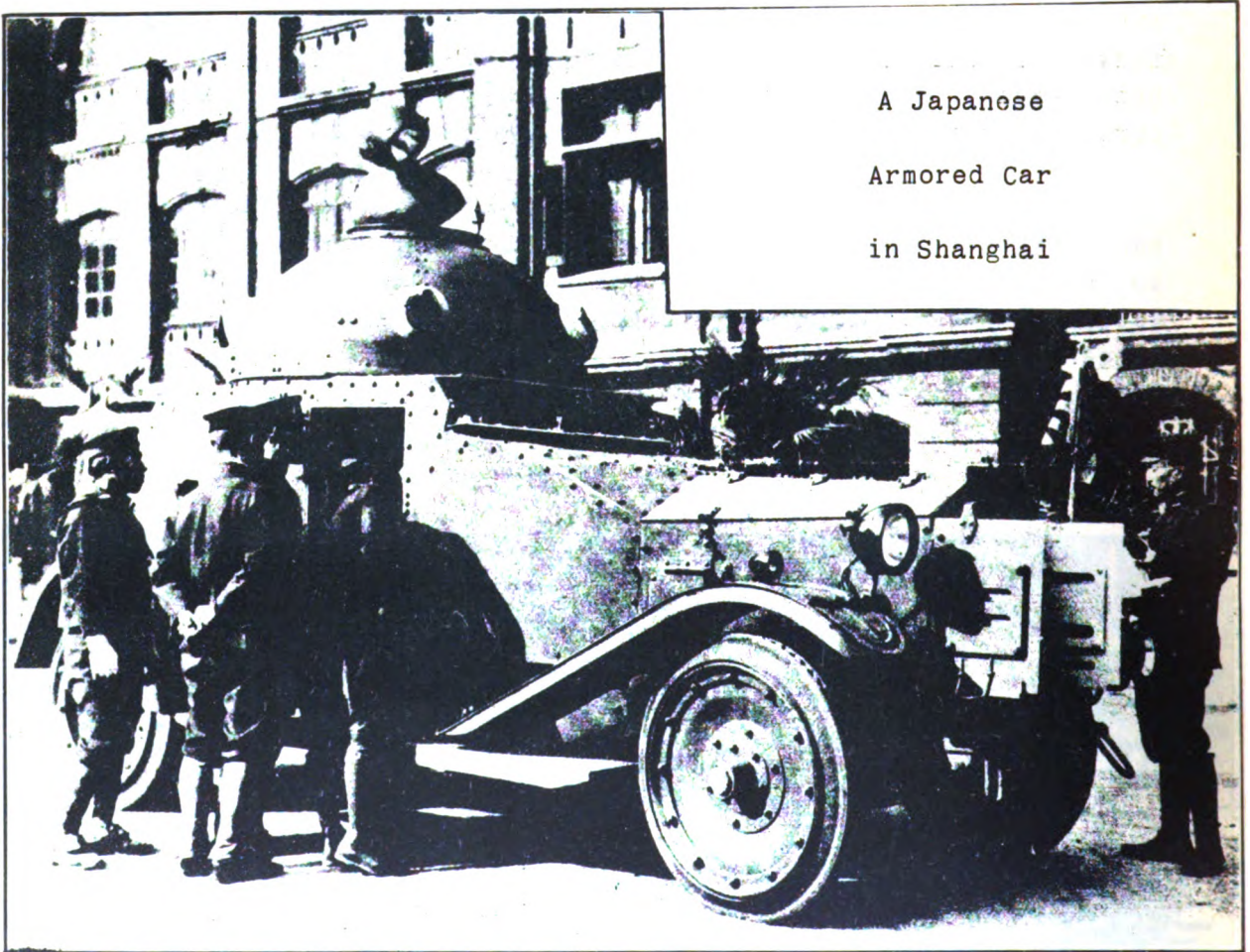
Italy apparently has given little thought to the development of a mechanized force and contemplates the use of tanks primarily in conjunction with the infantry division. She has, however, further mechanized her cavalry by the use of armored cars and experimental motorcycle machine gun units.

Germany, by the Treaty of Versailles, is forbidden the manufacture of tanks, and has none. She has given consideration to mechanization, however, and during all field maneuvers simulates the use of armored cars and tanks by using ordinary passenger vehicles or other means.



Japanese Tanks During a Lull in the Hostilities at Shanghai

Japan has done little towards the development of mechanized combat vehicles. At present, her standard tank equipment includes both the French "Renault" and the British "Vickers" tanks. Her employment of these vehicles appears to be similar to that used during the World War. Very little information regarding the mechanization of cavalry has been obtained. That considerable thought has been given to this subject is proved by the use of armored cars during recent operations in China. These vehicles have been employed for reconnaissance missions. Whether this employment was as an integral part of the cavalry organization or independent appears doubtful at this time.



