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GENERAL C. P. SUMMERALL
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GENERAL SUMMERALL

ON November 20, 1930, the active military service of General Summerall will terminate with the completion of his duty as Chief of Staff of the Army.

Throughout his extraordinary career, he has ever been a leader, a model and a pioneer in our arm. As a battery officer his gallant deeds in distant lands, his inspiring instruction at the Military Academy; as a battalion commander his tireless energy, his masterful knowledge of his profession, his outstanding ability; as a brigade and division commander his indomitable will, his inspired leadership and his relentless tenacity have been the boast, the pride and the glory of those who served under him.

The Field Artillery yields with grief and reverence to the inevitable retirement of this great American soldier, one of history's leading artillerymen.

FIELD ARTILLERY PROGRESS

BY C. P. SUMMERALL, GENERAL, CHIEF OF STAFF

AT no other time in history has Field Artillery occupied such a conspicuous place as it won in the World War. The far-seeing artillerists in Europe, and especially in France, visualized its role long before the War came. The emptiness to view of the battlefield, forced by the effectiveness of modern arms, necessitated a method of fire that would surely reach the unseen enemy. This was obtained by a volume of fire covering the area over which it was known that its Infantry must advance or the area over which the enemy advanced. Due to the general adoption of this doctrine, Field Artillery was able to protect its Infantry within its resources of guns and ammunition and to inflict the majority of casualties sustained in battle.

Unhappily a corresponding doctrine was not adopted for Infantry fire, with the result that the rifle was little used when it might have been employed with annihilating effect.

At the same time the War pointed to still further usefulness of the Field Artillery which after twelve years is far from realization. The mission of Field Artillery of destroying that element of the enemy which at the moment is most dangerous to its own Infantry is unchanged and unchanging. It is equally true that its best protection must always be its own fire. It matters not what form the enemy's attack assumes or by what medium he appears, the Field Artillery must be able to overcome him. Thus, with the mobile army, it must destroy landing operations from the water or aviation onslaughts from the air with the same power at it meets hostile forces on the ground. It is unthinkable that Field Artillery should remain silent and helpless while hostile planes swoop down upon it and its Infantry with the destructive fire possible from the attack plane. The defense against aircraft is ground fire and until it is more powerful than the air projectiles, the ground troops must be exposed to what might become disabling losses.

A field gun is only a machine to fire projectiles required for its mission. In the long period of evolution, the gun and its mount have undergone many changes in form and power, but each change was rendered necessary by its increased mission.

Mobility has always been a prime characteristic, but it has never been allowed to defeat the essential quality of fire power. The time has come for another extreme change in form and mobility to meet the new demands. Two pilot all-purpos field gun mounts have been constructed. Both designs not only permit almost vertical and all-around fire against aircraft, but they overcome that heretofore inherent deficiency of field guns to reach the majority of ground targets without extensive excavations for the trail to permit the necessary traverse and elevation. Unhappily the tests of these mounts have been long delayed. It is incumbent upon the Field Artillery to demand energetic and effective action to perfect this or some other type of armament which will destroy both air and surface targets and to secure appropriations within the annual budget to re-arm the regular regiments in time of peace. Both the 75 mm. gun and the 105 mm. howitzer should be so mounted. There can be no departure from the principle that the necessary volume of fire over the ground or in the air can only be delivered by a large number of small projectiles fired with great rapidity. Due to the absence of an anti-aircraft weapon in the Field Artillery, the Coast Artillery naturally desires to expand its antiaircraft units to supply the needs of the mobile army. It is imperative that the Field Artillery should qualify itself to assume this new but inherent mission without the intervention of other arms.

There was a growing demand in the War for an accompanying gun. It was based upon the successful employment of batteries by the German forces practically in the infantry lines during the initial phase of the assault. Their adoption of this procedure was due to the failure of communications between the infantry and the artillery in the early stages of the War when in open warfare the infantry were deprived of adequate support of the guns. There is apparently a strong tendency now in the German Army to guarantee the close support of infantry by keeping guns so near to the infantry lines as to make them independent of mechanical communications which, at best, are precarious in the maneuvers of the battlefield.

In 1918 the accompanying gun was adopted as a means of giving to the Infantry regimental commander a sure means of

fire for overcoming machine guns or strong points that could not be reached by distantly controlled fire. Unfortunately such guns were quickly put out of action by casualties to horses and men as soon as they became exposed. However the idea persists, and there are now appearing in the Infantry and Cavalry 37 mm. guns drawn by horses and called accompanying guns with the characteristics of Field Artillery. There is no doubt that a real need exists for closely supporting guns, and unless the Field Artillery supplies them, the other troops will replace it in this sphere of activity. Fortunately the self-propelled mount offers a means of mobility less vulnerable than horses and it should afford protection to the men. So far, efforts to manufacture a suitable design of self-propelled mount have not produced results satisfactory to the using arm. Great range is not essential, but mobility with sufficient power and protection to men are indispensable. It is the certainty of movement and maintenance of fire, and not the losses which must be considered. At the same time, artillery tactics that result in disabling casualties to the cannoneers render a poor service to the Infantry. Not only would the self-propelled mount have possibilities as an accompanying gun, but it is indispensable for a mechanized force, which has obtained an enduring place, certainly until the next war, in our forces. Here the guns are essentially accompanying artillery, and if successful tactics are developed they should have the same application with the Infantry and Cavalry.

Such a weapon should be used by batteries, and it may be by battalions, with either a mechanized force or the assault battalions of the Infantry or Cavalry. It remains true that one gun is not only no gun, but it becomes the target of so much fire that its usefulness is soon terminated. Closely supporting batteries of self-propelled mounts should be widely deployed and should seek such cover as may be available. Under many circumstances their exposure would be little more than that of guns placed close enough to maintain liaison and deliver effective fire in the early stages of the assault.

The appearance of the all-purpose field gun and the self-propelled mount emphasize the question of motorization for Field Artillery. It is inadmissable that the horse should be replaced

by the motor unless it can be demonstrated that the latter is equally as reliable as animals. With the progress made in perfecting tractors, the time may come to change in whole or in part. It may well be that the all-purpose mount will be too heavy for horse mobility and will force the use of tractors altogether for this type. The Field Artillery must address itself to the commercial development of a tractor that will have the requisite power, speed, and endurance for division artillery to accompany troops in motor transport. It is doubtful if any form of prime mover truck will serve the purpose of marching and of maneuvering to positions away from roads. It would be useless to construct a special type of tractor since it could not be procured at the outbreak of war. The Christie chassis promises to comply with artillery as well as tank needs. The using arm should undertake the procurement of this or some other commercial tractor and should insist on appropriations to supply the motorized division artillery in being. At this time it would be useless to consider dispensing with the horse for the movement of the great mass of artillery that would be available in the event of war.

It is not enough for the Field Artillery to rest on its past performances and to perfect its training in gunnery and tactics. There are lessons of the most vital import to be learned from the last War and from the advance in science since then. The arm as a whole must be keen to place itself in the forefront of research and experiment. Other arms are becoming aggressive, and properly so. Each branch must vindicate the necessity for its existence and must demonstrate the source of its usefulness or others will not be slow to occupy its vacant possibilities and either curtail or absorb it. Competition is rife and aggressiveness is essential to the accomplishment of soldiers and services in peace as well as in war. Strong leadership radiating impulses to be amplified by each element of command and each individual is the guarantee of successful results. Each man must resolve to be worthy of the glorious traditions of the arm and to enhance its future by reason of his contribution.

Changes in Infantry tactics and Infantry methods of fire must require corresponding modifications in the employment of the

guns. The airplane, the anti-aircraft gun, the semi-automatic rifle, the tank, the mechanized force and the chemical warfare have created new relationships in armament and tactics which require careful analysis and sound judgment to arrive at a wise method of procedure. The Field Artillery must contribute its full share to the task.

Too many years of my life were spent in the arm not to carry to my retirement affection for all that it signifies and to leave with its officers and soldiers a heartfelt wish for their success and welfare. I would enjoin upon them to study its history and maintain its traditions, and in the words of the immortal Riley "Let there be nothing to explain."

USE OF GAS BY ARTILLERY

BY CAPTAIN L. M. McBRIDE, CHEMICAL WARFARE SERVICE

THE use of gas by the artillery may be divided into two general classes,—tactical and technical.

Tactical considerations include the selection of the target, or area, kind of fire, the time of starting and duration of fire, the type, kind and amount of gas to be used and the type and caliber of weapons to be employed.

Technical considerations include method of fire, number of batteries required, rate of fire and number of rounds.

Kinds of fire with gas shell may classified as destruction, neutralizing and harrassing.[1]

Destruction fire with gas differs from destruction fire with shell in that the former applies primarily to personnel and animals and not to material or structures.

Neutralizing fire includes the neutralization of a target, zone or area and broadly would include interdiction and counterbattery fires, although the latter could be classed under fire for destruction of personnel and animals.

Harassing fire with gas is a type of neutralizing fire but should be considered separately due to its tactical possibilities and economy of ammunition expenditures in hampering enemy movements, causing exhaustion of personnel due to continuous wearing of gas masks and protective clothing, possible contamination of food, water and supplies, and breaking down resistance and protection with a view to later executing fire for destruction.

Inasmuch as the general principles of artillery fire with gas shell differ only in certain details from fire with H. E. shell or shrapnel, it is proposed to show wherein these differences affect the artilleryman in the preparation and execution of fire with gas shell and to present data and means for lessening the time and labor of calculations in executing such fire and also to show such differences in characteristics of the shell as are known or may be expected to affect the fire and to indicate wherein certain changes, modifications or new designs are desirable with a view to improvements in the future.

[1]TR 430-105, Par. 153.

To fully realize the possibilities of obtaining definite and positive results with gas shell fire and the methods of best obtaining same, it is necessary to have a general idea of the principal characteristics of the chemical agents used.

CLASSES, TYPES, AND KINDS OF CHEMICAL AGENTS USED IN ARTILLERY SHELL

Chemical agents are divided into classes, such as gas, smoke, incendiary.

War gases are divided into two general types only:

(a) Persistent.

(b) Non-persistent.

A persistent gas is one which, ten minutes after burst of the shell, under conditions reasonably favorable for the use of gas, there is a sufficient quantity remaining at the point of burst to cause casualties or make the wearing of the mask or protective clothing necessary.

Hence, if the gas has disappeared or dissipated within ten minutes, it is non-persistent.

Based on the above definition, gas shell are distinctively marked to readily indicate whether they are of the persistent or non-persistent type and the artilleryman needs only to familiarize himself with these markings.

War gases are further classified according to their physiological effects, as:

(a) Respiratory irritants;

(b) Vesicants; (skin blistering agents)

(c) Lachrymators; (tear-gases)

These physiological classifications will not particularly concern the firing battery personnel as the data they receive will pertain only to the general classification of persistent or non-persistent.

Various kinds of gases have been given lettered symbols to eliminate the necessity of remembering the chemical name. The symbols of those gases which are now loaded into artillery shell, and some which may be used later, are given below:

Symbol	*Chemical Name*
HS	Mustard gas, or dichlordiethylsulphide,
CG	Phosgene, or carbonylchloride,
CN	Chloracetophenone,
PS	Chloropicrin,
M-1	Lewisite, or chlorvinyldichlorarsine,
DA	Diphenylchlorarsine,
DM	Diphenylaminechlorarsine,
WP	White Phosphorus, (screening smoke)
FM	Titaniumtetrachloride, (screening smoke).

Of the above, HS and CG are the principal and representative kinds of persistent and non-persistent gases, respectively, with which shell are now loaded. PS has been used and a considerable quantity of shell are now on hand but it is of doubtful utility. It is quite possible that M-1 will be used and although it is similar in action to HS, it has some advantages and some disadvantages. CN is the present standard tear-gas used in other munitions and may be used in artillery shell for harassing purposes due to its great economy in causing masking or effectiveness against an enemy without mask protection. DA was used by the Germans during the War in their Blue Cross shell, primarily for its penetrating effect on gas masks. However, it is difficult to load into shell and is ineffective against modern gas masks. DM, developed by the Chemical Warfare Service after the War, will penetrate modern gas masks when properly disseminated and is used in certain munitions, but as yet no entirely satisfactory means have been developed for its employment in artillery shell. WP, primarily the most efficient smoke producing agent is also a casualty producer due to its burns and as a consequence has a marked demoralizing effect, hence, has a dual utility in blinding enemy observation and machine guns and its effect on personnel. It also has an incendiary effect on light inflammable material. FM is a liquid smoke material and was used in artillery shell as a screening smoke and also for adjustment when liquid filled gas shell were to be fired.

PHYSICAL CHARACTERISTICS OF GASES

Gas, so-called, as contained in an artillery shell is, in fact, either a liquid or a solid and not a gas in the sense of the well-known compressed oxygen, hydrogen and similar gases used commercially in cylinders.

Non-persistent gases, such as phosgene, (CG), are gases at

normal temperature and pressure but upon cooling below their critical temperature liquify and are so filled into shell which are then closed, the gas again vaporizing instantly upon being released when the shell is burst.

On the other hand, pure mustard gas, (HS), is a liquid at normal temperature and pressure and vaporizes slowly. As it freezes at 57°F, it is seen that it is in a solid state in a shell at or below that temperature. However, when HS is dispersed by the bursting charge of the shell, the liquid (or solid) is finely divided thereby increasing the total surface exposed to the air, and augmented by the heat of the explosive charge of the booster, causes quite rapid evaporation and produces considerable vapor in the immediate vicinity of the shell burst, the remainder being scattered over the ground, grass, bushes, or other objects, in droplets of liquid, remain for many hours, and even days, to produce casualties of an enemy coming in contact with it.

These characteristics explain the persistent and non-persistent nature of such substances.

CONCENTRATION

In referring to the use of a war gas in the field, the term "Concentration" is used to indicate the quantity of gas, in vaporous form, contained in a given quantity of air, usually calculated in "parts-per-million," milligrams per liter, ounces per cubic foot, etc., or in the case of a liquid, such as HS, the quantity applied to a given area, usually measured in terms of pounds per square yard, hence, this term should not be confused with the artillery definition of "Concentration".[2]

CALIBERS AND TYPES OF ARTILLERY WEAPONS WHICH FIRE GAS AND SMOKE

The following table shows the calibers and types of artillery weapons at present authorized to fire gas and smoke:

Caliber and Type of Weapon	Fires GAS		SMOKE
	Non-Persistent	Persistent	
75 mm. Gun	None	x	x
155 mm. Howitzer	x	x	x
155 mm. Gun	x	x	None

[2]TR 430-85, Par. 420.

From the above it will be noted that the 75 mm. gun does not fire a nonpersistent gas, the reason being due to the low shell capacity not having sufficient volume to build up an effective concentration in the required time without a prohibitive number of guns, requiring an entire regiment to cover an area 100 × 100 yards in two minutes.

The 75 mm. gun is, however, almost ideal for firing a persistent gas such as HS due to distribution of the liquid more uniformly over an area. In firing smoke, it is not as efficient as the medium caliber, but can be used to advantage in many situations and in filling gaps in a screen fired by the howitzer.

The 155 mm. howitzer fires both types of gas, and smoke, while the 155 mm. gun fires gas only for the purpose of interdiction far into the enemy rear areas and at ranges beyond which there would be no necessity to use smoke not capable of being covered by the howitzer.

It is seen that there exists in the three weapons a combination of gas and smoke fire power suitable for practically all situations.

GAS SHELL AND BOOSTER

The artillery gas shell functions in a somewhat different manner from the high explosive shell in that its content is not explosive and the shell is simply a container, the method of closing the shell being modified due to the requirement of forming a gas tight seal.

The function of the booster is changed from initiating the detonation of the high explosive charge and is itself required to open the shell body and release the gas.

As the shell is only a container for the gas and the low bursting charge of the booster cannot be expected to cause any great effect from fragmentation, the shell should be designed to carry a maximum amount of gas or smoke material with the minimum amount of metal that will give sufficient strength to withstand set-back and firing stresses in the bore of the gun. However, the problems involved in the manufacture of a special type of shell have retarded the development of such a design and our present gas shell is the Mk. I, common steel H. E. shell modified to take a taper threaded adapter and designated as Mk. II shell for the

75 mm. gun and the 155 mm. howitzer, and Mk. VII for the 155 mm. gun.

The booster of the gas shell is of vital importance as it is required to perform several functions, some of which are oppositely disposed.

First, it must be of sufficient power to rupture the shell leaving a minimum of base-cup to trap gas and carry it into the ground upon impact, yet, the booster displacement should be as small as possible to economize space. Also, the booster charge should not create a force or develop a temperature sufficient to decompose the gas, nor, in the case of a non-persistent gas, (CG), dissipate the cloud formed at the point of burst, but in the case of a persistent gas (HS), it should distribute the liquid over a maximum area.

Inasmuch as the booster is located on the central axis of the shell its explosive force must be transmitted through the gas content to reach and rupture the shell wall, hence, with the present design it cannot be expected to fulfill all of these requirements and a compromise must be accepted until such time as a complete re-design and production of a suitable and efficient gas shell and booster can be effected.

FUZE

The fuze adopted for use with gas and smoke shell during the War was the French I.A.L., which, due to its elongated form and instantaneous action tended to burst the shell above the ground before burying itself together with its gas content. This fuze modified and designated as the Mk. III or "Long" fuze is now the standard for issue and use with all of our gas and smoke shell.

At angles of fall of about 10°, or approximately a range of 3000 yards when fired from the 75 mm. gun, this fuze frequently fails to function on flat terrain due to the bourrelet of the shell striking the ground before the head of the firing pin of the fuze and results in either a richochet that may function on second impact at a greatly increased range, or, a dud, due to breaking off of the fuze on first impact, therefore, at ranges much less than 3000 yards the Mk. V, (Short) fuze should be substituted.

The dispersion of shell armed with the Mk. III, (Long) fuze is considerably greater than with other types of fuze and as dispersion is the chief cause of a greatly increased requirement of ammunition at increased ranges with the consequent increased amount of artillery required to fire it, consideration should be given to a re-design of fuze which will give better ballistic effect but retain the advantagees of the Long fuze.

GAS SHELL FILLING

The filling of artillery shell with any chemical agent is a function of the Chemical Warfare Service; the manufacture of metal components and the storage and issue of filled shell resting with the Ordnance Department.

Since most of the gases used are filled into the shell as liquids, they expand as liquids when heated, and it is, therefore, necessary to leave a space or "void" to allow for this expansion in order to prevent excessive pressures and resultant leaks.

The void varies from approximately 5 to 12 per cent of the total capacity of the shell depending upon the coefficient of expansion and vapor pressure of the particular gas. From this it will be seen that the weight of filling does not vary according to the specific gravity of the filler and the shell capacity, as is the case with high explosive, but according to the physical characteristisc of the gases, as mentioned, which determines the void.

The weight markings of gas filled shell conform to the markings as now used for H.E. shell of both calibers; *i. e.,* gas shell marked "L," one "cross" to four "cross" for the 75 mm. gun and two "square" to six "square" for the 155 mm. gun and Howitzer, have the same corresponding total or final weights as H.E. shell of these calibers similarly marked.

WEIGHT OF CHEMICAL FILLING

Due to conditions mentioned above, the weight of a chemical agent filled into a shell varies with the void, and as the void varies with the kind of gas, and to a certain extent on the method of filling, *i. e.,* whether by "constant level," "constant weight," "constant volume," etc., the actual weight varies between certain limits.

The average weights of some of the principal chemical agents used in artillery shell are given in the following Table:

Caliber	Kind of Gas (Lbs.) HS	CG	PS	CN	Smoke WP	FM
75 mm.	1.35	*	1.60†	1.30	1.90	1.71
155 mm.	11.30	11.00	13.66	11.00	15.85	14.30

SHELL EFFICIENCY

The term, "shell efficiency," has been adopted to indicate the ratio of weight of chemical filling to the total weight of loaded shell; *e.g.*, the 75 mm., Mk. II, Fuze Long HS xxxx, has a total mean weight of 13.03 lbs., the mean weight of HS filling is 1.35 lbs.; 1.35/13.05=0.103=10% Efficiency.

In the case of the 155 mm., if the total weight of shell is 95 lbs., and the amount of HS filling is 11.3 lbs., the Efficiency is nearly 12%.

This shows that 88 to 90 per cent of the total weight of gas shell as fired is ineffective as gas and accentuates the desirability of improvement in design and construction of artillery gas shell as before mentioned.

IDENTIFYING MARKING OF CHEMICAL SHELL

The method of marking gas and smoke shell during the War was rather complicated, difficult to remember, and as several colors were used, tended to cause confusion with those of other classes of shell.

The former method has been declared obsolete and a more practical and simple form devised and adopted,[3] as described below:

a. The body of all chemical shell, gas or smoke, are painted GRAY.

b. GREEN bands indicate GAS;

c. YELLOW bands indicate SMOKE;

d. ONE Green band denotes a NON-PERSISTENT GAS;

e. TWO Green bands denote a PERSISTENT GAS;

* Not fired in 75 mm. Gun (Shell will hold 1.32 lbs.)

† Obsolescent.

[3]A.R. 30-1270, Mar. 21, 27, Par. 42.

f. Only ONE Yellow band is used as Smoke is not divided into types.

g. In addition to the above, the word "GAS" or "SMOKE" is stencilled on the body of the shell;

h. The symbol letters (HS, CG, WP, etc) of the particular gas or smoke are also stencilled on the shell body.

By keeping in mind that GREEN is GAS and YELLOW is SMOKE it is easy to differentiate between the two classes of chemical shell.[4]

Then, considering that one is less than two and the *non*-persistent means *less* persistent, it is easy to remember that *one* green band means *less* or *non-persistent* gas, hence, *two* green bands mean *more* or *persistent.*

We now have *all* chemical agents identified as to whether they are:

1st. *Gas* or *Smoke;*

2nd. The *type* of gas.

If it is now desired to know the *kind* of gas in a particular shell, it is only necessary to look at the symbol letters on any shell with green bands, and if looking for a particular kind of *persistent* gas it is only necessary to inspect shell with *two* green bands.

By this method chemical shell are easily and rapidly identified as to *class, type* and *kind*.

To illustrate how this would be used, assume that a battery is ordered to fire; "Shell, Mk. II, Persistent Gas"; then the battery would fire *any* shell on hand with *two green* bands without reference to any other marking. However, if they were ordered to fire "Mustard Gas," it would then be necessary to remember (or refer to data), that Mustard Gas is Persistent, (Two Green) and that its Symbol is "HS." Then from among any lot of shell with two green bands, those stencilled HS would be selected and fired.

In the event of future development and adoption of a new chemical agent for war use it would, first, be *classified* as to whether it was a gas or a smoke and given the designating

[4]One Purple band would indicate an Incendiary Shell, however, as there is no incendiary shell authorized at this time it is not included. In addition to the purple band it would be stencilled "Incendiary" or "Incend" and be given a symbol letter.

color; second, its persistency would be ascertained according to the definition given on Page 610, to determine its Type and given appropriate Symbol letters to indicate the Kind, hence, the only change being an addition to the list of Symbols.

The colored bands are one-half inch wide and when two bands are used they are one-half inch apart. For the 75 mm. shell the first band is one-half inch below the bourrelet. On the 155 mm. shell the bands are one-half inch above the bourrelet, on the ogive, to prevent obliterating when the shell is rolled.

Shell packing boxes are marked by the same system, except that stripes instead of bands are used and that when the entire box is not painted gray it will have a gray patch as a background for the stripes, symbol and word.

BALLISTICS, RANGE AND DISPERSION

As previously mentioned the Mk. II Gas shell is the Mk. I H.E. shell modified to take a taper-threaded adapter.

Certain factors enter which tend to change the ballistic coefficient of the Mk. II shell, such as a liquid filling instead of a solid; and a change in the adapter which changes the form and the distribution of weight.

In the Mk. I H.E. shell, the adapter has a straight thread and is seated flush with the noze of the shell and forming a continuation of the ogive.

In the Mk. II Gas shell the adapter being taper-threaded (Briggs Standard), does not seat flush with the nose, varying from two to as much as five threads, and as a heavy hexagonal head is required to screw the adapter down to a gas-tight joint, breaks the stream-line of the ogive in addition to placing additional weight at the nose of the shell.

Also, as the adapter carries the fuze, it is seen that the variation in extension of the adapter also causes a variation in the over-all length of shell and fuze causing a further displacement of weight forward and a tendency to shift the center of gravity forward of that in the Mk. I H.E. shell.

The additional weight at the nose, the interruption of the ogival stream-line and the shifting of the center of gravity certainly must have some effect on the ballistic coefficient.

Since the advent of liquid filled gas shell during the late War, there has occurred some discussion as to the action of the liquid filling during the travel of the shell in the bore of the gun and its effect on the flight of the shell. Several theories were advanced but no experimental information was obtained until 1926 when in connection with development work on the 4.2" Chemical Mortar, a thin walled shell was used in which the ratio of weight of liquid filling to weight of metal shell was about as 1:2, giving a shell "efficiency" of 30% or better. However, this shell would tumble when filled with liquid but remained stable when filled with a solid. This led to an investigation of the cause, and tumbling of the liquid filled shell was eliminated and true flight obtained by means of longitudinal vanes or baffles in the shell interior designed to produce a positive rotation of the liquid simultaneous with the rotation of the shell body during its acceleration in the bore of the gun.

From this it was deduced that the liquid filling does not normally take up rotation for some appreciable time after the shell has left the muzzle, *i.e.*, there is a slip between the liquid and the interior of the shell wall. As a result of there being no appreciable rotation of the liquid, there is no centrifugal force acting and, consequently, no gyroscopic reaction from this portion of the total mass of the shell tending to stabilize it during the initial part of its flight. During the travel of the shell in the bore of the gun, rotational energy is imparted to and acquired by the solid shell body (metal) only. This energy is represented by and proportional to the moment of inertia of the shell body. After the shell has left the muzzle the liquid filling is gradually brought up to the rotation of the shell due to friction between the surface of the liquid in contact with the interior of the side walls of the shell. The energy required to accelerate the rotation of the liquid filling is proportional to the moment of inertia of the mass of the liquid when rotating. The energy required to produce this rotation must come from the rotational energy initially stored in the shell body, hence, the shell rotation is decelerated as the liquid rotation is accelerated in proportion to their respective moments of inertia.

This slowing down of the rotation of the shell detracts from

its stability and in the event that the difference between the moments of inertia is small, the shell will lose stability and tumble early in its flight; if, however, the difference is such that true flight is maintained throughout a considerable portion of its trajectory the additional slowing down of rotation due to air resistance will reduce its rotational energy beyond the point of stability and tumbling will occur at a later period in its flight. It is apparent, then, that some ratio exists which will not cause tumbling but which may produce unstable and erratic flight, especially at long ranges, and cause a loss in range.

It is also to be noted that during set-back the non-rotating liquid is displaced to the rear of the shell and retains this position until linear acceleration ceases and until rotation of the liquid is taken up. As this occurs the liquid filling gradually changes its form and position to that of a hollow cylinder, the exterior surface of the cylinder conforming to the interior of the shell wall, the hollow portion of the cylinder being due to the void left in filling. From this, it is evident that the center of gravity of the shell is farthest to the rear during the period of linear acceleration and then gradually moves to a forward position as rotation of the liquid takes place.

These effects may be wholly or in part cumulative or they may be compensating, but in any event it is evident that a complex situation exists differing widely from H.E. shell and which should have careful consideration in the future design of gas shell and experimental verification and satisfactory functioning obtained before being put into production.

In the case of our present artillery gas shell, the ratio of liquid to metal is about as 1 : 8½ for the 75 mm. and 1 : 7½ for the 155 mm., hence, with these larger ratios it is not to be expected that they will be seriously erratic. However, it was observed during the War that a variation in range between Gas and H.E. shell existed.[5] Inasmuch as no American gas shell were shipped

[5]"Gas Manual" (A.E.F.) Part II, 1919, pg. 7-12 a: States that "correction must be made for the difference in ballistic coefficient between the solid field H. E. shell and the liquid filled gas shell. For the 75 mm. caliber the difference in range btween H. E. and gas shell is negligible at 2000 meters, but at 7000 meters gas shell range short of H. E. by 200 meter." * * * "Range differences for other calibers of shell will be published as soon as available." The latter do not seem to have been published and no data is available to show that the firing tests were ever made.

overseas during the War,[6] this observation must have been made, either on shell of the Allies, or on American shell fired at proving grounds in this country. The method of closing gas shell as used by France was such as to make no change in the exterior form of the shell[7] and no data is available to show that there was any difference between the ranges of French Gas and H.E. shell of the same caliber and weight when fired at the same muzzle velocity. In fact, they used the same data for Gas and H.E. shell.[8] They did, however, furnish one smoke-producing shell for every eight gas shell of certain types, not containing "fumigen," for observing bursts for ranging purposes.[9] This may have been due to there being no effort made to maintain uniform weights between Gas and H.E. shell, thereby requiring a special shell for adjustment.

German data indicates that an appreciable difference existed between the ranges of Gas and H.E. shell, being less in the case of gas shell,[10] however, the same data shows that the gas shell was appreciably lighter than the H.E. shell,[11] and also that the exterior form of both types of shell was the same.

Referring again to the reported difference in ranging of American Gas and H.E. shell, test firings were conducted at

[6]"America's Munitions, Report of Benedict Crowell, Ass't. Sec'y. of War, 1917-1918, Page 408.

[7]"Manual of Artillery" Saumur Artillery School, 1918, Vol. II, Pg. 230.

[8]"Artillery Firing," W.D. Document No. 808, 1918 Translation from French. Par. 276 stated "The methods of adjustment for H. E. shell are applicable in the case of gas shell. The trajectory of gas shell may be taken as the same as that of the corresponding H. E. shell."

[9]"Gas Manual" (A.E.F) Part II, 1919, Pg. 30, Par. 67.

[10]"Notes on German Shell," 2nd Edition, May, 1918, (S.S.420 BRITISH) (Compiled from captured documents and official German handbooks, blind and captured ammunition.)

On Page 390, is shown the German official maximum ranges for gas shell. The average is about 1500 yards short of H. E. for the 7.7 cm. Guns and 10.5 cm. Howitzers of various models with a maximum H. E. range of 9000 to 10,000 yards. The heavy 10 cm. Gun, Model'04, with a maximum H. E. shell range of 11,264 yards gave 9,843 yards for Gas shell, a difference of 1,421 yards, while the Model '14 with a maximum H. E. range of 12,085 yards was short by 2,242 yards with gas shell. Their 15 cm. Gun, '16, with a maximum range of 24,934 yards is reported to have fired Yellow Cross Shell (Mustard Gas) with false cap, "at least 20,000 yards" (Page 422). This is short of the H. E. shell, which also uses a false cap, by 4,934 yards.

[11]The following is taken from various parts of the reference under 10 above:

Weapon	*H.E.*	*Total Weights of Shell Gas, Yellow Cross (HS)*
7.7 cm. Long Pattern Field Gun	7.35 Kg.(16.2 lbs.)	7.14 Kg.(15.7 lbs.)
10.5 cm. Long Pattern Light Field Howitzer	15.6 Kg.(34.4 lbs.)	14.8 Kg.(32.6 lbs.)
15 cm. Gun, '16 False cap	51.5 Kg.(113.5 lbs.)	50.0 Kg.(110. lbs.)

Aberdeen Proving Ground during the summer of 1918 and results furnished the A.E.F.[12] The report stated that the results were "not altogether satisfactory" but tended to show that at a range of 7400 meters the 75 mm. H.E. shell outranged the gas shell of the "same weight" armed with the same fuze, by about 200 meters. The propellant powder, however, was from different lots.

Another test fired at Aberdeen Proving Ground in September and October, 1918,[13] reported that gas shell were not appreciably less accurate than the H.E. shell; that the difference in range was small, and concluded that one range table could be used for both gas and H.E. shell.

Further tests at Aberdeen in the summer of 1921,[14] were reported as follows:

"It is evident that the ranges of the Mark II gas shell are appreciably smaller than those of the Mark I, H.E. Shell at the higher elevations, whereas the gas shell have slightly longer ranges at low elevations.***

"The slightly longer range of the gas shell at low elevations is probably due to the slightly higher muzzle velocity of these shells; it is considered that the better form of the H.E. shell has no appreciable range effect at the low elevations and moderate velocity considered. At the higher elevations, however, it is evident that the blunt nose of the gas shell has resulted in an appreciable range loss."

The above firing was conducted with H.E. shell of a weight of 12.65 pounds and Gas shell of 12.55 pounds. Muzzle velocity of H.E. shell 1785 f/s, and gas shell 1790 f/s.

From the above the following conclusions may be drawn:

That the report in foot-note 5 is based on information obtained from the reference in foot-note 12;

That the several Aberdeen Proving Ground tests are not entirely consistent;

That the results reported from all sources have not been based

[12]"Bulletin Sheet" Office of the Chief Ordnance Officer, A. E. F., September 23, 1918. (Stamped, "Rec'd. Hdqrs. Chemical Warfare Service 25 Sept. 1918—A. E. F. Hdqrs, S. O. S.").

[13]"O. D. Program No. 2439" Aberdeen Proving Ground, February 26, 1919.

[14]"Ordnance Program No. 4246, T.S.T.P., No. 1921-35, O.C.M. Item 1431, Aberdeen Proving Ground, Sept. 28, 1921.

on exactly equal conditions, *i.e.*, the shell weight, muzzle velocity or powder lot has been different in each case;

Finally, that there is no definite proof that Gas and H.E. shell of the same or similar form, of the same weight, fired with the same powder lot with equal muzzle velocities and under the same conditions, will differ in range or accuracy.

In view of this lack of information and the fact that no Gas Shell Firing Tables exist for either the 75 mm. gun or the 155 mm. gun and howitzer, it would seem appropriate for the Artillery to request that final and definite tests be conducted and in the event that it is determined that an appreciable difference exists to an extent that render the use of the Firing Tables for H.E. shell not suitable for use in firing Gas shell, then Firing Tables should be made for the latter shell.*

AMMUNITION REQUIREMENTS

The effect of gas shell fire differs from that of H.E. and shrapnel; with the latter type of ammunition, it is generally possible to determine, at the time of firing, a definite indication of the results obtained. However, with gas shell, results may not at once be apparent due to delayed action of the gas, or its method of use, such as interdiction of an area by a persistent gas (HS), and, in fact, it may be days, weeks, months, or even after the termination of a war before the extent and nature of casualties inflicted on an enemy are determined. Also, effectiveness of gas depends upon the nature of the protective equipment, training and gas discipline of an enemy, weather conditions, terrain features and other factors which introduce variables into any given situation.

As a result, ammunition requirements can be stated within wide limits only, as a general guide.

To determine the maximum and minimum limits of ammunition requirements it is first essential to establish a basic amount of a given type of gas to obtain effect on a given or unit area.

For a persistent gas, such as HS, this is based on the area

*Tests are being conducted as a result of which the probable error of gas shell will be more accurately determined and a general check of the applicability of present firing tables will be made.—EDITOR.

covered effectively by a burst of a single shell of a given caliber and can be directly determined in pounds per square yard.

In the case of a non-persistent gas, such as CG, the situation is different, as the gas immediately forms a cloud upon the burst of the shell and is rapidly diffused in the air, hence, a time element enters if a lethal concentration is to be built up, and inasmuch as the cloud rises from the ground, the cubic dimension of the cloud must be considered.

It has been determined that the initial gas cloud does not rise to any extent above 30 feet (10 yards), hence, this dimension can be taken approximately as a "constant" and the data calculated for a unit surface area, that is, per square yard.

It requires about .0368 lbs. of HS (persistent) to effectively cover one square yard.[15]

For CG (non-persistent) a lethal concentration is taken as

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[15] *"Gas Manual"* (A. E. F.) Part II, 1919, Page 6, Par. 8, shows that one 75 mm. shell per 25 square meters (5 meters square) is required then, 1.35 HS per shell and per 25 square meters equal .054 per square meter; .054/1.2 square yards equal .045 lbs. per square yard.

Page 9 Par. 16 and Chart, Figure 2.

Basis of chart: "Assuming" that 100 Kg. are necessary per 100×100 meters equal .01 Kg. per square meter=.0184 lbs. per square yard. However, the Note at bottom of page 17 states: "Whenever enough ammunition is available, use a 'factor of safety' by *Doubling* the amounts obtained from the chart," hence, .0184×2=.0368 lbs., per square yard.

"Artillery Firing," War Department Document #808, 1918—Translation from French.

Par. 278—Table; 75 mm., 500 rounds per hectare; 500×1.3=650 lbs. per 100×100 meters=.065 lbs. per square meter=.054 lbs. per square yard. 155 mm. 50 rounds per hectare; 80×7.5=600 lbs. per 100×100 meters=.06 lbs. per square meter=.05 lbs. per square yard.

"The Use of Yperite Shells"

French G. Hq., General Staff Armies of the North and North East, May 29, 1918, signed "Petain."

Par. 4, 1—75 mm. shell per 20 square meters, 1.3/20=.065 lbs. per square meter=.054 lbs. per square yard.

1—155 mm. shell per 200 square meters=7.5/200=.0375 lbs. per square meter=.031 lbs. per square yard.

"Notes on German Shells," 2nd Edition May 1, 1918, (S.S. 420) (British) Page 387 (Extract from German document dated July, 1917), Gas "Ammunition Expenditures" per hectare 7.7 cm. Field gun, 100 rounds*

10.5 cm. Lt. Field Howitzer, 50 rounds*

(Pages 398, 399, 406, 407 gives capacities of above shell as 7.7 cm., .8 Kg.=1.76 lbs.; 10.5 cm., 1.58 Kg.=3.5 lbs.)

*With "Yellow Cross" shell *double* this amount.

100×2×1.76=352 lbs. per 100×100 meters=.0352 lbs. per square meter=.0293 lbs. per square yard.

50×2×3.5=350 lbs. per 100×100 meters=.035 lbs. per square meter=.0292 lbs. per square yard.

1.6 of liquified gas per cubic meter (or 1.6 mg/L).[16] This amounts to .00368 lbs. per cubic yard, and as the height of the cloud is taken as constant at 10 yards, reduces to .0368 lbs. per square yard.

It will be noted that the amounts of HS, a persistent gas, and CG, a non-persistent gas, happen to be identical. This is simply a coincidence as the characteristics, physiological effect and method of application are entirely different.

The square yard is too small a unit for use in field calculation, therefore, a unit of 100×100 yards (10,000 square yards) has been adopted by the Chemical Warfare Service and termed a "square."

Therefore, the basic maximum quantities per "square" of both types of gases, persistent and non-persistent (HS and CG taken as representative kinds) are 368 lbs.

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[15](Continued.)

"When a shell bursts, almost all the mustard gas is distributed on an egg-shaped surface whose axes have about the following dimensions":

Caliber of Shell	*Longer Axis*	*Shorter Axis*	*Area of Ellipse*	
			Sq. Meters	*Sq. Yards*
77 mm.	6 meters	4 meters	18.85	22.6
105 mm.	9 meters	6 meters	42.41	51.
155 mm.	16 meters	9 meters	113.09	135.
210 mm.	18 meters	12 meters	169.65	203.

The above calibers are those of the German guns, hence, taking the shell capacities of "Yellow Cross" (Mustard Gas) for these shell from "Notes on German Shell," the following quantities of gas in pounds per square yard are obtained:

77 mm. @ 1.76/22.6	gives .079	lbs. per sq. yard
105 mm. @ 3.5/51	gives .0685	lbs. per sq. yard
155 mm. @ 7.69/135	gives .0565	lbs. per sq. yard
210 mm. @ 17.6/203	gives .0865	lbs. per sq. yard
AVERAGE.....	.0726	lbs. per sq. yard

A large amount of other data has been studied, but the majority of it appears to have been derived from the same source, or is a duplication, hence, the references are not included.

Taking an average of the above references, a value of .04358 lbs. per square yard is obtained and the writer has previously advocated the use of .04 lbs. per square yard, which amounts to an even 400 lbs. per "square," however, the Chemical Warfare School has adopted and use the value of 368 lbs. and it is, therefore, used herein.

[16](a) "C.C.P. 2994"
British Report on "Chamber Experiments" carried out at Porton.

(b) C. W. S., 1st Ind. (E.A.) 672/1.

(c) "Gas Manual" (A.E.F., 1919) Part II, Chart, Fig. 1.

The above references entirely correspond, (c) being taken from (a) in establishing a lethal concentration, for a 3-minute exposure, of 1.6 cc/cu. meter, (or 1.6 mg/Liter) for CG (Phosgene).

An even figure of 50 Kgs. was used by the British and French, and also in (c) for a front or objective of 50 meters wide by 50 meters in depth and 9.18 meters (30 ft.) in altitude. This reduces to .00368 lbs. per cubic yard, or .0368 lbs. per square yard.

Table on page 616 gives 1.35 lbs. of HS in the 75 mm. shell:

Then, 368/1.35=273 rounds to place a maximum quantity of HS on a unit area of 1 Square.

The amount of HS in the 155 mm. shell is 11.3 lbs. and 368/11.3=33 shell per square.

As the 155 mm. shell holds 11.0 lbs. of CG, (368/11.0), 34 shell are required.

The above gives the maximum amount of gas and number of rounds of shell to place on one square to obtain intensive effect.

This is based on a uniform distribution of the gas over the area, which is obviously impossible due to dispersion and the various errors entering into artillery fire.

It is, therefore, necessary to make allowances for these causes and fire an additional number of rounds sufficient to place the basic amount on a target.

The principal factor causing additional ammunition requirements is dispersion, and as dispersion tends to increase with the range the ammunition requirements increase proportionally.

Knowing the probable error of a given weapon and projectile for various ranges and the basic number of rounds required, the expenditure of ammunition can be computed in advance.