A Japanese
Armored Car
in Shanghai

Russia has quite recently manifested considerable interest in tanks. Russian Renaults (similar to the French Renault) have been purchased and are being manufactured. She is also developing an 80 ton tank with a speed of 6 miles per hour designed to carry two 3" guns and four machine guns. Her use of these tanks appears to be similar to their employment during the World War. Information is lacking of any intentions to organize independent mechanized units or to further mechanize the Cavalry.

Many of the smaller powers include tanks in their armies, but none of these have taken any steps towards organizing them into units capable of independent action.



The New Christie Tank, T3, Traveling
at 25-Miles an Hour

The United States is generally equipped with war-time tanks. Several pilot models of new design have been built and have provided valuable engineering data and caused considerable conjecture regarding their tactical employment. These newer models developed by the Ordnance Department include a medium tank weighing about 23 tons, with a speed of 10 miles per hour, and two or three models of light tank design, weighing approximately 7-1/2 tons, with speeds of 18-25 miles per hour. The medium tank exceeds, by about 8 tons, the specifications set up by the General Staff for this class. One or two of the light tank models have been very favorably considered. The most remarkable vehicle of this nature was produced by the United States Wheel Track Laying Corporation (Christy). This vehicle weighs about 10 tons when equipped for combat, and has developed official speeds of more than 42 miles per hour across country on tracks, and nearly 70 miles per hour on roads on wheels.

Our ideas of employment of tanks contemplate their continued use in the division and assignment as GHQ troops for use in conjunction with infantry operations. Since 1925, in prospect of the development of a much faster tank, considerable thought has been given to an increased mechanization of units.

It was not until 1928 that funds could be obtained for conducting experiments in further mechanization and motorization. These tests were initially conducted that year at Camp Meade. Probably the most definite information obtained from this first effort was the unreliability and inappropriateness of the vehicles employed. As they were mostly a conglomeration of cars left over from the war, the tests were primarily problems of transport rather than of mechanization.

In 1930 sufficient funds were obtained for conducting further tests. About October of that year, troops, forming what was designated as the "Experimental Mechanized Force", were concentrated at Fort Eustis, where they functioned until October, 1931. Although the organizations and the vehicles were rather limited in strength and numbers, a considerable variety of both were included. The tests and experiments were intensive and covered a large field. The results permitted the drawing of rather definite conclusions regarding the composition and employment of certain mechanized units.

We at first were prone to believe as did the British,

"That a separate self-contained mechanized force, capable of carrying out a complete operation from initial contact to final victory, should be organized." For the present at least the organization of such a force is not contemplated for the following reasons:

The following is an extract from the Report of the Secretary of War, 1931: "The inherent weaknesses and limitations of the machines themselves, which preclude their employment in many types of terrain." "The impossibility of having a considerable number of suitable armored vehicles available at the outbreak of war."

Since the first idea has been discarded of employing a large mechanized force to replace the division or larger unit, and carrying an operation through to a conclusion, there would appear to be two general uses for mechanized units:

First - the established usage for the tank in the infantry division and in conjunction with major infantry operations.

Second - use of the fast tank in roles requiring maneuver terminated by fast striking actions.

In the first case, the mechanized units will require tanks weighing from 7 to 15 tons in order that they may carry sufficient armor to withstand small arms fire up to at least the .50 caliber machine gun. Such a vehicle will be vulnerable to the larger caliber anti-tank guns and to light artillery fire. Provision for adequate protection against these larger weapons would weight it down to the point where it could not move at all over the battlefield. Such tank units consist only of tanks operating with or as a part of the infantry, assisting its advance by neutralizing hostile machine guns and destroying wire defenses. Tank units, thus employed, are supported by the artillery operating with the infantry and make use of the reconnaissance and communication facilities of the infantry. Primarily due to weight, their mobility is limited. Again, due to the necessity of closely coordinating their action with that of the infantry and artillery, great mobility is not so essential. The use of tanks with the infantry decreases the necessity for long bombardments and increases the element of surprise.

In the second case (the fast tank), it does not appear economical to restrict such a highly mobile vehicle to the spaces bounded by the artillery barrage in front and by the infantry in rear. Tanks or combat vehicles having these characteristics must necessarily be more lightly armored than those used with or as a part of the infantry. Such vehicles appear well adapted for use by units, the missions of which are based upon their tactical and strategical mobility, with quick hard striking power. As any tank type of machine is relatively blind and vulnerable to hostile anti-tank fire when halted, a unit built around such vehicles must include other types of machines and other means of defense. In operations over suitable terrain a force of this type should be capable of extending, or taking over, when the terrain is favorable, the roles of cavalry in the performance of the following missions:

As a mobile reserve.

Operations on the flank or rear of a hostile force.

Pursuit.

Exploitation of a break-through.

Terrestrial reconnaissance and counter-reconnaissance.

Raids and the disrupting of hostile lines of communication, etc.