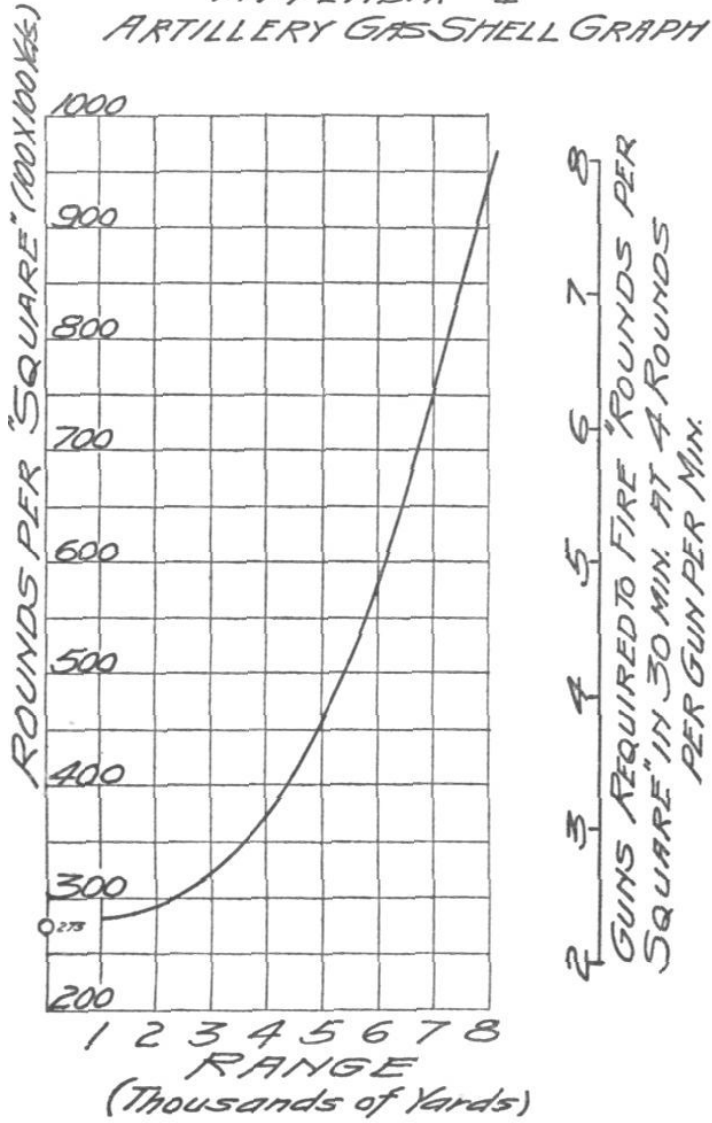
This has been done in the case of the 75 mm. gun for firing HS and the 155 mm. howitzer for firing HS and CG, and curves have been plotted which show the required number of rounds at various ranges and incorporated in graphs presented herewith as Appendices I, II and III.

The grap in Appendix I is for the 75 mm. gun firing HS and those in II and III are for the 155 mm. howitzer firing HS and CG, respectively.

The dispersion curves are computed from the probable errors obtained from Firing Tables, (a) for the 75 mm. Gun, Model of 1897 (French), 1923, H.E. Shell, Mark I, Fuze, Long, Normal charge, and (b) for the 155 mm. Howitzer, Model of 1918; 1923, H.E. Shell, Mark I, Narrow band, Fuze, Short. These are the only tables applicable at this time. The curves are computed for one range, or elevation, only for each square and on the assumption that the center of impact is at the center of the square.

APPENDIX - I

ARTILLERY GAS SHELL GRAPH



HS - 75mm GUN
SHELL MK. II.

Lateral dispersion was not included as it is negligible up to medium ranges and is not excessive at extreme ranges.

HOW TO USE THE GRAPHS

The range to the target having been determined, the number of "Rounds per Square" will be found at the left side opposite the intersection of the "Range" ordinate and the dispersion curve.

At the right side, opposite the same intersection, will be found the "Number of Guns" required to fire the number of rounds, in a given time and at a given rate of fire.

These values are *maximum* amounts on a *minimum* target or area and no reduction should be made when using a non-persistent gas (CG).

When a persistent gas (HS) is used for harassing effect a smaller amount may be used but the minimum should not be less than one-fourth of the amount given in the graph.

When firing a persistent gas (HS) on an area of two or more squares which are adjacent, a correspondingly smaller amount per square may be used as the number of squares increase. This is primarily due to overs and shorts from one area being partially effective in adjoining areas and also due to the fact that a persistent gas is cumulative in effect, that is, if enemy troops passing through a large area are exposed to or in contact with several small quantities of the gas the total effect will be approximately equivalent to an exposure to or contact with a single equal quantity in a small area.

As a guide to the amount by which the basic quantity may be reduced on adjacent squares, a Reduction Factor Graph is given herewith as Appendix IV, from which an empirical factor is obtained to determine the total ammunition requirements. This reduction factor is entirely arbitrary but is proposed by the writer as a means of more accurately determining the amount of persistent gas required on large areas.

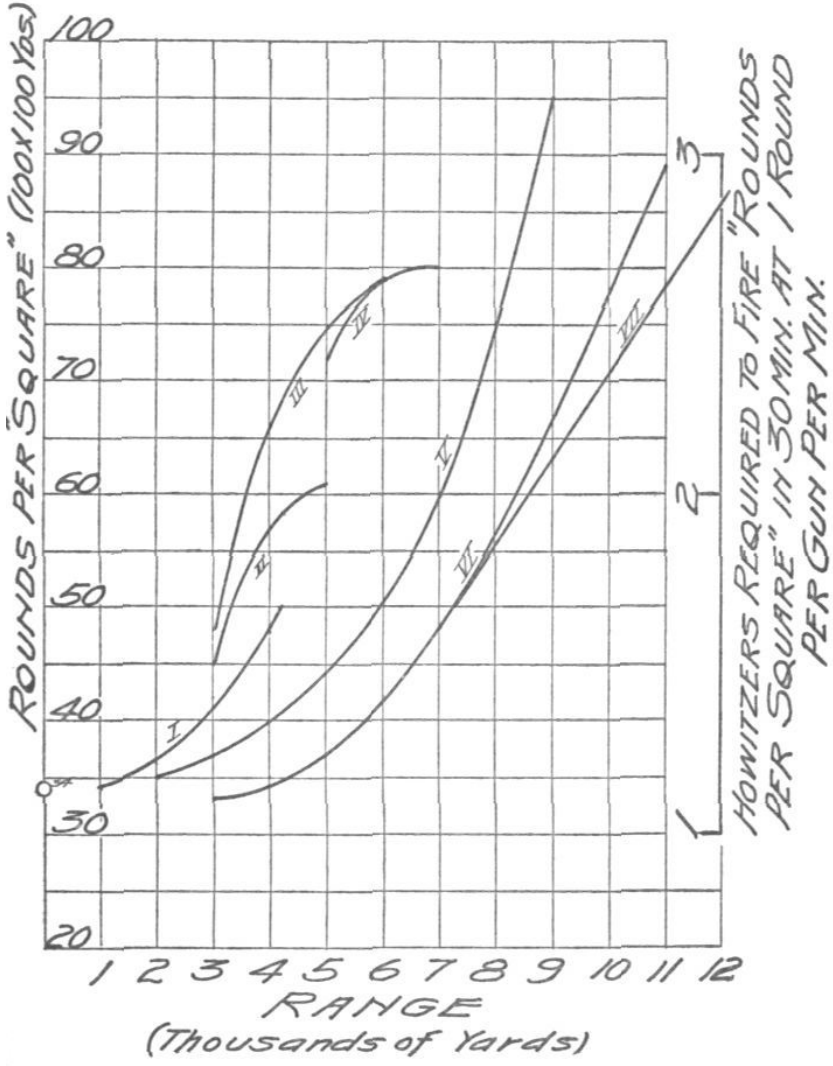
The method of the Chemical Warfare School[17] is as follows:

"When areas larger than one square are to be mustardized

[17]"Ammunition Requirements and Methods of Calculating Them," Chemical Warfare School, Book IX, 1927, Par. 7e.

APPENDIX – II.

ARTILLERY GAS SHELL GRAPH



HS – 155 mm HOWITZER
SHELL MK. II.

the areas may be divided up into squares like a checkerboard and the fire delivered on alternate squares."

Several other methods were used during the War, one of which[18] employed the following rule Hectare=100×100 meters:

1 to 10 Hectares		basic amount per Hectare
10 to 50 Hectares	½	basic amount per Hectare
Over 50 Hectares	¼	basic amount per Hectare

Neither of these methods gives a uniform distribution or proportionate amount per unit area.

A more or less casual study of the problem indicates that the method proposed herein will give more consistent results.

The graph, Appendix IV, is based on the use of a semilogarithmetic curve. A better form, or value of factors, may be found upon further study or future experience, however, the principle of the use of a factor is believed to lend simplicity to calculations.

USE OF THE REDUCTION FACTOR GRAPH

Having determined the number of squares contained in the area to be gassed, and knowing the range, first obtain from Graph I or II the number of rounds and corresponding number of guns for *one* square. Multiply these quantities by the number of squares and then by the factor found at the bottom of Graph IV, intersecting the curve opposite the number of "Squares," the result being the total number of rounds required and the total number of guns necessary to fire them in a given time: This may be simply stated as:

Rounds per square × squares × factor=Total Rounds

Guns per square × squares × factor=Total Guns

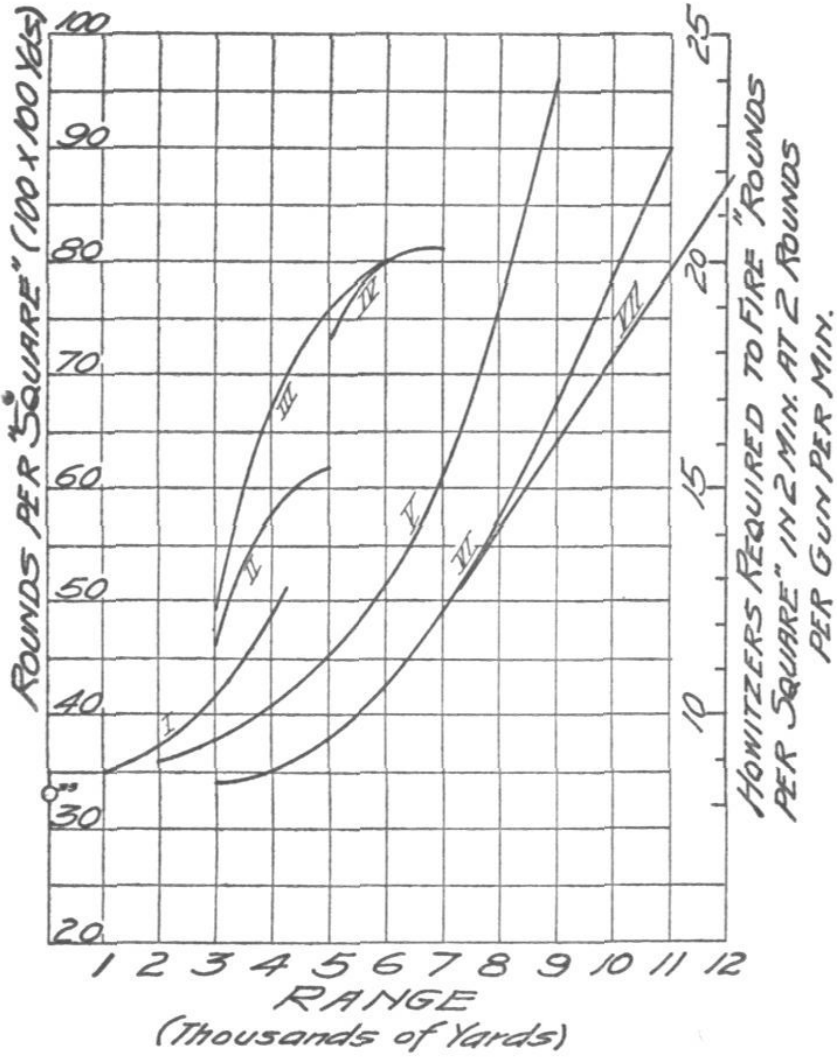
The following example will illustrate the use of the graphs:

It is desired to neutralize an area of 10 "squares" with HS; Range 7000 yards, 155 mm. Howitzers; Charge VI. Required: the number of rounds and guns.

From Graph II, the 7000 range ordinate intersects the Charge VI dispersion curve opposite 60 rounds; going across to the

[18]"Artillery Firing," W. D. Document #808, 1918. Translation from French, Par. 278.

APPENDIX III
ARTILLERY GAS SHELL GRAPH



CG - 155 mm HOWITZER
SHELL MK. II.

right is found "2" guns; then referring to Graph IV, 10 squares intersects the curve at Factor .55

Then, 60×10×.55=330 Rounds, Total,

and 2×10×.55= 11 Guns (Howitzers), Total.

Additional graphs for the 155 mm. Gun, or for other gases, may be readily constructed from data therein.

If found to be of service, they can be reduced to field note book size for convenient reference.

MINIMUM AMMUNITION REQUIREMENTS

As stated above, ammunition may be reduced under specific conditions. However, a general tendency toward any reductions beyond those indicated should be avoided as it is hardly conceivable that the maximum will be exceeded while there are innumerable causes tending to reduce the effective amount, such as:

Dispersion greater than normal;

Shortage of ammunition or guns;

Duds, due to malfunctioning of fuze or booster;

Loss of gas content due to burying of shell in ground;

Errors involved in calculation of data, location of guns and targets;

Poor observation of fire due to low order of bursts of gas shell, night firing, fog, smoke, etc.;

Individual guns going out of action;

Necessity of resting guns;

Slower rate of fire than expected;

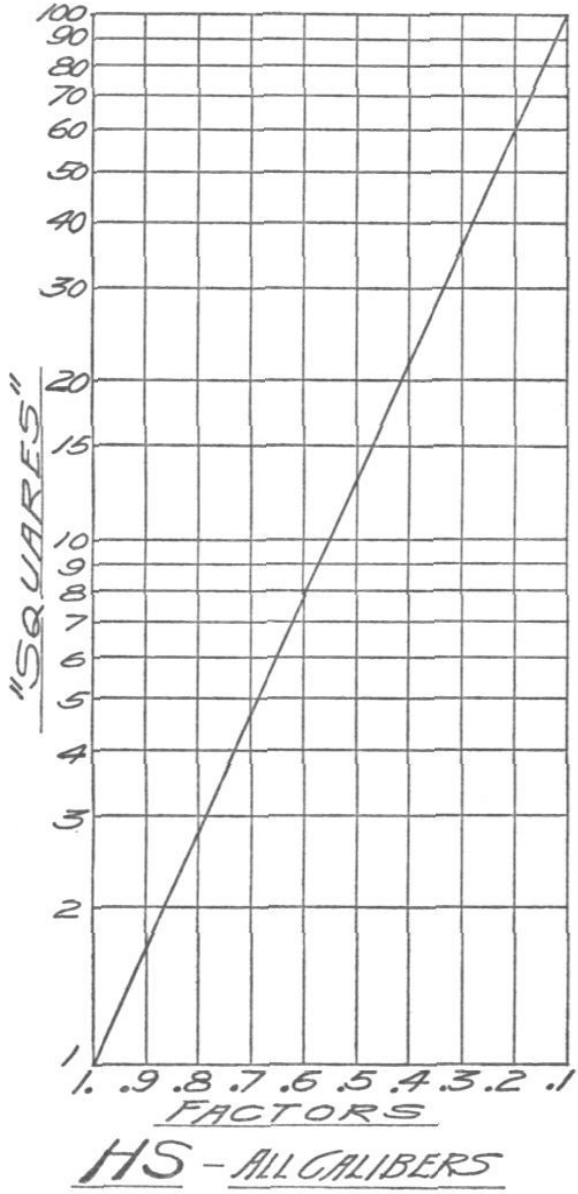
Effect of adverse weather and terrain conditions, etc.

In firing gas shell, it is believed that a rule should be adopted similar to that of the Corps of Engineers regarding the use of explosives in demolition work and firing of mines, which is: "Do not spare the powder. *The worst mistake* that can be made is having the *charge too small."*[19]

This is based on the logic that if more than is necessary is used the excess may be considered as wasted, but if less than the proper amount is used, not only is the total quantity used wasted, but the time and labor spent are also wasted, and the advantage to be gained by successful firing is lost.

[19]"Engineer Field Manual," 1918, Par. 233.

APPENDIX-IV
ARTILLERY GAS SHELL
REDUCTION FACTOR GRAPH



HS - ALL CALIBERS

The fact that it is futile to fire gas in small quantities was recognized during the War as is evidenced by the following:

"Single shots are valueless."

"Firing with single guns is ineffectual."[20]

Von Buelow in an order to the German 1st Army in September, 1916, stated: "There have recently been many instances of T-Shell and Green Cross shell being fired in small quantities. This is a waste of ammunition, as with all gas shell good effects are to be obtained only by using them in large quantities."[21]

Petain, "emphasized the impossibility of obtaining results during bombardments with special shell if the targets are inaccurately judged or are so extensive that a sufficient concentration cannot be maintained over them."[22]

METHOD OF FIRE

The following methods of fire are suggested in view of there being no definite instructions in training regulations existing at the present time. They are based on the data as used by various countries during the War, with some modifications.

WITH NON-PERSISTENT GAS (CG)

Adjustment:

As this fire is invariably for surprise effect, adjustment should be made by registering on an auxiliary target sufficiently distant not to attract attention or disclose the purpose, and then make a transfer of fire to the objective by the most appropriate method.

Fire for Effect:

No wind: Execute precision fire, as with H. E., firing the required number of rounds as rapidly as possible and not exceeding two minutes.

With wind: Adjust the center of impact about 1/6 fork to windward, i. e., up-wind from objective, and fire as above.

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[20]"Gas Warfare," Part I.
German Methods of Offense.
W.D. Doc. No. 705—2-18-1918, Par, 189, Par. 157.

[21]Par. 163 of reference under (20) above.

[22]"The Use of Yperite Shells."
(French G.H.Q., General Staff, Armies of the North and North East) May 29, 1918.

Do not fire non-persistent gas if wind velocity at objective is in excess of about seven miles per hour.

Do not fire H. E. in conjunction with non-persistent gas.

WITH PERSISTENT GAS: (HS)

Adjustment and Fire for Effect.

On a small objective, less than one square, or such as a battery emplacement:—Seek a narow bracket and execute zone fire for effect.

On an area of two or more squares, the fire should be distributed by omitting from a fraction of a square to one or more intervening squares according to the extent of the area.

In the case of large areas, in general, it will be effective and more economical to select important local areas and individual targets within the large area and fire a heavy concentration on each rather than to attempt to cover the entire area uniformly.

This could well be accomplished by preparing an overlay, similar to a barrage chart, to be furnished the firing batteries.

H. E. shell may be fired in conjunction with a peristent gas without detrimental effect. In fact, in some cases it may be of distinct advantage due to better distributing the liquid gas on the ground and increasing its rate of vaporization. H. E. may also be used to mask the fire of persistent gas and mislead the enemy as to its use.

The above covers a few essential details of methods of fire. The firing of gas by the artillery will vary as any situation varies and should be considered and studied accordingly. Applying the general principles of the usual forms of fire with shell and shrapnel, modified as may be necessary to take full advantage of the possibilities of gas, will obtain effective and economical accomplishment of missions.

CONCLUSIONS

First. In view of the high casualty rate produced by artillery gas shell in the World War, as evidenced by authentic records,[23] and that artillery fire constitutes one of the most efficient methods

[23]Reports of the Surgeon General.

of gas projection, it should receive a proportionate amount of consideration in instruction, training, firing, and in problems and maneuvers.

Second. The present status of our artillery gas shell, including fuze and booster, being practically the same as it was at the termination of the War, it is subject to decided improvement in capacity, efficiency, accuracy, and methods of production.

Third. Consideration should be given to providing Firing Tables for gas shell.

Fourth. As there are three services or arms which have certain responsibilities in the design, development, production and use of gas shell; (a) the Artillery, as the using service and in initiating recommendations and suggestions; (b) the Chemical Warfare Service, and (c) the Ordance Department, who are jointly and concurrently responsible for design and production, and separately responsible for filling, storage and issue,[24] co-ordinated action is essential to obtain results in establishing and maintaining efficient preparedness in the use of gas by the Artillery.

[24]National Defense Act—Sec. 12a, and W.D. G.O., No. 54, 1920.

AFTER THE EXPLOSION OF THE CRATER AT PETERSBURG

HISTORICAL PARALLELS

BY LIEUT. THOMAS NORTH, 5TH F. A.

In the history of warfare, combinations of circumstances have recurred in so many instances as to indicate quite conclusively that although the human will may create the immediate occasion for the outbreak of war, its course thereafter is largely shaped by influences more enduring, influences that are geophysical in nature. Going a step further it can even be asserted that the development of civilization has been the resultant of various factors, of which the shape of the earth's surface is probably the most important.

To gain the historian's viewpoint during current happenings is next to impossible; to our myopic vision our trials and tribulations, our wars, our pacts, our protocols loom large. Viewed in its true historical perspective the human element fades; it is but the raw material of which history is moulded by the massifs, the watercoures, the fertile plains, which, to us as individuals seem but the mere background to our immediate activities.

So, for instance, the narrow English Channel permits the British to dispense with all but a "contemptible little army" until the long-range cannon and the airplane threaten in effect to annihilate that bulwark. So, wave after wave of invasion sweeps along the northern edge of the forbidding Ardennes, and Flanders becomes the cockpit of Europe.

During the period of written history Laon on its isolated hilltop has been besieged no less than forty-two times—by the Kymris, the Vandals, the Huns, the Franks, the Burgondes, the Normans; by Merovingians, Carolingians, and Capetians; by Mayors of the Palace; by Dukes of France and Dukes of Lorraine; by Plantagenets, Bourbons, Armagnacs, Burgundians; by Russians, Prussians, and Austrians; by Napoleon; by the Germans of von Moltke and by those of his son. Similarly, Soissons has been the unhappy witness to thirty-two sieges or major battles, and the men of our 1st, 2nd, 26th and 32nd Divisions who in 1918 trudged the highways of the Soissonais were but following in the footsteps of the armies of Divitiacus, Caesar, Clovis, Charles Martel, Charles Quint, Turenne, Napoleon, Blücher and von Bülow. By what stretch of the imagination could one

have dreamed that young men by the hundreds would leave the shops of Detroit to defeat the German invaders of France on the exact spot (Juvigny) where Clovis had drubbed the Roman invader a thousand years before Columbus set sail? Or that Texas and Oklahoma would, like Turenne and Louis XIV, restore Stenay to France? Château-Thierry has its place in the history of Henry V, of England, of Joan of Arc, of the Emperor Charles V, of Philip II of Spain, and of Napoleon; while Poitiers witnessed two decisive battles at an interval of six centuries.

These were no more coincidences. Far from it. In fact, when history has chosen to repeat itself it has not always contented itself with staging the scene over mere general areas. It is possible to cite instances in which battles have been fought over the identical ground, though years had passed between.

In 1708, England, Holland, Austria, and most of the principalities of the Empire were at war with France and Spain; the occasion was the question of the Spanish succession, the reason: balance of power. Two years previously the French had lost command of the Netherlands at the battle of Ramillies, but had once more invaded the country, being received with open arms by Ghent, Bruges, and other cities. To consolidate their hold upon these two places they advanced upon Audenarde, which was in the hands of the English-Dutch combination, with the intention of besieging and reducing this fortress. Marlborough, with the English forces, was in the neighborhood of Lessines, to the southeast, which he swiftly seized; thence by forced marches he advanced to the aid of Audenarde.

The French troops were commanded nominally by Louis XIV's grandson, the Duke of Burgundy, but in reality by the Duke of Vendôme, an experienced soldier. It would appear that the former preferred to avoid meeting Marlborough, and, when an engagement became inevitable, to take up a defensive position. Vendôme for his part did not seem to believe that Marlborough would molest him.

So, on July 11, 1708, the French were advancing at a leisurely pace upon Audenarde, which today is a sleepy old country town of some 7,000 inhabitants. They felt that the fortress would be an easy prey. As they came into close view of the town about

1 p. m. they were astounded to see Marlborough's Prussian cavalry crossing the Scheldt a short distance downstream. Vendôme promptly ordered his troops to attack in order to fling the Allies back into the river. Burgundy issued instructions to the effect that they occupy the low ridge from Wanneghem to Huysse, which was undoubtedly a stronger position for defensive purposes. This lack of harmony, which manifested itself throughout the battle, could not fail to bring disaster.

Following Vendôme's orders, seven battalions pushed forward to Eyne and Heurne, but were routed by Marlborough's advance guard infantry and cut to pieces by his Hanoverian dragoons in the pursuit. Thereupon Vendôme decided to hold the Wanneghem-Huysse position. Meanwhile the mass of the Allied army was crossing the Scheldt, taking up positions west of the highway to Ghent, from Schaerken to Herlegem in the flats below Huysse.

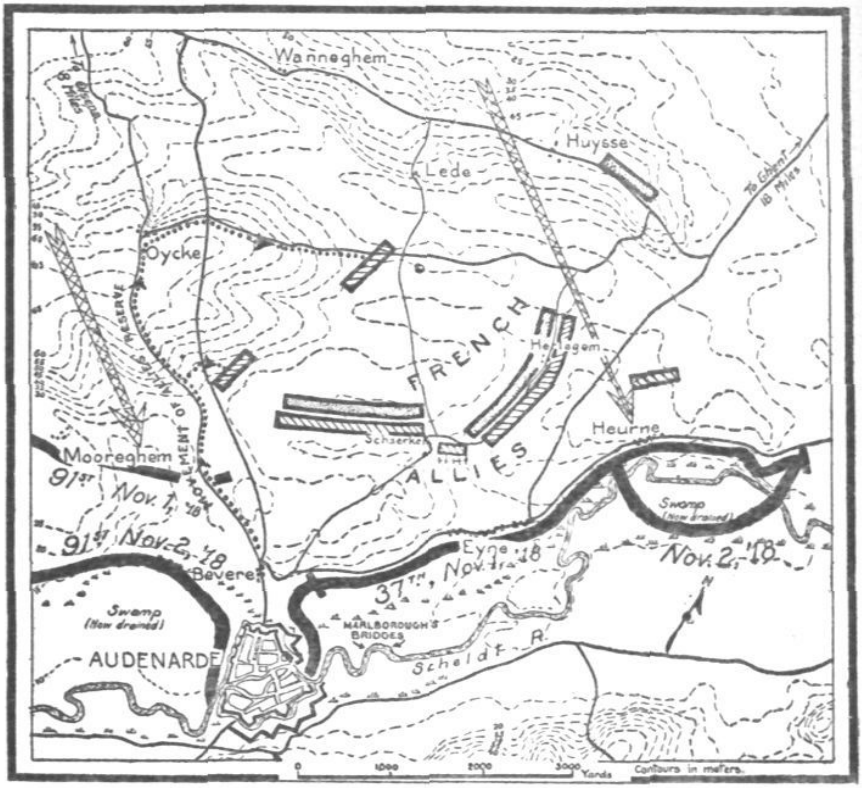
Stung by the French setback and with the excellent hope of enveloping the Allies and pushing them back to the river, Burgundy ordered his right to attack. Thereupon Vendôme likewise ordered the center and left to advance, and a fierce mélée developed when the Allied positions were reached. Fearing the existence of swamps, Burgundy ordered the left to remain in place. As a result Marlborough was able to check the French attacks and, since their left remained pinned in place, he virtually cut their force in two.

Meanwhile Marlborough had discovered that the French right wing was completely "in the air". Taking advantage of this knowledge he sent his Dutch reserves around by Mooreghem and through Oycke, so completely encircling the French that the two extremes of the Allied line fired upon each other. It was now eight o'clock and the approaching darkness threatened to aggravate the confusion. Marlboro therefore gave the order to cease firing; using the rallying calls of the dazed French, the Huguenots among his force were able to decoy some 9,000 prisoners who might have profited by this situation. The remainder of the beaten army fell back upon Ghent.

Two centuries passed, and once more the French were advancing upon Audenarde. In mid-October 1918 the American 37th Division had left the Toul region with Flanders as its

destination. Upon detraining it was attached to the XXXth Corps of the French VIth Army, which formed one of the group of Armies commanded by King Albert II. The offensive movement which had begun on September 28 had forced back the enemy's line, but he was making a stand on the ridge which divides the valley of the Lys from that of the Scheldt.

On the nights of October 29-30 and 30-31 the 37th Division entered the line east of the Lys, near Olsene, and at 5.30 a. m. on October 31 took part in a general advance toward the Scheldt. It



reached the watershed that day and the following morning started down the eastern slope. By 7.40 a. m. Nov. 1 the 148th Infantry had reached Wanneghen, and, resuming the advance three hours later, the 145th and 148th Infantry passed over the ground which had been so bitterly contested at an epoch when

their native State, Ohio, was still an unknown wild, a century before it was admitted to the Union. At Eyne and Heurne considerable opposition was met when the Division attempted to cross the Scheldt, but under cover of darkness light footbridges were thrown across the river, enabling some of the infantry to fight their way across that night and others on November 2 to consolidate the bridgehead.

Meanwhile the 91st Division, which had come from the Argonne and which had advanced with a similar mission, was pushing forward on the right. On November 1 it reached Mooreghem and the next day occupied Audenarde.

A highway bridge across the Scheldt at Eyne, the gift of the people of Ohio, and a stone memorial which has been erected upon the site of the ramparts of Audenarde by the United States Government, will recall to future generations the army that came across the Atlantic to tread in the footprints of the warriors of the Grand Monarch as they marched down to the Scheldt.

Let us now turn to the Franco-Prussian war. It is late August 1870. Marshall Bazaine, by popular acclaim commander-in-chief of the Army of the Rhine, has succeeded in bottling himself up in Metz with 150,000 of the flower of the French Army following a series of bloody engagements which were lost to the French by the criminal supineness of their leader. Marshal MacMahon has taken command of and reorganized the Army of Châlons, composed of troops salvaged from the unfortunate beginnings in Lorraine and of new units garnered from Paris and elsewhere, whose lack of training and discipline cannot fail to cause him the gravest concern.

To make matters worse he is bombarded by conflicting orders from the War Department and the Imperial family. He is torn between the natural desire of the soldier to rush to the rescue of Bazaine and the politico-military necessity of covering Paris against the advance of the German armies which are surging westward from around Metz.

On August 21, alarmed by news of the approaching enemy, the Army of Châlons broke camp and lumbered towards Reims. The very next day, however, a message was received from Bazaine stating that he intended to retreat from Metz by way of Montmédy—Paris could not yet know that these were but the

idlest of words. The sequel was disastrous, for MacMahon needed but little more urging to abandon Reims; within twenty-four hours he set out in the direction of Verdun and Metz with the object of joining Bazaine. The march was characterized throughout by hesitations, mistakes and delays. Meanwhile, von Moltke, at first incredulous then joyfully convinced, launched the overwhelming weight of two heavily reinforced armies towards the right flank of MacMahon's command, causing him to sidle northwards, crab-fashion, drifting away from Verdun; lured first by the mirage of Bazaine at Metz then impelled by the desperate realization that he must escape von Moltke by way of Mezieres and the west, he was to me trapped into the catastrophe of Sedan.

The village of Beaumont lies in a sort of basin, about two miles west of Meuse river and fifteen miles southeast of Sedan. The hills roundabout the village rise some 100 to 150 feet above it. For about 2,500 yards to the south they are bare; beyond lie the woods of Port Gérache and of Belval, forming part of a continuous mass three miles in depth known as the Forest of Dieulet, a remnant of that Forest of Argonne which formerly extended to the Meuse. The Forest of Dieulet is traversed by few roads. One muddy track ran northwards from Nouart and Belval, emerging from the wood of Port Gérache near la Tuilerie farm which lies 400 yards out in the open.

On August 29 the V Corps, which formed the right wing of MacMahon's army was engaged with the enemy near Nouart. Late in the afternoon it broke away and slipped through the woods to Beaumont. The morale of the V Corps was low. The movement from Châlons with its orders, counterorders and wavering, its marches and its countermarches, aggravated by almost continuous harassing by the enemy cavalry, had told severely upon the troops. No rations or supplies had been issued for three days. The Corps had to march all night and the rear guard did not arrive at Beaumont until 5 a. m. on the 30th. The men were tired and hungry, and as no reconnaissance had been made they dropped to sleep where they halted. MacMahan arrived about 7 a. m. and insisted that not only the V Corps but also the whole Army put the Meuse between themselves and the

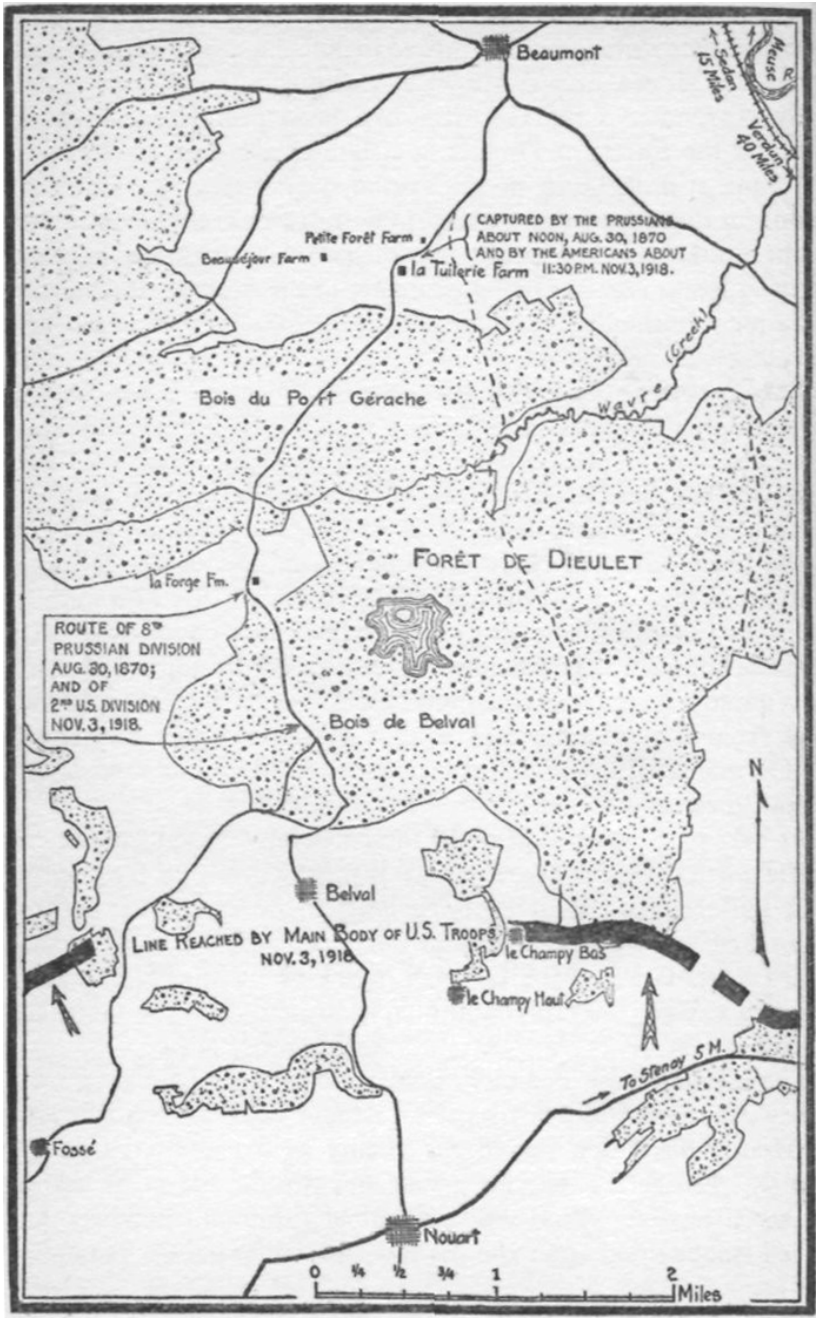
enemy with the least possible delay. Deeming the halt but a temporary one, and believing that the enemy had moved eastwards towards Stenay, the Corps commander did not judge it expedient to correct the manifestly dangerous situation of his troops. A few guards were posted along the hilltops to the south and in the north edge of the Forest where they could see nothing. As the morning advanced some of the men were still sleeping, others busied themselves with distributing rations and supplies, cleaning up, and grooming their horses. An atmosphere of listlessness and dejection lay upon the camp. It was a half hour past noon.

Suddenly a cannon barked. From the north edge of the forest a shell crashed into the camp, followed by salvo after salvo. The confusion was indescribable, the result inevitable. Hastily gathered units put up a brave resistance, but the dismembered Corps was scattered northwards over the hills, sharing with the rest of the unhappy army the coup de grace which was administered two days later at Sedan.

What had happened? Early on the morning of August 29 one of MacMahon's staff officers bearing orders for the disposition of the V Corps for August 30 had been captured by the enemy's cavalry. von Moltke took immediate advantage of this information; his Army of the Meuse, supported by his III Army pushed forward upon the unsuspecting prey, stimulated on the morning of the 30th by the report that the Army of Châlons was actually crossing the Meuse and might be caught off their guard. Unopposed, the 8th Prussian Division crept up the wood road from Nouart and Belval, and debouching from the north end of the forest seized la Tuilerie farm, the infantry deployed along the north edge of the woods and the batteries went into action just west of la Tuilerie farm; falling like a thunderbolt upon the astounded French they raised the curtain upon the last act of the tragedy of Sedan.

Half a century passes and Argonne is once more a battlefield. Foch's mortal blows are telling upon the enemy who is in full retreat.

On November 1, 1918 the American 1st Army, in a general assault broke through the last of the German organized defenses.


Beaumont
Meuse R.
Sedan 15 Miles
Verdun 40 Miles
CAPTURED BY THE PRUSSIANS ABOUT NOON, AUG. 30, 1870 AND BY THE AMERICANS ABOUT 11:30 P.M. NOV. 3, 1918.
Petite Forêt Farm
Beaudéjour Farm
la Tuilerie Farm
Bois du Petit Gérache
Wavre Creek
FORÊT DE DIEULET
la Forge Fm.
ROUTE OF 8TH PRUSSIAN DIVISION AUG. 30, 1870; AND OF 2ND U.S. DIVISION NOV. 3, 1918.
Bois de Belval
N
Belval
LINE REACHED BY MAIN BODY OF U.S. TROOPS NOV. 3, 1918
le Champy Bas
le Champy Haut
To Sivray 5 M.
Fossé
Nouart
0 ¼ ½ ¾ 1 2 Miles

Although the enemy made every effort to stem the advance so as to gain adequate time to permit him to make an orderly withdrawal across the Meuse, he was allowed to respite.

By November 3 the Germans had been pushed northwards as far as the Forest of Dieulet, and late that afternoon, following some stiff fighting in the region of Nouart, the German troops in that area were ordered to withdraw through the forest in the hope that they might be reorganized along the heights south of Beaumont. Owing probably to the heavy rain and the consequent difficulty of communications the withdrawal was not altogether completed.

The American 2nd Division saw its chance. That night, through pitch darkness and driving rain, a column marched out along that fateful road from Belval through the forest. In the lead was the 3rd Battalion of the 9th Infantry, marching in column of twos, with a detachment of German-speaking soldiers at the head. Behind came the other battalions of the 9th Infantry and the 23rd. This hazardous feat is worthy of an epic; the risks comparable to those of d'Ulloa's march through the sea to Schouwen. As the column progressed through the forest they quietly seized the occasional enemy sentries; through the trees from time to time they caught glimpses of the flashes of the German artillery which continued to fire into our lines from behind their backs.

At half past eleven that night the column came into the open on the north side of the forest and fell upon a group of the enemy at la Tuilerie farm, which they speedily made their own; before dawn they had deployed along the north edge of the woods, to the utter consternation of the German high command. Thus, after fifty years, were the tables completely turned upon the German Army.

The ultimate object of more than a month's hard fighting was now within reach of our troops—the main railroad from Sedan to Montmédy which served the enemy as a principal line of supply. His retreat became a rout and two days later he asked for the armistice which was granted at the moment when the Allied troops stood upon von Moltke's positions before Sedan.

THE DEVELOPMENT OF RESERVE FIELD ARTILLERY IN THE SIXTH CORPS AREA

By GEORGE G. SEAMAN, COLONEL, 567TH F. A. PRESIDENT, ILLINOIS STATE DEPARTMENT RESERVE OFFICERS' ASSOCIATION OF THE U. S.

DURING the winter and spring of 1927 and 1928 plans were laid for the first time to have a Reserve Brigade of Field Artillery go to training camp under command of its senior Reserve Officer who would be charged with the entire responsibility for its two weeks' training. This was done, and the 161st F. A. Brigade under the command of Colonel Judah, laid down and carried out a program of training so advanced that it ended with a most successful two-day Brigade Field Problem involving fire with service ammunition from all positions occupied in the various phases of the problem, which took place in almost continuous rain.*

Similar advances in the training of the other arms within the Corps Area were evidenced that year, and inactive training began to fall more into the hands of the unit commanders.

In 1929 the training of the Artillery by brigade was repeated, this time under the command of the author who had the experience of the preceding year and the highly valuable assistance of Major T. J. J. Christian, F.A., the Regular Army Senior Instructor, to help him, as well as the suggestions and keen interest of the new Corps Area Commander, Major General Frank Parker.

General Parker timed his visit of inspection to Camp McCoy so that he witnessed the second day of the two-day field problem of the Brigade. At the conclusion of the exercise he announced that during the inactive training period to come, he intended to develop a map problem which would involve the use of every unit of the Regular Army, the National Guard and Organized Reserves in the Corps Area and for that purpose to organize them into the Sixth Instructional Army.

In the same talk to the assembled officers he urged each and every one to become members of the Reserve Officers' Association, that they might better be able to express their ideas and

*This two-day Brigade problem is described in the November-December, 1928, issue of THE FIELD ARTILLERY JOURNAL.—EDITOR.

wishes. This repeated and strengthened what he had previously said in a letter to each commanding officer, with the request that the letter be read to all officers in training throughout the Corps Area.

During the winter the Sixth Army problem was developed and worked out at Corps Area Headquarters by the commanders and staffs of the Army, Corps, Divisions and Brigades of the Regular Army, National Guard and Organized Reserves of the three states of the Corps Area, viz: Illinois, Michigan and Wisconsin.

Generals Lassiter and Malone accomplished a very great deal to forward the training of Reserve Officers in every way. Both of them established more practical training standards and visited practically every chapter of the Reserve Officers' Association in the Corps Area. This greatly increased the interest of the Reserve Officers in their own organization. General Parker, by his development of this same line of thought to a type of training whereby every map problem, tactical exercise and field problem in both active and inactive training of the National Guard or Reserves, can be tied into and made a part of a problem involving all the units of the three components within the Corps Area, has developed the most interesting and instructive training that I have seen or heard of in our Army anywhere except during the war.

When training is interesting it is not difficult for a regimental commander to keep his regiment on its toes and his officers active. It also means additional membership in the ROA.

Since practically all reserve matters of a purely military nature within the Corps Area are under the sole and direct control of the Corps Area Commander, the development of an adequately trained group of Reserve Officers can be accomplished only if the General in command has a clear understanding not only of the purely military elements of the situation but also a sympathetic human understanding of the peculiar combined military and civilian status of the Reserve Officers, many of whom maintain their connections with the Army at a considerable sacrifice. Such understanding knowledge we have had from nearly all our Commanders in this Corps Area, but never

have the three state departments of the ROA, the various units of the Organized Reserve, the National Guard and the Regular Army been so closely in accord as they have since the organization of the Sixth Instructional Army by General Parker. In this Corps Area we now have what we have dreamed of in the Reserve for so long, a tangible, existing, functioning if skeletonized, peace time Army of which we are actually a participating part.