Deep water courses, wooded areas, swampy ground, and steep rocky hills remain as unconquerable barriers for motor vehicles. Unfortunately they will always be found in any theatre of war. This means that we are not yet prepared to supplant the horse by other means. Wherever mobile troops are required, cavalry must continue to be employed. The future will probably find horse cavalry and mechanized or light armored forces supplementing each other as the cavalry and air corps are doing today in reconnaissance missions.

Based upon War Department studies of both American and foreign experiments with mechanization, the following extract from the Report of the Secretary of War, 1931, shows conclusively the responsibility of the separate arms in further development:

"The Cavalry has been given the task of developing combat vehicles that will enhance its power in roles of reconnaissance, counter-reconnaissance, flank action, pursuit and similar operations. One of its regiments will be equipped exclu-

sively with such vehicles. The infantry will give attention to machines intended to increase the striking power of the infantry against strongly held positions. Every arm is authorized to conduct research and experiment with a view of increasing its own power to perform promptly the missions it has been especially organized and developed to carry out. Every part of the army will adopt mechanization - and motorization - as far as is practicable and desirable. To the greatest extent possible, machines will be used to increase the mobility, security and striking power of every ground arm, but no separate corps will be established in the vain hope that through a utilization of machines it can absorb the missions and duplicate the capabilities of all others."

NEWS ITEMS AND COMMENTS

CHEMICAL ATTACK BY LOW-FLYING ATTACK AVIATION

An article, "Field Artillery and the Low-Flying Attack", by Major Louis E. Hibbs, F.A., appears in the January-February issue of The Field Artillery Journal. This excellent article gives an analysis of the problem of defense against low-flying attack aviation well worth careful study. The author, however, has made one assumption that is not supported by the present trend of thought, namely, that chemicals "are conceived to be more profitably suited to air formations other than low-flying attack."

For a number of years, the Chemical Warfare Service has recognized the possibility of chemical attack with persistent agents such as mustard gas dispersed from low-flying planes. Development of such a method of chemical attack meant a major problem in protection, and consequently steps were taken to determine its feasibility. Study and tests conducted over a considerable period of time have resulted in the conclusions that this form of attack is entirely feasible.

Not only the Field Artillery, but all ground troops, therefore, will find their defense against low-flying planes complicated by possible attack with chemicals. Machine gun attack can be made simultaneously with chemical attack. As pointed out in Major Hibbs' article, the present fragmentation bomb cannot be used from the low altitudes desired for machine gun fire.

The possibility of chemical attack also makes the use of smoke more feasible as the air man does not need to see his target for this type of operation. The broad belt that could be covered by a trio of attack planes would insure striking the average attack aviation target.

The covering of an area with chemicals will greatly reduce the protection obtained through scattering or using open formations, while the necessity of taking steps to protect personnel from possible chemical attack will greatly reduce the time available for a defense by fire power. The constant wearing of completely protective equipment will probably be impracticable as it is extremely doubtful if any such equipment can be developed that will not lower the physical energy of troops and

greatly reduce the rate of movement. This equipment will therefore have to be adjusted after the warning of air attack has been sounded, causing delay in opening fire and probable reduced effectiveness of such fires.

The continued action of persistent chemical agents should not be lost sight of. Not only may ground troops be directly attacked, but also routes and areas these troops will wish to use may be infected prior to their arrival without any danger to the airplanes.

The conclusions reached by Major Hibbs as to the methods of defense are not altered by the injection of chemical attack into the picture, but on the contrary are emphasized. Concealment will not be a defense as the hostile air man will only need to feel that the road or area is subject to use, to warrant his placing persistent chemicals upon it. Open formations will not only be subject to the drawbacks shown by Major Hibbs, but will not be a defense, as concentrated targets are not needed to make chemical attack effective. Defensive fire appears to be the only solution, if solution there be, and this fire will be subject to the complications of operating in gas masks and other protective equipment, including gloves.

To the analysis by Major Hibbs, we should therefore add the possibility of the low-flying attack being chemical attack. The question should be given careful study and the ground forces should cooperate to the fullest extent with the Chemical Warfare Service in the development of protective equipment and methods to meet this new threat. No problem in protection against chemical attack is greater today than the possibility of such attack by aircraft.

**NOTICE TO CHEMICAL WARFARE RESERVE OFFICERS
ARM AND SERVICE ASSIGNMENT GROUP**

The selection of Chemical Warfare Reserve Officers, Arm and Service Assignment Group (formerly B.A. Group) for training during the coming training season will be made in the following manner.

Reserve Officers (A.S.A. Group) will be selected by the Office, Chief of Chemical Warfare Service for summer training, based primarily on previous active duty training and inac-

tive duty training. A form letter, advising them of their tentative selection for training, the place and date of the detail, together with application blanks, will be forwarded to each officer designated for training, through the Corps Area Chemical Officer early in the year. If the officer concerned can accept the detail, he will execute the blanks and return promptly through the Corps Area Chemical Officer. If an officer selected is unable to go on an active duty status, an alternate will be selected in the same manner.