U. S. FIELD ARTILLERY ASSOCIATION

RESOLUTION ADOPTED UPON THE RETIREMENT OF MAJOR GENERAL FRED T. AUSTIN

WHEREAS, Major General Fred T. Austin has been president of the United States Field Artillery Association from December 17, 1927, to February 15, 1930, and during that period has evinced a most sincere interest in the United States Field Artillery Association and the FIELD ARTILLERY JOURNAL, and has devoted much of his time, care and thought to the welfare and progress of said association to the end that it might successfully accomplish its purpose as set forth in its constitution, and that the FIELD ARTILLERY JOURNAL might be a military magazine of recognized value;

WHEREAS, Major General Fred T. Austin, the second Chief of Field Artillery has, during the period of his incumbency, from December 20, 1927, to February 15, 1930, guided the policies and activities of our army in a most efficient manner;

WHEREAS, Major General Fred T. Austin has served with outstanding loyalty and distinction in the Field Artillery from its organization in 1907 until it became necessary for him to request to be retired from active service on account of physical disability;

WHEREAS, his many personal accomplishments, his sincerity, kindliness and fine judgment having endeared him to the members of the United States Field Artillery Association;

NOW, THEREFORE BE IT RESOLVED that the United States Field Artillery Association congratulate Major General Fred T. Austin upon the distinction and success he has attained in his military career;

BE IT FURTHER RESOLVED that these resolutions be spread upon the minutes of the United States Field Artillery Association and published in the FIELD ARTILLERY JOURNAL and that an engrossed copy of the same, signed by the officers and members of the executive council of the association, be furnished to Major General Fred T. Austin.

Washington, D. C.
May 13, 1930.

THE USE OF AIR PHOTOGRAPHS BY THE FIELD ARTILLERY

By LIEUTS. C. C. BLANCHARD AND E. L. SIBERT, DEPARTMENT OF GUNNERY, THE FIELD ARTILLERY SCHOOL

ALTHOUGH much has been written on the subject of aerial photography during the past few years, it is considered desirable to present briefly the characteristics of present day air photographs and their application to Field Artillery work.

GENERAL

Great strides have been made since the war in the development of cameras and equipment and in the means of taking picturs. Although experiments are still going forward and minor improvements may be expected in cameras and the quality and speed of pictures, the types of cameras used have been fairly well standardized. In general, the cameras are of two classes, the single lens as represented by the K-series, and the multiple lens, represented by the T-series. The type of pictures also falls into two general classes, the oblique in which the plane of the picture varies considerably from the horizontal, and the vertical in which the plane is as nearly horizontal as conditions permit. Examples are shown in Plates A, B, C and D.

OBLIQUES

The oblique photos are taken with cameras of the K type held or suspended over the side of an airplane. These pictures have a popular appeal and are of some value for intelligence work but have little significance to the Field Artillery.

THE SINGLE LENS VERTICAL

The vertical photograph made with the single lens camera is of more interest to the field artilleryman than the other types. Several terms are in use in connection with these pictures. A "pinpoint" is a single photo taken to include a certain designated area or point. A "strip" is a series of overlapping photos. Two or more strips whose sides overlap constitute a "mosaic." All the above may be taken with the same type camera, the difference in terms referring to the difference in missions.

To use these photos intelligently, several characteristics must be understood. From figure 1, it is evident that the scale of a photograph may be expressed by the formula: RF = $\frac{1}{L}$ = $\frac{\text{Focal length}}{\text{Height}}$ The angle of view which will give a clearly defined and undistorted picture is limited by the capabilities of a lens to about 50 degrees. Fom the figure or formula, we note that with the height remaining constant, as the focal length is increased, the scale of the picture is increased. The size of a camera which can be handled in an observation plane has led to the development for general purposes of the K-3 Camera, having a focal length of 12″ and taking a picture 7″ × 9″. For intelligence work where an increased scale is desirable, the K-4 Camera has been developed, having a focal length of 20″ and taking the same size picture as the K-3. With a particular camera, an increased altitude gives a smaller scale photo covering a larger area, these elements being limited by the ceiling of the service ships which is about 20,000 feet. As an example, at 20,000 feet, the scale of a K-3 photo becomes 1 foot (12″) /20,000 feet, or 1/20,000. The area covered is $\frac{(7\times20{,}000)}{36} \times \frac{(9\times20{,}000)}{36}$, or about 4000 yards × 5000 yards. Using the K-4 camera at the same altitude, the scale becomes 20″/(12×20,000)″, or 1/12,000. The area covered is $\frac{(7\times12{,}000)}{36} \times \frac{(9\times12{,}000)}{36}$, or about 2300 yards by 3000 yards.

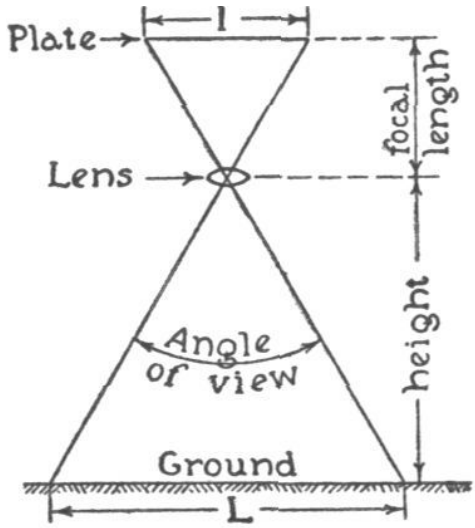


Figure 1

In case the camera is not verticle at the moment a picture is taken, the scale will not be uniform. In figure 2, an object near A will appear at a larger scale than a similar object near B,

since A is nearer the camera. Also, angles in the horizontal plane of AB will appear distorted. It is impossible to determine whether or not a picture is tilted but, fortunately, the tilt is small when the picture is taken from a good airplane with an experienced pilot, especially in the smooth air found at high altitudes, and so produces errors which are negligible for our work. Errors introduced by distortion of shutter, imperfection of the lens, and similar causes are small and may be ignored.

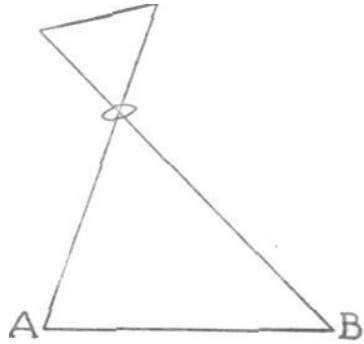


Figure 2

The relief of the terrain, however, introduces errors which must always be considered. In figure 3, the point A which is above the horizontal plane through the center of

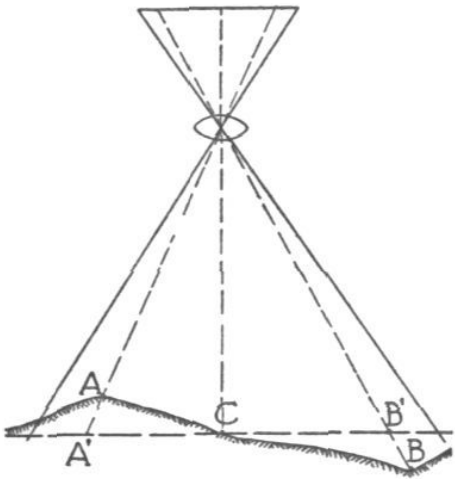


Figure 3

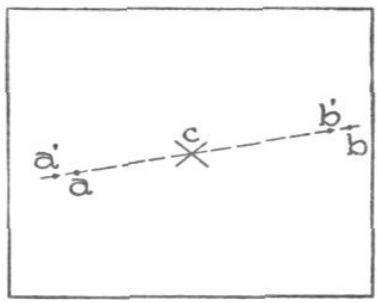


Figure 4

the picture appears farther from the center than it would if it were on the same level. Similarly, B appears nearer the center point than it should. These displacements are the result of *distortion due to relief*. Considering figure 3 as any vertical section through the axis of the lens, we see that all these displacements due to

relief are radially away from or towards the center as shown in figure 4. The amount of displacement of a point varies directly with the amount the point is above or below the horizontal plane through the center and with the distance from the center. When the amount of displacement and the distance from center are known, the difference in altitude may be computed.

COMPOSITE PHOTOGRAPHS

The composite photograph is a development primarily for mapping purposes. A T-series camera with which they are made, is really a battery of cameras, making one vertical and two or more obliques. The obliques are printed through a transformer at such an angle that the resultant prints are on the same plane as the vertical. The prints are then trimmed, assembled, and mounted on a piece of cardboard. The great value of the composite photographs lies in the large area covered.

AIR PHOTO MAPPING

Though mapping by air photography is not an artillery function, it is interesting to us in that it gives us an assurance hitherto impossible, that we will nearly always have maps of at least horizontal control. A few words explaining what is accomplished and how, should be of interest, for some of the methods can be used in our work.

With the T-2 camera, a four lens affair using a 6.5″ lens, we can get at an altitude of 10,833 feet a photograph whose RF=1/20,000. Suppose an advance into an inadequately mapped country is projected. Once the route and the width and depth of the advance is decided upon, the Air Corps may send its photographic planes to take overlapping strips of T-2 pictures of the area. (See figure 5.) These would be taken so that each successive picture overlapped its neighbor about

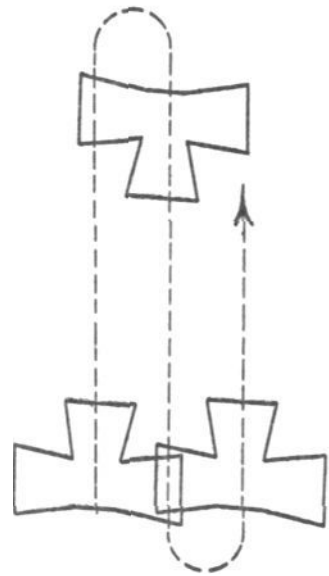


Figure 5

60% and so that the lanes or strips overlapped each other at least 40%.

Assume an advance of 200 miles on a 10-mile front. Three lanes would be flown and the 2000 square miles of territory photographed in about six hours. Additional lanes, made across the area, are usually taken. These pictures would be developed and printed in 18 hours and turned over to the Engineers for map making. It is believed that the work of producing a map showing all features except contours and elevations, can be done for an area of this size in about three days. This means that once an area is decided upon, four days later the troops may be furnished maps thereof, provided of course that good photographic weather prevails at the proper time and that the enemy is unable to interfere.

Given a strip of overlapping pictures, the Engineers map the area by carrying forward a primary triangulation system and later filling in the details.

A method of carrying forward a picture traverse is given below. In practice, the work is somewhat more complicated than appears here. To get an accurate scale and orientation, a surveyed base line, A-B, must appear in the first three pictures.

The procedure is as follows. Mark and label on the first photograph its center, C1, the center of the second picture, C2, and the ends of the base line, a1 and b1. Draw radial lines from C1 to the other points. Place the picture under a celluloid sheet and trace the data as shown in Figure 6. On the second picture, locate and label C1, C2, C3, a2, and b2, and draw radial lines from C2 to the remaining points. Now place the second picture under the celuloid so that C1-C2 on the picture coincides with C1-C2 on the sheet. Some adjustment may be necessary in case the length of the line C1-C2 on the second picture differs from that of the first picture. (Described later in the discussion of strip mosaics.) Trace the lines C2-a2 and C2-b2, thus locating A and B by intersection. Label the position of C2. Trace the line C2-C3 for the orientation of the next picture. The scale of the celluloid projection has been fixed as we now have four points located thereon. (See Figure 7). On the third picture draw the radial lines C3-C2, C3-a3, and C3-b3. Place the picture

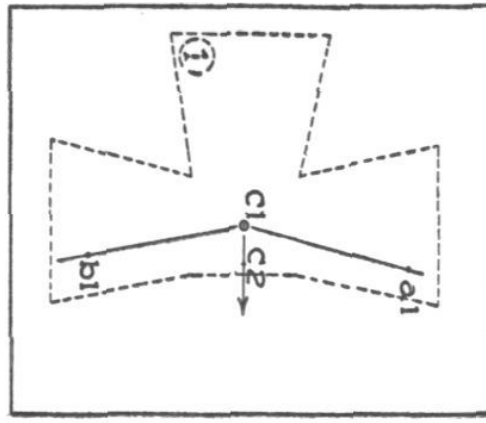


Figure 6

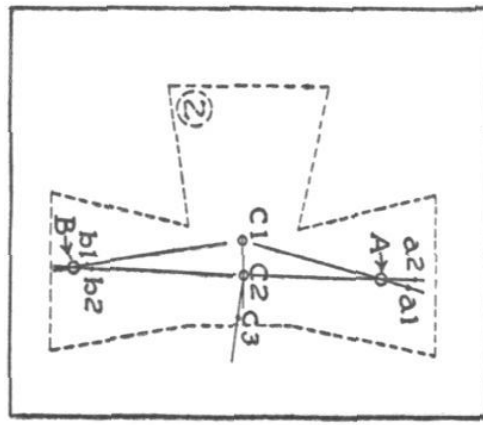


Figure 7

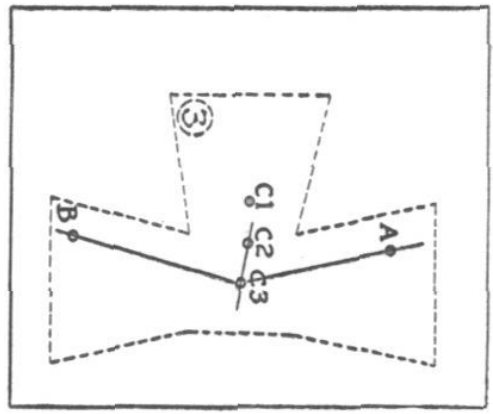


Figure 8

under the celluloid so that these lines pass through the points C2, A, and B, respectively. Mark the location of C3, as shown in figure 8. Additional control points for the orientation of succeeding pictures are located in the same manner as A and B were located and the traverse is carried forward to the end of the series.

Details are filled in by adjusting individual photographs under the projection sheet and tracing small areas at a time. The resultant map must now be reproduced to some convenient scale such as 1/20,000.

The map cannot however show contours without a long and tedious process of computation based on the amount of distortion due to relief, but even so, without contours it is very much better than no map, and when used in conjunction with air photographs and the artillerymen's method of computation of angle of site, allows a fair preparation of fire.

USE OF SINGLE VERTICAL PHOTOGRAPHS FOR PREPARATION OF FIRE

First let us consider this question with the assumption that we have a regular contoured fire control map. In a situation of this sort, the function of the photograph will be to detect the location of enemy installations which we want to neutralize or destroy. In this work the examiner of the photograph will be aided by reports from other sources such as sound ranging, balloon observers, etc. Having found at or near the center of a photograph, an enemy battery for instance, our next step would be to transfer it onto the map. (See note.) This may be done in many cases simply by eye, by spotting a point on the map which bears the same relation to a group of points that the target does to the corresponding points on the photograph. Very often, however, we cannot do this with accuracy and must use what most artillerymen know as the tracing paper method. The first step is to identify on the photograph 3, 4, or preferably 5 points that appear on the map. Designate them a, b, c, etc., on the photo and a', b', c', etc., on the map. Tack the photograph over a piece of tracing paper and with a needle, prick through the target

NOTE: Photographs of large scale will be taken in strips with 60% or more overlap between successive pictures and 40% or 50% overlap between strips for mosaic making and general intelligence work. We can therefore find a photograph that will show any given particular point near the center.

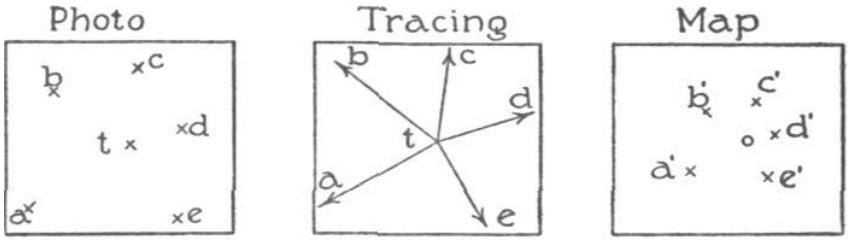


Figure 9

(t) and the control points selected. Take out the tracing paper and mark the pin pricks to correspond to the control points. Mark the target t. Draw ta, tb, tc, etc. Place the tracing paper over the map and manipulate it until the rays ta, tb, tc, etc., pass through a', b', c', etc. Prick through the point t onto the map and accept it as the best available map location of the target. In case a solution cannot be found for the five points it indicates that one of the points is in error. If four rays match correctly, the ray in error is discovered and discarded. For best results, the target should be near the center of the photograph because as has been discussed, distortion due to relief is radially from or toward the center of a photograph; consequently the angles from the center of a photograph to various points thereon, remain true regardless of distortion.

For the detection of targets we often need photographs of large scale, say 1/5,000. This means a 12″ lens at an altitude of 5000′. The area shown will consequently be small. In open country, this area may not afford sufficient control points and it may be desirable to have in addition a smaller scale (larger area) photograph of the same objective taken at 10,000′ or 15,000′. Having found the target on the large scale (1/5,000) photograph, it would be spotted by eye on the 1/10,000 or 1/15,000 photograph and then transferred to the map by the tracing paper method. In making a tracing paper transfer, one must bear in mind the necessity of selecting control points that common sense would indicate as having been accurately located on the map. Also the rays ta, tb, tc, etc., should make good intersections with each other and a, b, c, etc., should not be on the circumference of a circle that might be passed through t.

IN CASE WE HAVE NO MAP

Sometimes we may be fortunate enough to have a T-1 or T-2 composite vertical photograph upon which appears or may be located both our battery position and an enemy target. In which case our problem becomes one of the determination of a K $\frac{\text{(adjusted gun range)}}{\text{photograph range}}$ by registration on some check point shown on the photograph, and in addition we must estimate the angle of site by means of what we can see on the photograph (drainage skeleton, ground forms, etc.,) and from what we can see on the terrain near the probable location of the target.

Usually, however, when we have no map, the best substitute available for the preparation of fire upon concealed targets, is the single vertical photograph of the target area. The method of preparing fire upon such targets is described in the new T.R. 430-85 under Transfers of Fire. The photograph to be most useful should be scaled and oriented by the Air Corps. To do this, they use a sensitive altimeter and an earth inductor compass.

The hard part of the problem is the finding of a suitable check point, that is, a point on the photograph that is visible from an available O.P. An artillery organization having a balloon at its disposal may find it a great help for this purpose.

WITH A FIRING CHART

In the absence of a map, the artillery often builds up a firing chart upon which are eventually located various terrain features within the enemy lines (base points, check points, etc.) In such cases, air photographs may often be used exactly as with a map.

SIMPLE STRIP MOSAICS

A new and, it is believed, a very useful development in this field is the rapid strip mosaic for artillery. An artillery organization goes into position in an unmapped area. The Air Corps knowing where they are and their sector, takes a series or strip of photographs of the sector with a 60% overlap. If more than one strip (or series) is necessary, it is taken and handled subsequently without regard to the other strip.

The photographs having been developed and printed, they are rapidly made into a simple strip mosaic as follows: Suppose

there are six pictures (scale about 1/15,000) to be tied together. Spot on each picture its center and the center of its neighboring pictures, *i.e.,* its predecessor (after the first) and its successor. If a spot at the center cannot be picked up, we take one within a quarter of an inch of the center. Select a piece of cardboard large enough to hold the strip and tack down the first picture. Draw on the first picture, a ray from its center to the center of the second picture as shown in the first picture. This ray is produced beyond the limits of the first picture onto the cardboard about 6″ and marked C. Draw on the second the same ray (C1 and C2) across the entire photograph. If C1 and C2 are of the same height we can by means of a needle through C1 on picture No. 2 place the second picture in its proper relative position with respect to the first. See Figure 10. The orientation is kept true by making ray No. 2 fall along No. 1 with C1 in No. 2 directly over C1 in No. 1. In case C1 and C2 are not at the same altitude, the difference between C1-C2 in No. 1 and in No. 2 is twice the displacement due to relief. This may be adjusted as we go along in order to keep the scale uniform. To do this proceed as follows: Find the difference in the length between the two rays discussed above, and place C1 in No. 2 one half the amount away from C1 in No. 1, but always along the ray C1-C2.

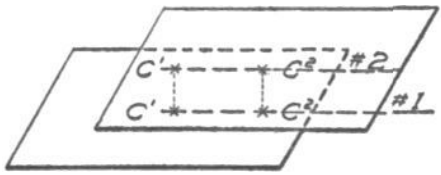


Figure 10

Another simple methods of keeping the scale uniform is to determine with a pair of compasses the center of C1-C2 in No. 1 and in No. 2 and superimpose these centers. The orientation is kept true as before. M2 should be placed over M1 and ray No. 2 made to fall along ray No. 1.

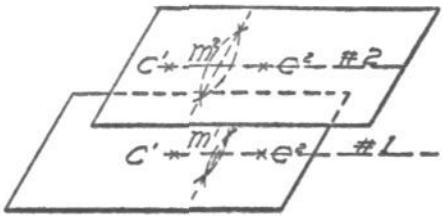


Figure 11

After the entire strip has been assembled by this method, we trim off all but the center half of each photograph so that the finished product is composed of a series of centers of photographs thereby eliminating as much relief distortion as possible. We do not trim the sides.

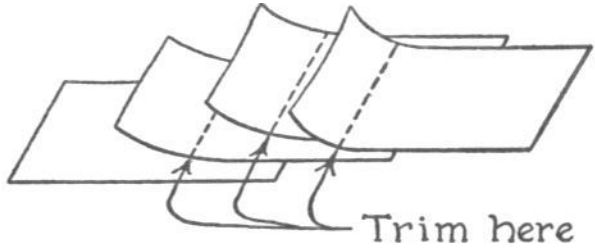


Figure 12

The resultant mosaic is copied and delivered in quantity to the artillery. The artillery use it exactly as a map in making transfers, etc. A deflection correction, DE, is important as well as a K.

GRIDDING PHOTOGRAPHS OR MOSAICS

Where copies of a photograph or a mosaic are being used in lieu of a map by an artillery organization such as a battalion, or by an airplane observer working with an artillery unit, it is highly desirable to have a grid on them. Assignment of missions or designation of targets by telephone or radio is almost impossible otherwise.

We will assume that we have a strip mosaic as shown in figure 13. In order to grid it, we must be able to determine the co-ordinates of at least two points, well separated, on the strip. This can be done from a control sheet or from the survey work which has been done by the unit. Mark the two points A and B. Draw through A a line making a convenient angle with AB. Lay a convenient

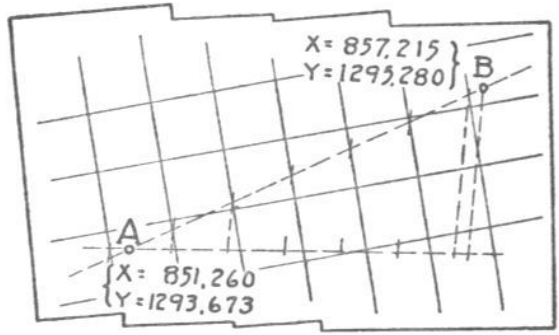


Figure 13

scale along this line so 1260 is at A. Mark the even 1000 divisions and 7215. Join 7215 of this line to B and divide AB proportionately. P and P' will be points where Y-lines cross AB. Similarly, find points where X-lines cross AB. Compute the Y-azimuth of AB. Using a protractor and straight edge, we can now complete a grid. The strip mosaic can now be photographed and a number of copies made in a few hours.

QUICK WORK PHOTOGRAPHY

At the present time, negatives may be developed in the airplane. With improved equipment, eventually prints will be made in the airplane. This work can be done in a few minutes and the film or print dropped directly to the artillery panel station. At present, the negative is dropped to the artillery panel station and printed in a dark-room vehicle on the ground. The entire process from time of exposure to delivery of a dry print to the artillery intelligence officer does not take over 15 or 20 minutes. These pictures may be used for all the purposes enumerated above except air photo mapping. T-type pictures cannot be done "quick work."

Photographs may also be taken on the darkest night by means of a flashlight bomb and a special device for synchronizing the flash and the opening the camera shutter. These night pictures may be developed by the quick work process as mentioned above. The area covered is small due to the great size of bomb necessary at higher altitudes. At present we cannot expect to get night pictures at much over 3000 feet. Using a 12″ lens this gives us an area of (3000×7×12)″ by (3000×9×12)″, or a little less than 600×800 yards. This means that the pilot must exercise great care to get the area desired. Ground cooperation in this matter is useful. For example suppose we suspect enemy activity at a certain crossroads after dark. We have a map. We mark the crossroads in question.

We place a distinctive light at A (Figure 14) within our lines and go back along the line CR—A a distance equal to CR—A and find the point B. Place a distinctive light there. This gives the pilot a means of spotting CR in absolute darkness and taking a picture thereof. To do this he flies BA and notes the time

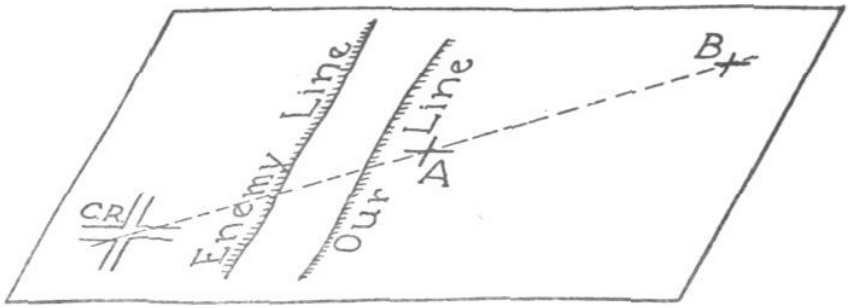
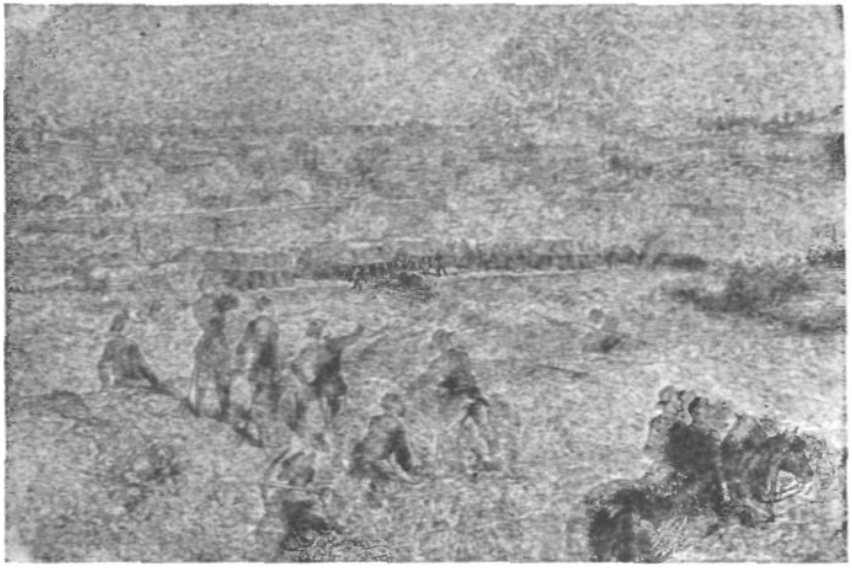


Figure 14

required. Now he can compute the moment he should drop his bomb so it will explode when he is directly above CR.

Much of this subject is still under process of development and though we cannot hope for pictures of greater area, we can hope for quicker and clearer pictures taken day or night.

If the Air Corps is smart enough to take them, it certainly behooves us artillerymen to know how to use them.



THE ATTACK AT PETERSBURG

EXAMPLES OF AIR PHOTOGRAPHS: PLATES A, B, C, D, and E (OVER)

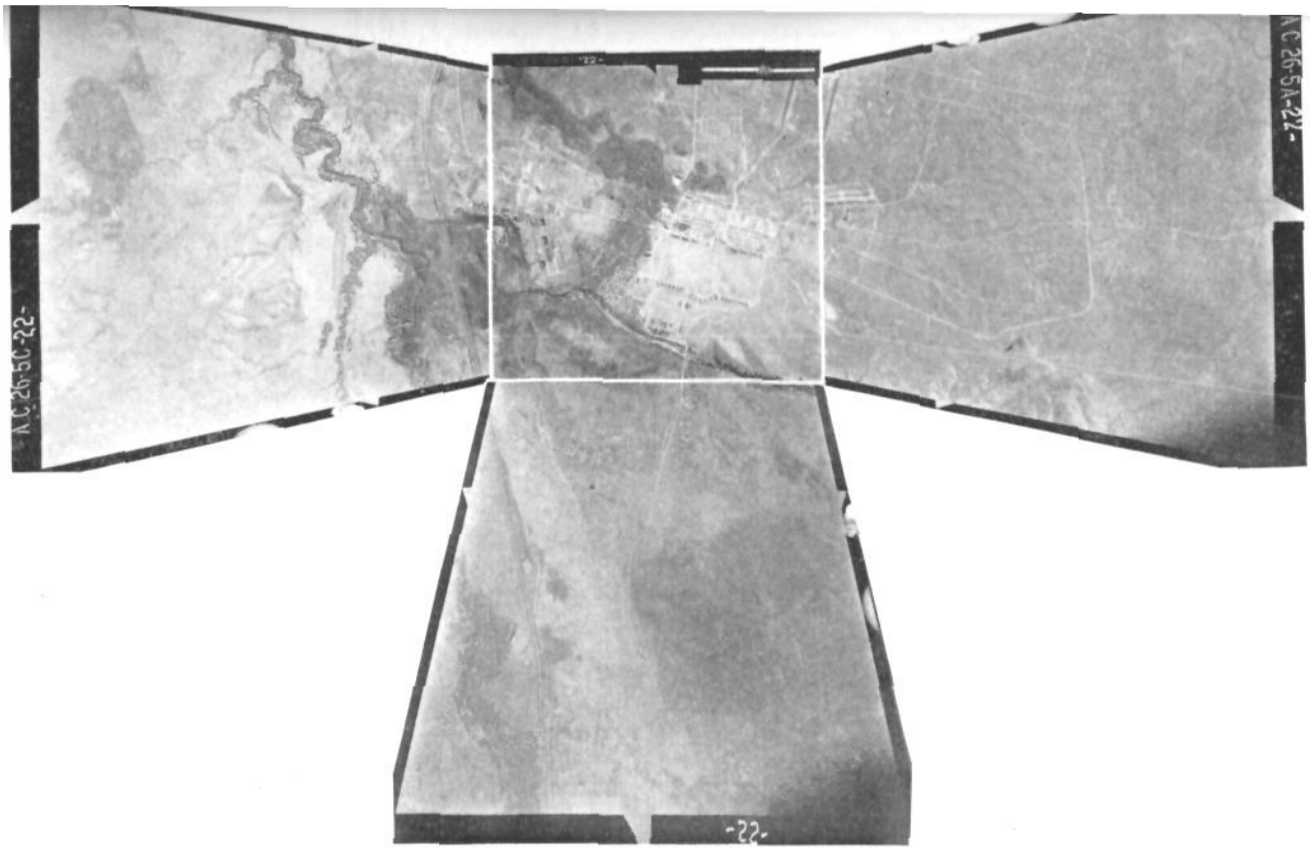


PLATE E. PHOTO FROM T-2 CAMERA COMPOSITE (SEE PAGE 653) FOCAL LENGTH OF CENTRAL LENSE: 6.5″; ALTITUDE 10,000 FEET SCALE OF ORIGINAL COMPOSITE PHOTO: 1/18,400. NOTE: ABOVE IS ABOUT 1/3 THE SIZE OF ORIGINAL PHOTO. WIDTH OF AREA: 11,000 YARDS; LENGTH OF AREA: 7,000 YARDS.

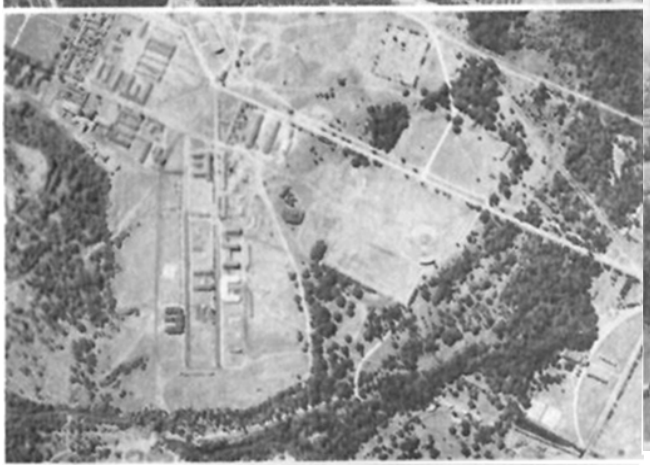


PLATE A (UPPER) K-3 CAMERA, VERTICAL: FOCAL LENGTH: 12″, ALTITUDE: 10,000 FEET; SCALE 1/10,000; AREA COVERED: 2,00 X 2,500 YARDS . PLATE B (LOWER) K-4 CAMERA VERTICAL FOCAL.

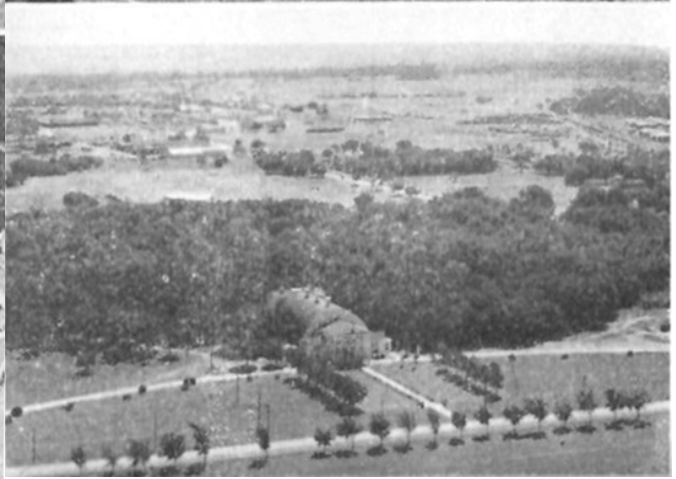


PLATE C (UPPER) K-3 CAMERA OBLIQUE: FOCAL LENGTH : 12”; ALTITUDE: 1,000 FEET. PLATE (LOWER) K-4 CAMERA OBLIQUE FOCAL LENGTH.

75 MM GUN MOUNT, T3, ON 6-WHEEL TRUCK MOUNT

By MAJOR G. B. BARNES, ORDNANCE DEPARTMENT

IN the May-June (1930) issue of this journal, the writer described at some length a new type of weapon for the Field Artillery, which had the following general characteristics: a 75 mm. gun with a maximum range of 15,000 yards, mounted on a universal type of carriage which could be trailed behind a prime mover at high speeds on good roads or across country. The carriage mounted dual wheels with balloon tires, roller bearings at the hubs, and semi-elliptic spring suspension, and was so designed that the gun could be placed in two firing positions.

In the first position, the carriage was similar to the split-trail type, the wheels being in place. Two outriggers were placed under the carriage to protect the springs, axle, and roller bearings from the firing load. The gun could be elevated between 0 degrees and 80 degrees and could be traversed 90 degrees. In the second firing position, the bogie was removed and the carriage lowered to the ground: the two additional outriggers being in this case attached to the carriage pedestal. In this position the gun could be traversed 360 degrees and elevated from 0 degrees to 80 degrees. When in either the first or second firing position, the gun trunnions could be cross-leveled plus or minus 6 degrees. This feature of cross-leveling not only greatly simplifies the on-carriage fire control instruments, but insures easy traversing of the gun even though the carriage proper is considerably out of level.

As stated in the above mentioned article, it is also possible to transport this gun and mount on a suitable prime mover by removing the bogie and all outriggers. A small crane built into the truck frame is used for raising and lowering the gun and mount.

It is the purpose of this article to illustrate and explain this last mentioned method of transporting the gun and carriage in more detail and to also add a description of an additional method of firing this same gun, which has been devised since the first article was written.

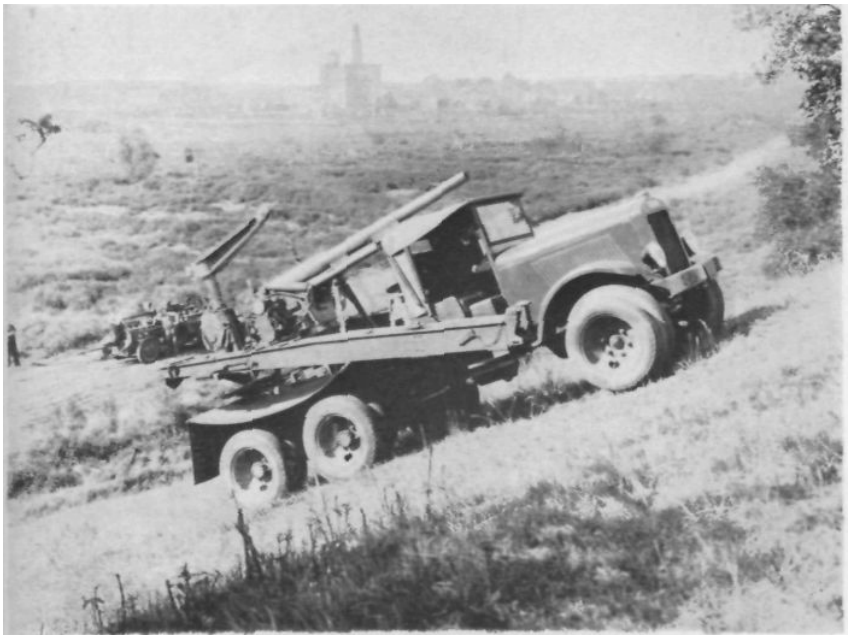


FIGURE 1: T-3 IN TRAVELLING POSITION NEAR WATERTOWN, MASS.

Figure 1 shows the 75 mm. T3 Upiversal Gun and Mount carried on a 6-wheel truck, of a commercial type, which was selected as a prime mover for this type of gun carriage. This truck, which weighs 7500 lbs. without the gun or crane, has a powerful commercial truck engine which will develop about 85 h.p. In a 6-wheel truck of this type, both of the rear axles are driven. Dual bus balloon tires are mounted on all three axles so that when going across country the load is supported on twelve pneumatic tires. In this way the pressure per square inch on the ground is very low, about 5 lbs. per square inch, insuring great cross-country mobility. The transmission provides eight speeds, giving sufficient reduction to insure hill-climbing ability. Grades as steep as 35 degrees can be negotiated with the gun and carriage in place on the truck. On level ground the truck carrying the gun and mount can travel at speeds up to 45 miles per hour. A small crane made of duralumin, for lightness, has been built into the end of the truck. This has sufficient capacity for lifting the gun and mount from the truck and lowering it on to the ground, or vice-versa. A special mechanism is also

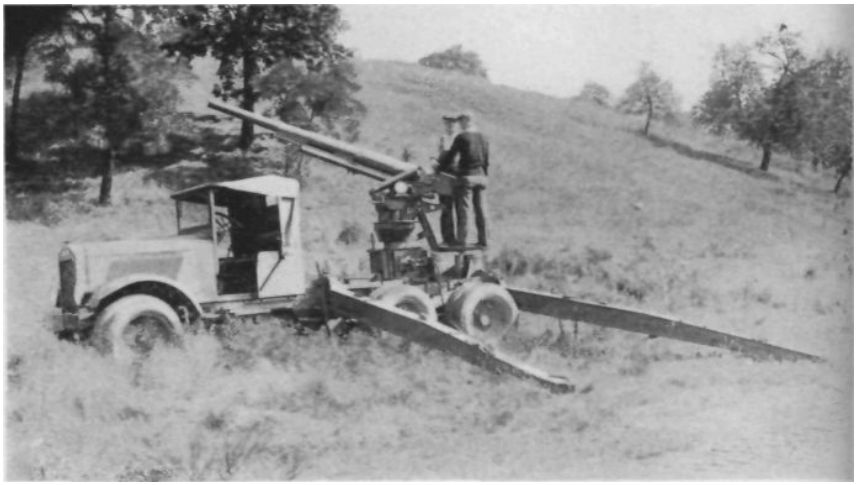


FIGURE 2: T-3 READY TO BE FIRED FROM TRUCK (360° TRAVERSE, 80° ELEVATION)

provided for securely clamping the mount to the truck when traveling. This mechanism is, however, so designed that the gun mount can be quickly unlocked from the truck frame and lifted or lowered by the crane. It is thus possible to remove the gun mount from the truck and place it on the ground in the firing position in which the gun can be fired throughout 360 degrees traverse and at any elevation between 0 degrees and 80 degrees elevation.* By using the crane, the gun and mount can also be raised from the firing position and returned to this position on the truck.

In this connection it might be stated that the parts for holding the mount to the truck and the crane, are secured to the truck frame by bolts. In case of accident to the truck motor or any other part of the truck, these parts could be removed and placed on another similar truck, the main restriction being that the truck frames have similar dimensions. A battery equipped with guns and mounts of this type would have trucks for carrying ammunition, supplies, and fire control instruments. The frames of these trucks could all be built to the same dimensions in order that any truck could be used for transporting the gun and mount by bolting the above mentioned parts to the truck frame.

*See illustrations, pages 242 and 245. THE FIELD ARTILLERY JOURNAL, May-June, 1930.

The new feature, which has been added to this all-purpose weapon, is that of firing the gun directly from the truck as shown in Figure 2. The four outriggers pertaining to this mount are, in this case, attached to the truck body. Four screw jacks bolted to the truck frame are also provided to protect the truck spring suspension and tires from the firing load. These jacks, which carry floats at the lower ends, should be screwed down tight against the ground in order to transfer the weight of the truck and mount from the truck wheels to the jack floats. The design permits the gun to be fired from the truck throughout 360 degrees of traverse and at all elevations between 0 degrees and 80 degrees. The crane can be dismantled and removed from the truck in about five minutes so as not to interfere with the gun when traversed in positions parallel to the truck body.

To recapitulate, the 75 mm. T3 Mount can be transported as follows:

(*a*) Trailed on its own wheels behind a prime mover.

(*b*) Carried on the prime mover. The bogie in this case being discarded altogether, or, if desired, trailed behind the prime mover.

It can be placed in the following firing positions:

(*a*) With wheels in place, trails opened like a split-trail carriage. In this position the gun can be traversed 90 degrees and elevated between 0 and 80 degrees and cross-leveled plus or minus 6 degrees.*

(*b*) The bogie removed and the mount lowered to the ground using the two outriggers as levers, and later attaching them to the pedestal as outriggers. In this position the gun can be traversed throughout 360 degrees and elevated between 0 degrees and 80 degrees and cross-leveled plus or minus 6 degrees.

(*c*) The gun and mount can be carried on the truck and removed from the truck using a small crane and placed in the same firing position as described in (b) above. (See Figure 3).

(*d*) The gun can be fired directly from the truck using the same out-riggers, which are in this case attached to the truck to give it the necessary stability. In this position the gun can be

*See illustrations opposite page 239 and on page 241. THE FIELD ARTILLERY JOURNAL, May-June, 1930.

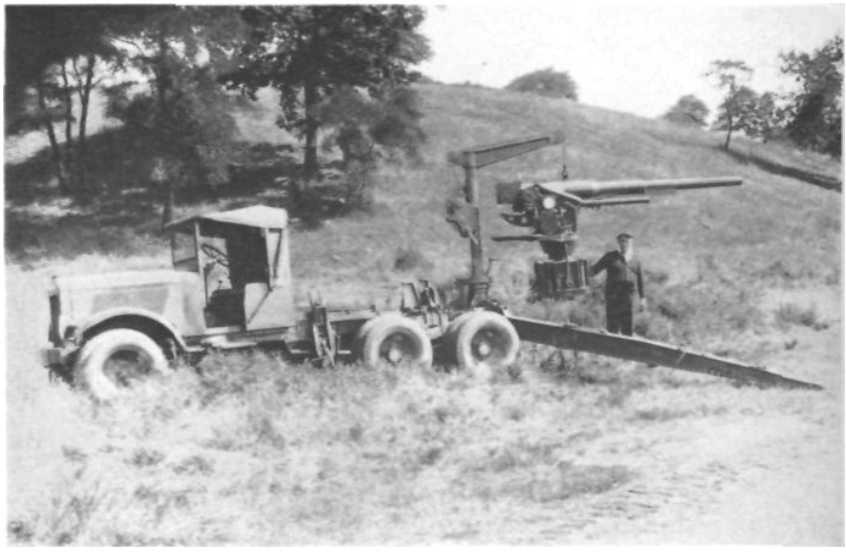


FIGURE 3. GOING INTO FIRING POSITION ON THE GROUND

traversed 360 degrees and elevated from 0 degrees to plus 80 degrees, cross-leveling plus or minus 6 degrees. (See Figure 2.)

In all of the four firing positions the gun is completely stable at all angles of elevation and traverse. There is no tendency of the gun carriage to lift from the ground, and the gun is not thrown out of level by the firing. The elevating and traversing mechanisms, which have been applied to this carriage, are designed so as to permit the gun to be continuously trained with great accuracy upon swiftly moving targets. In short, the weapon, in addition to its use for strictly division artillery missions, is also an ideal anti-tank and antiaircraft weapon.

I have outlined above the outstanding capabilities of this new division weapon. In the previous article, the writer discussed at some length the fire control apparatus which should be used with this new weapon, in order to realize its capability as an antitank and antiaircraft gun.

Will the officers of the Field Artillery now work out the tactical uses to which this new high-powered mobile weapon can be put? Would you not like to have artillery, with these characteristics, in your battery, regiment or division, in the next war?

WAR DEPARTMENT GENERAL MOBILIZATION PLAN

FIELD ARTILLERY

AUGUST, 1930

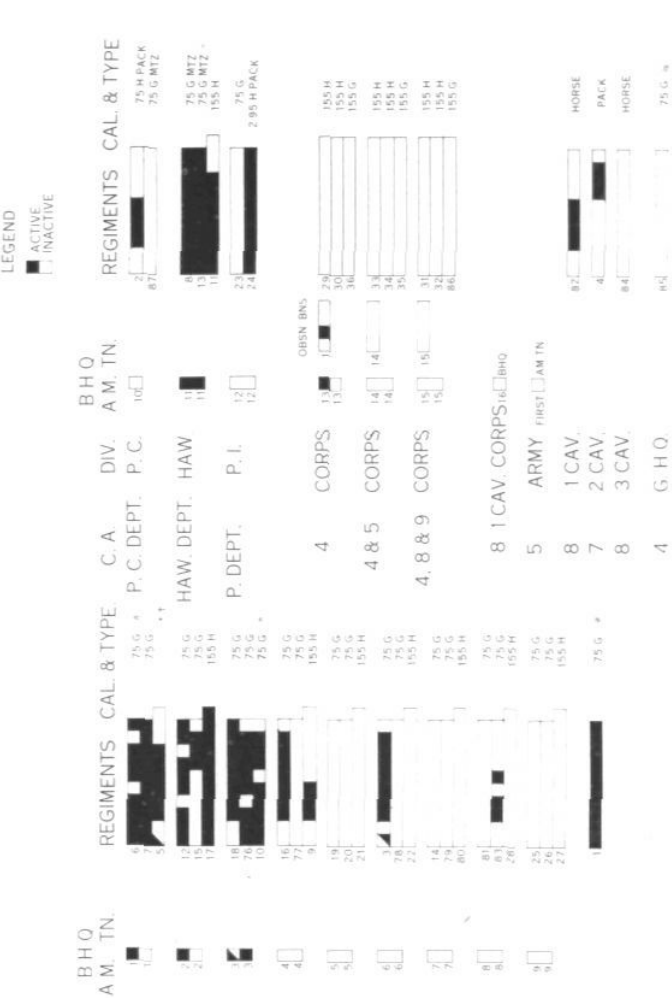
Units		DIVISION				CORPS					ARMY			GENERAL HEADQUARTERS RESERVE							
		Brig Hq	Am Tns	Regiments		Brig Hq	Obsn Bns	Am Tns	Regiments		Brig Hq	Am Tns	Regiments	Brig Hq	Obsn Bns	Regiments					
				75 G	155 H				155 H	155 G			75 G Horse			75 G TD	75 G Port	155 G	240 H	6 G	TM
4th Period	O R	9	9	18	9	3	3	3	6	3		1	2	3	1	3	3	2	2	1	1
	O R	9	9	18	9	3	3	3	6	3		1	2	3	1	3	3	2	2	1	
2d Period	O R	9	9	18	9	3	3	3	6	3		1	2	3	1	3	3	2	2	1	
1st Period	O R				2	6	6	6	10	4		2		9	3	5	7	6	6	3	
	N G	18	18	36	16				2	2			4			3	2				
	R A	9	9	19 *	9	3	3	2	6	3	1 (Cav Corps)	1	3 (1 Pack)			1					
	(Total)	54	54	109 *	54	18	18	18	36	18	1	6	13	18	6	18	18	12	12	6	1
	R A (Overseas)	3	2	6 **	1																
	(Total)	57	56	115	55																
	R A Extra bns			Bns 18	Bns 6																

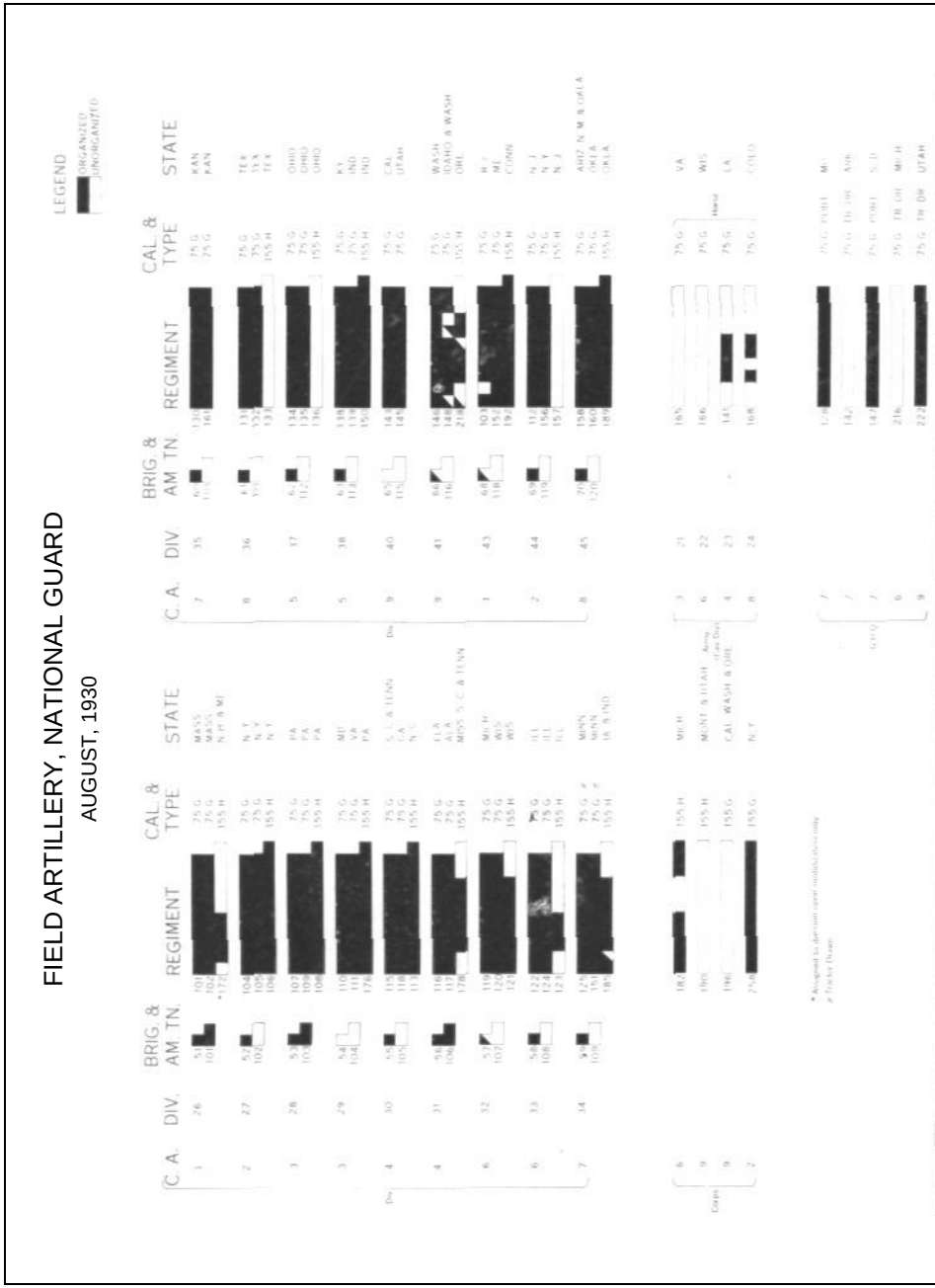
* Includes one School Regiment unassigned.

** Includes one 75 G Regiment, three 75 G Regiments, Mtz one 75 H Regiment, Pack, and one 2.95 H Regiment, Pack.

FIELD ARTILLERY, REGULAR ARMY

AUGUST, 1930




FIELD ARTILLERY, NATIONAL GUARD
AUGUST, 1930
LEGEND
ORGANIZED
UNORGANIZED
C. A.
DIV.
BRIG. & AM. TN.
REGIMENT
CAL. & TYPE
STATE
C. A.
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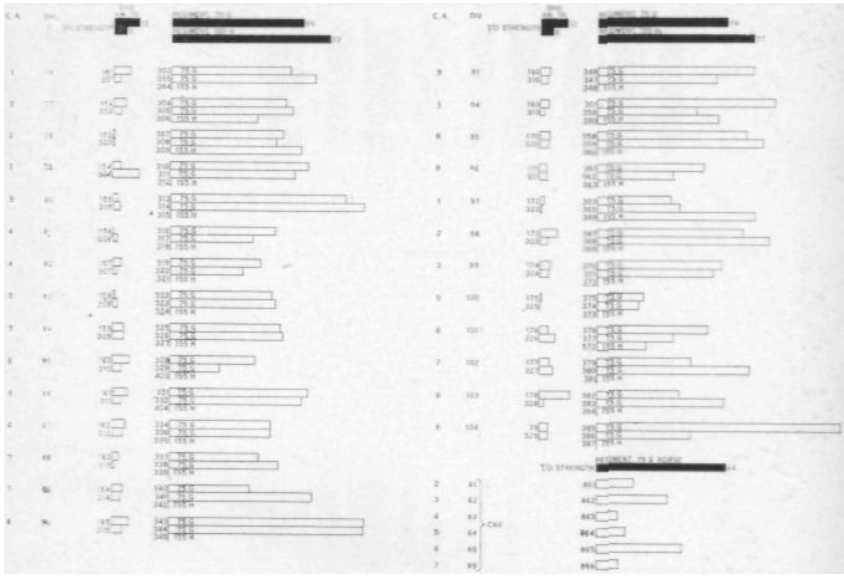
STATE

FIELD ARTILLERY, ORGANIZED RESERVES
DIVISIONAL UNITS
AS OF MAY, 1930

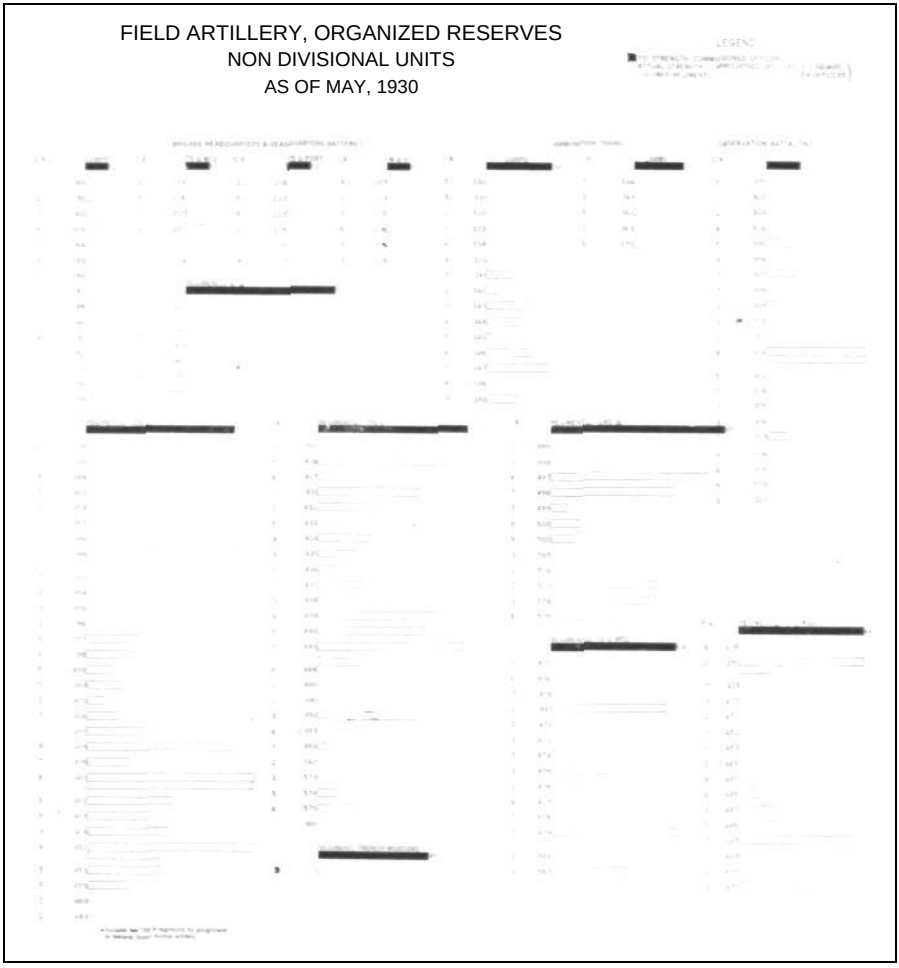


NOTE:

THE COMMISSIONED STRENGTHS OF ORGANIZED RESERVE UNITS ARE THOSE REPORTED BY CORPS AREA COMMANDERS TO THE ADJUTANT GENERAL AS OF JUNE 30, 1929, WITH ASSIGNMENTS OF UNITS CORRECTED UP TO MAY, 1930 AT FORT MYER FUNERAL CAISSON

CHART

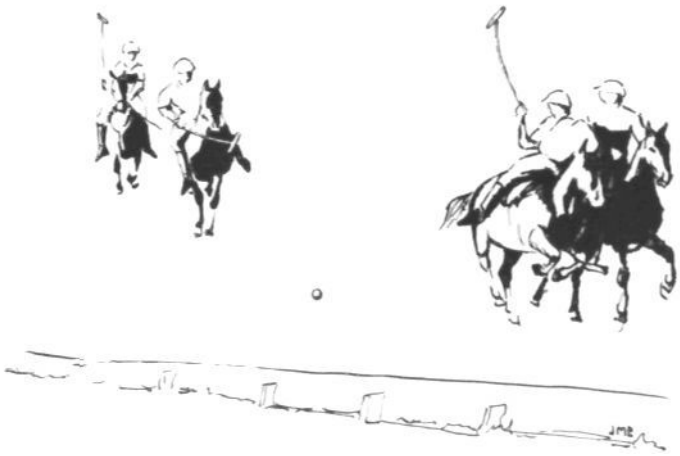
FIELD ARTILLERY, ORGANIZED RESERVES
NON DIVISIONAL UNITS
AS OF MAY, 1930

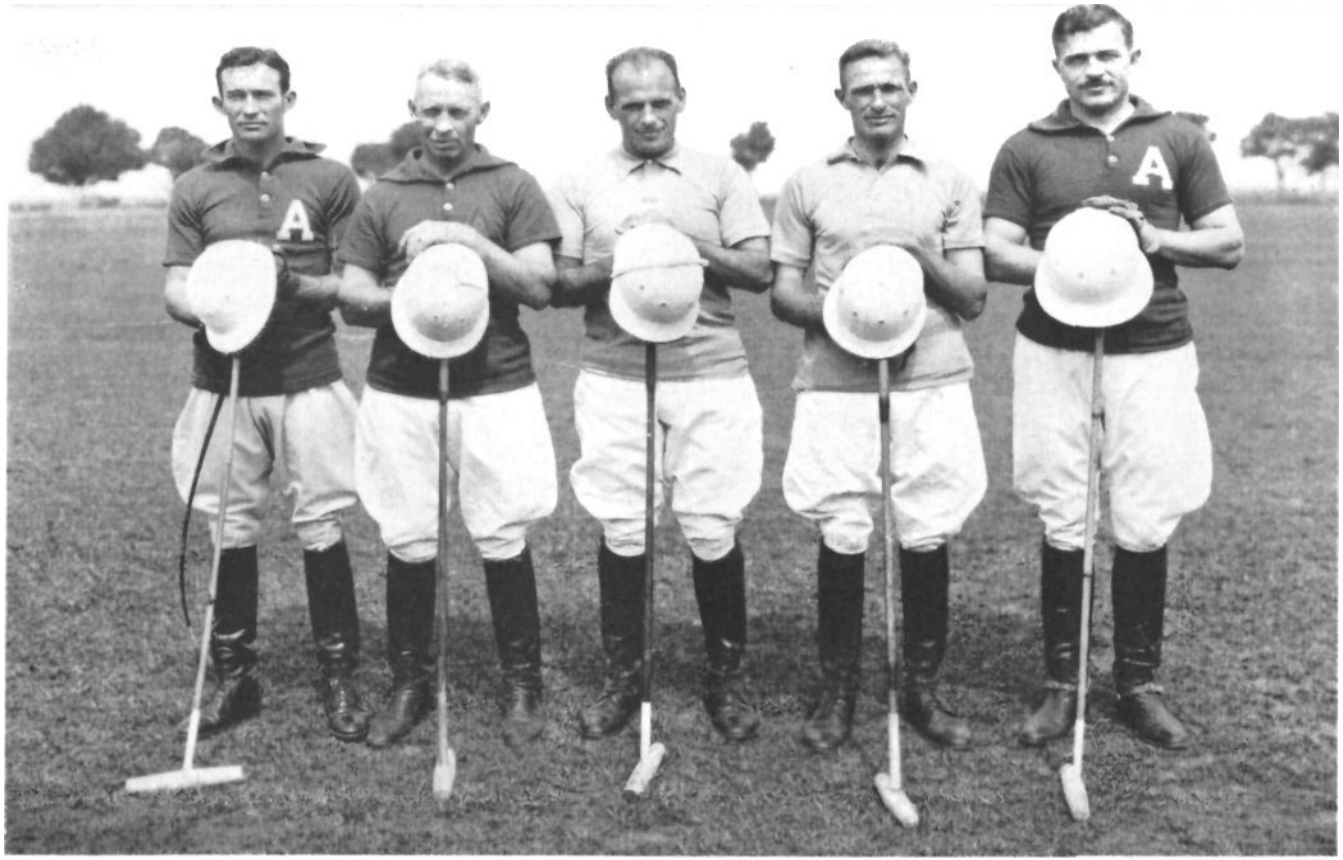


POLO

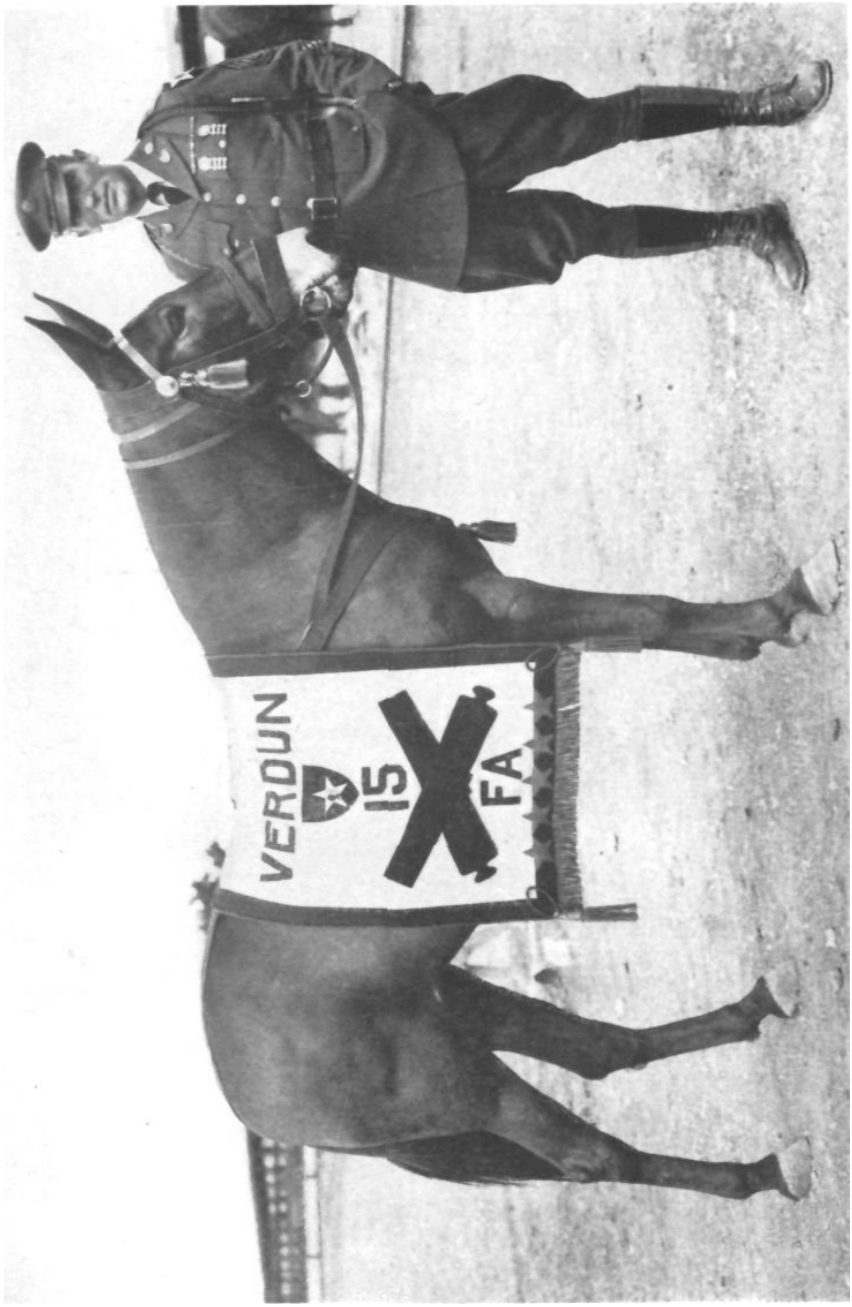
After winning the Junior Championship in July at Rumson, New Jersey, the Army Polo Team set sail for the Argentine to strive for international honors. It arrived in Buenos Aires on September 30, where it will participate in the international polo tournament, mounted on ponies furnished by the Argentines.

1930 has been a very successful year for army polo. In addition to winning the Junior Championship, Army teams won five of the nine circuit championships, namely the Southeastern, the Southern, the Rocky Mountain, the Southwestern and the Northwestern.





THE ARMY POLO TEAM REPRESENTING THE UNITED STATES IN ARGENTINA—LEFT TO RIGHT: LT. M. McD. JONES, CAV., CAPT. C. A. WILKINSON, CAV., CAPT. P. P. RODES, F. A., MAJOR C. C. SMITH, CAV., LT. HOMER KIEFER, F. A. THIS TEAM WON THE JUNIOR CHAMPIONSHIP IN JULY, 1930



1ST SERGEANT ANTONIO D. CONE, WITH VERDUN, THE FAMOUS MULE WHICH WAS FOALED UNDER SHELL FIRE IN E BATTERY AND LATER ADOPTED AS THE REGIMENT'S MASCOT, BOTH ARE STILL SERVING WITH THE FIFTEENTH AT FORT SAM HOUSTON, TEXAS

BATTERY "E" GOES TO WAR

BEING EXTRACTS FROM THE WARTIME DIARY OF
FIRST SERGEANT ANTHONY D. CONE,

Battery E, 15th F. A., Second Division

FIRST INSTALLMENT

There is very little pomp and glory in war nowadays, even if there ever was any. It is a dirty, disagreeable business, and Sergeant Cone shows it in its true colors. Every young Field Artillery officer should read this journal—should read it several times slowly, and digest it. I know of no better way for him to get a picture of reality.—W M. J. SNOW, MAJOR GENERAL, RETIRED, CHIEF OF FIELD ARTILLERY, FEBRUARY 10, 1918—*DECEMBER* 19, 1927

Sergeant Cone, soldier in every admirable sense of the word, commanded Number Two Gun of E Battery, 15th Field Artillery, from the day the outfit was organized, June 1, 1917, until after the Armistice. He was promoted First Sergeant June 1, 1919.

This means that he was with it day and night for the duration of the war; from Pine Camp to Camp Merritt, Southampton, Havre and Voldahon; in action at Verdun and Marbach and throughout the great battles of Chateau Thierry, Soissons., St. Mihiel and the Argonne.

During that time, like every Chief of Section, he kept in his pocket a little black notebook with brief daily entries concerning the business in hand and he has been prevailed upon to allow a large part of this to be printed. The business with which he was concerned, it will be seen, was war, pure and simple.

The full meaning of this chronicle lies not altogether in what he says, vivid as that is, but also in what is left to be read between the lines. His outfit was part of the cutting edge of the A. E. F., and there will be found no mention of Paris, London, Monte Carlo, mademoiselles, the Ritz, pretty war workers and gay night life. On the contrary, it is merely a straight forward account of the grim business which absorbed all the energies of the battery.

For, however much war has changed in its larger aspects, the combat soldier is still confronted by the same diverse and implacable foes which have existed for ages. His existence continues to be a bitter conflict with hunger, mud, weariness, thirst, vermin, rain, dust, uncertainty, cold, contradictory orders, heat, snow, delays and disease. Through all these, he struggles to come to grips with the mortal enemy, where his reward may be nothing more than swift destruction.

All these are in this record and there are still others which it will recall. Intangible things, yet of a lifelong permanence; evanescent, but enduring. It will bring back the smells of damp straw in billets, of innumerable picket lines, of wet wool uniforms, of sweating horses, of frosty mornings and rainy nights; the odors of steaming marmites, hot coffee and of burnt powder; the sound of creaking leathers; the clop-clop of hoofs on the pavée and the rattle of equipment, mingled with the clash and rumble of guns rolling across France; and there is in it the rending crash of arriving shells, the intermittent, diabolical tattoo of machine guns and the roar of stupendous bombardments.

It is a picture of the war as it actually was and not as it is now often portrayed, distorted, mellowed and heavily embroidered with the fancies of twelve intervening years.—RAYMOND E. LEE, MAJOR, F. A. (G.S.)

JUNE 1, 1917, the 15th Field Artillery was organized at mobilization camp at Syracuse, New York, by the transfer of men from the 4th Field Artillery, which had been recruited to well over strength. On being organized and not having tents, we were billeted in the large grand stand, on the State Fair Ground.

June 19, 1917, we moved into tents in our new camp which we had built. Here we had plenty of mud. During our stay

here we were drilled on the 2.95 mountain gun, and in the school of the soldier. July 4th, we drew our first horses, and at this time we found we had become Light Field Artillery.

August 17, 1917, the regiment left for Pine Camp, N. Y. The first night we camped at Cicero; August 18th, we camped at Hasting; August 19th, Pulaski. To show their appreciation, the people welcomed us with ice cream and cake. August 20th, camped at Adams Center. Received much pie. The next morning while passing through Adams, N. Y., the people treated us with many sandwiches. That afternoon we arrived at Watertown, N. Y. More pie and cake. Arrived at Pine Camp August 22nd. On our long remembered hike from Syracuse to Pine Camp, having no harness or equipment, the men were forced to ride the horses bareback or walk. The riding of the horses caused both men and horses to become very sore. During our stay at Pine Camp we had target practice with 2.95 guns.*

On September 9th, 1917, the horses of the entire regiment, with the exception of "E" Battery, broke loose from the corral and stampeded. They started down the main road into Watertown a distance of 25 miles. Some of them went as far as Adams Center, five miles below Watertown. When the people in Watertown heard them coming, they thought it was an earthquake. The night was very dark, and it rained pretty heavily. Call to Arms was sounded, and every man turned out to gather the animals together and bring them back. It was an all night and most of the next day's job. There were quite a few horses killed at a railroad crossing, when they ran right into a train. One of the boys was also injured, having three ribs broken. It was a very hard job to get them all together, and bring them back to camp, and an experience which we will never forget.

*By this time the fall was well advanced and the weather was growing steadily colder. Many of the officers had their tents pitched over dug-outs. The kitchen and the mess hall were similarly dug in and walls of pine boughs were erected around them. The men were sleeping on canvas cots with bed sacks full of straw for mattresses and nearly everyone suffered from the cold. Many of the men slept in "heavy marching order," fully undressing only on the most moderate nights, for the Sibley stoves were inadequate to heat the big pyramid tents throughout the night. At one time the supply of wood became exhausted and, at the direction of Captain Lee, Sergeant Cone took a detail of men on an expedition over the reservation in search of anything that would burn. Not a board or a dry branch of a tree rewarded the efforts of the searchers.—Extract from the "The History of E. Battery," by Verne H. Torrance.

On November 29th, 1917, we entrained at Pine Camp and arrived at Tenafly, N. J., November 30th. We remained at Camp Merritt till December 11th, 1917, when we entrained for the port.

On the afternoon of December 11th, we were safely aboard the transport "Adriatic" and on the early morning of December 12th, we left the States behind. The second night we encountered a seventy mile gale of wind. The next morning we arrived at Halifax. The harbor was filled with debris from the terific explosion of a transport that was loaded with ammunition.

We arrived at Liverpool, December 25th. Our Christmas dinner consisted of a half portion of boiled potatoes. However, we were glad we arrived safely.

Entrained at Liverpool night of the 25th, and arrived at Southampton the morning of the 26th. We left on a channel steamer, the afternoon of the 26th, and arrived in Le Havre, France, the early morning of the 27th. We crossed the Channel on an English cattle boat. We were packed in as though we were cattle. We were cold and hungry and it was a very disagreeable trip. Spent the night at an English rest camp, but in our estimation it was a restless camp. Zero weather, bum tents, and no stoves and plenty of snow.

We entrained at Le Havre late on the afternoon of December 28th. Arrived at Camp Du Valdahon in the early evening of December 30th, 1917. This was our first introduction to the now famous Hommes-40, Chevaux-8. There were 40 men in each car, and so crowded that, if one man wanted to move, he was sure to penetrate his hob nails into some one's face. It was far below zero weather, and to try and keep warm was in vain. We found a bucket and built a fire in it with coke. This helped very little to make us comfortable as the smoke caused us to open doors and windows. In fact, during the whole trip, everything was combined to make it as disagreeable as possible. On our arrival at Valdahon, we were quartered in French barracks, which we found very comfortable.

On January 3rd, 1918, we were equipped with French 75's and on the 15th, we had our first target practice. The range

was about three kilos from our barracks and we were forced to draw our guns and caissons to their positions by hand. The snow and mud were deep there and the hills were steep. We had target practice three time a week.

January 17th, we drew our first pay in France.

February 1st, while adjusting by aeroplane, we were firing H. E. shell with red fuse. The second piece exploded, due to a defective fuse. The fragments from the piece caused two casualties. Sergeant Whitby, who had charge of the third piece, had his right leg nearly severed and lost it afterwards. Our other casualty was Private Andrews. He was acting No. 1 and was hit in the right knee and was unable to resume his duties.

The whole month of February we had some real hard training. March 7th, we fired the first rolling barrage and were qualified for the front. This ended our target practice. Fired approximately 3112 H. E. shell and shrapnel.

Our Battery Commander, Captain R. E. Lee, was promoted to Major at Valdahon and was given charge of the Second Battalion, Lieutenant Waters taking command of the Battery. He was later promoted to Captain.

March 8th, we draw our horses.

March 16th, full pack inspection. Cold and rainy.

The 12th, 15th, and 17th Field Artillery received their training at Valdahon. These three regiments composed the 2nd Field Artillery Brigade.

March 19th, we left on a thirty kilometer road march at 9 P. M. for Besancon. We hiked all night in a continuous downpour of rain; we were wet, hungry and sleepy and I might say it was one of our meanest hikes.

We arrived at Besancon early the next morning and were willing to take a rest.

Entrained at Besancon. Detrained at Souilly in the Verdun sector and here for the first time we heard the guns of the enemy. We hiked to Cinq Freres (Five Brothers) Camp, arriving late in the afternoon of March 21st. This place was our first experience of the kind of life we expected to find at the front. We were met by rats about the size of a cat. They immediately started a war on our reserve rations. Also saw

some interesting air battles and a number of bombs dropped quite close.

Shortly after dark, March 25th, the firing battery left for the front and took up firing positions behind Rupt, on the hill N. W. of Mouilly. Mouilly was a mass of ruins and not a whole house remained standing. This may be said of all the towns in the vicinity. While near a cross road we heard the whiz of a German projectile for the first time. It was a moonlight night and the battery crossed this road at a gallop, for they were being dropped every few minutes. We reached the positions which had been occupied by the French since 1915, when they were discovered by the enemy and were chased to other positions. It was up to us to keep well camouflaged, for to be discovered would mean that we would have to vacate.

The gun pits were dug well into the ground and were covered overhead and on the sides by steel and timber and rocks. The dugouts, or our sleeping quarters, were dug much deeper than the gun pits, with but one opening, a door, which led down the steps to our quarters. They were damp and not a bit comfortable.

The second piece, No. 10102, at noon of March 28th, fired the first 25 rounds of H. E. shell meant for the destruction of the enemy. The gun squad consisted of Chief of Section, Sgt. Cone; Gunner, Cpl. O'Driscoll; No. 1, Pvt. Wm. Smith; No. 2, Pvt. Carlson; No. 3, Pvt. Hubler; No. 4, Pvt. Staub; No. 5, Pvt. Fryczak.

Our kitchen was on the side of a hill below our positions. We went for our chow one and two at a time and often, while on our way, Jerry would open up and we would make a hasty retreat to our dugouts. Many a messkit of chow was spilled on this journey.

We carried our ammunition about a half a kilometer and some times we worked all night, and when daylight came we would have to quit and remain concealed for the rest of the day and resume our work when darkness set in again.

Our first time to be under heavy fire was March 26th and it did not take us long to get into our dugouts. To an observer, it would look as though it was a bunch of rats crawling into

their holes. Everyone seemed a little excited, but we soon overcame this in the days following.

We fired our first barrage Easter Sunday at 10:30 P. M., on March 31st, in answer to a call from the 23rd Infantry, whom we were covering. The enemy attacked and were repulsed. We realized the importance of our barrage and it was sent over on time, with great success, which encouraged us greatly. We had a strange feeling when we fired our first barrage. We felt then that we could meet the best troops the enemy had.

About this time nearly every man was infested with the enemy called cooties, and these gave us very little rest during our whole stay on the front. A simple method we found of getting rid of these pests was to lay our underwear on an ant hill and let them battle it out with the ants, who generally won.

The 6th day of April, 1918, the 2nd Platoon moved to Hill No. 422; the night was dark and the roads were muddy, the mud coming up to the axles of the carriages. Many times we were stuck. Got on the wrong road and had to go back about a kilometer. We at last got to our position and then our difficulty began. That was getting the guns into positions. The first platoon was still on Hill No. 441 and on April 10th, for the first time, we were gassed heavily with mustard gas. This was one of the worst gasses that the enemy had. They sent it over for about two hours and then we were forced to wear our gas masks for another hour until the all clear signal was given.

Our battery was very fortunate, for Battery "F", on our left, had about 50% of their men gassed. They were nearly all blind and were leading each other to the dressing station. The night the second platoon left for Hill 442, they had not been gone an hour when Jerry opened up and the 4th Section gun pit was demolished by a direct hit. The total H. E. shell and shrapnel fired by our battery on Hills Nos. 441 and 442 amounted to 12,484.

The firing battery withdrew from both positions on the night of April 23rd. We had many difficulties in getting away. Our horses were very weak, due to the lack of forage, and overwork. We joined forces with our echelon.

April 24th, the entire battery left our echelon at Blancardville, and proceeded to Ambly, where the echelon was established.

The firing batteries continued toward the front and took up positions on the outskirts of LaCroix-sur-Meuse. We hiked all day of April 24th and on the 25th we hiked all day and night while our echelon soldiers were eating steaks and biscuits.

May 1st, about 4 A. M., we had three men doing outpost duty as observers, somewhere near the front-line trenches. The Germans made a raid, dressed in the uniforms of French soldiers, and came to the mouth of the dugout where two of the observers were sleeping and called them out, using French language. Our men did not suspect anything and went out unarmed, and the Germans jumped upon them and demanded their surrender. They refused to surrender and started to clean the enemy up in good old Yankee style. They found that they could not overpower the Americans, whereupon they threw a hand grenade which mortally wounded Private Mountain, who died the 6th of May. Corporal Williams was overpowered and dragged back to the enemy's lines. This is the story of Private Mountain before he died. Corporal Thygeson, on duty on the outpost, did not know anything about it. Private Mountain was awarded the Croix de Guerre for this act of bravery. This was the first decoration given to any man of the battery.

May 4th we were shelled heavily with 10-inch projectiles of the German howitzers. They started at 1 P. M. and lasted till 5 P. M. These were four long hours, but we were well under cover in a French tunnel dug into a large hill and we were quite safe from shell and fragments. After the bombardment, we went out to see what damage was done. We found that there were only a few dugouts remaining. We got through lucky on this front, and on May 8th we were relieved by French artillery and joined our echelon.

While we were on the front, at LaCroix on May 5th, 1918, Major Lee received orders to return to the U. S. A. with our regimental commander, Colonel Merrill.

May 9th, the entire battery left Ambly and hiked to Cinq Freres.

May 10th, we hiked to Hargville, where we were billeted for the night.

May 11th, we were again hiking, and arrived at Brillon. We were billeted here in stables and received many replacements. We also received overseas caps here. These were our first and we said good-bye to our campaign hats.

May 19th, we hiked to Mussy where we entrained. We swam in the Meuse River here. The water was very cold. We passed through the eastern outskirts of Paris and detrained at 4:30 P. M. Supper along the road and camped for the night near a small village.

May 21st, at 9 A. M., we were again on the road, had dinner at Marines and arrived at Dellencourt at 4:00 P. M. In this place we were first introduced to the French rations, called monkey meat, and bread of poor quality.

May 30th, we had a parade and memorial services in honor of our dead comrades.

We remained here in reserve for the First Division, which was at Cantigny. We were here ten days.

On May 31st, we left Dellencourt, hiked about 10 kilometers, and entrained at Liancourt. We detrained at Ormoy-Sur-Marne at 4:00 P. M. of June 1st. Between 4:00 P. M., June 1st, and June 3rd, we hiked 65 kilometers to Chateau La Rue. We met wagonload after wagonload of refugees who were forced to leave their homes, taking with them but very little of their belongings. The Germans were advancing on Paris. The road was crowded with our infantry, who were on the hike day and night with very little to eat. We hiked 36 hours without anything to eat.

June 3rd at 11:00 A. M., we hiked from Chateau La Rue for the front. The echelon was established in Villers-Sur-Marne and the firing Battery took up positions about one-half kilometer east of Copru, which is six kilometers west of Chateau-Thierry.

As we were nearing Copru, we were attacked by enemy aeroplanes. "C" Battery of our regiment brought one of the planes to the ground with a machine gun. We had just entered Copru and the enemy opened up and threw much shrapnel among us and a few H. E. shells. Luckily we had no casualties. While the battery commander was looking for our positions, the cooks

got busy and served a very light lunch. We were under fire the whole time we were eating, a French battalion firing a barrage while we went into positions. To get into position we were forced to cross an open field where we were in plain view of observation ballons. One section at a time galloped across the field to the woods, close by which we took up our positions. This was our first time to battle in the open, having nothing to protect us but camouflage. We had no sooner got into position than we began to fire. We were under shell fire almost continually.

June 5th, the casson sections were bringing ammunition to us. They were stretched along the road from Copru to our positions when Jerry opened up with H. E. shell and did much damage. We lost one man, who was killed, Private D. A. Paul, and had two men wounded, Corporal Brenizer and Private Bure. While this was going on, we were firing a defensive barrage. The enemy was attacking but were beaten back, the barrage lasting for three hours. This was the last time they tried to advance, and from this time on they were steadily beaten back. The machine gun fire was something fierce and kept up for twenty minutes before the artillery opened up. At intervals, when we were swabbing our guns, we could hear the incessant rattle of machine guns and rifle fire. We captured about 500 prisoners that night.

June 5th, the division complete in all elements, took over the sector with a front of 12 kilometers, extending from the S.E. corner of the Bois De Marette to a point on the Champillion Bussiares road, about 800 meters north of Champillion. The Third Brigade, on the right, extended from the Bois De La Marette to Triangle. The Fourth (Marine) Brigade from Triangle to the left extremity. The 12th F. A. supported the 4th Brigade, the 15th F. A. the 3rd Brigade, the 17th F. A. supported both infantry brigades. The 3rd Infantry Brigade consisted of the 9th and 23rd Infantry; the Fourth (Marine) Brigade, the 5th and 6th Marines. The six groups of French artillery remained on duty with the Division. The terrain is hilly, with many small woods that at this season afforded excellent concealment for the troops of the contending armies. Good roads run in every direction, connecting the numerous villages, the

main highway being the Chateau Thierry-Paris road. On the German side, our front was occupied by two divisions and part of a third. They had the advantage of position. From Hill 204, the crest of which they held, the Paris road could be observed for a long distance. To the N. W. near Etrepilly, is a high ridge which overlooks much of the ground we captured. They also had control of the air, and watched our movements from sausage balloons and airplanes, whose duty it was to inform the German artillery.

This made concealment, during the daylight hours, absolutely necessary. No movement of the troops near the front could take place at these hours without certain exposure to artillery fire. Units in the support and reserve, miles from the front, could not assemble for the same reason. We were strengthening our position by digging trenches. Those engaged in that work must sleep in the woods by day and work at night. The supply of cooked or hot food to the front line was difficult. No fires could be built, for the tell-tale smoke would make a target for the German guns. The rolling kitchens were put in sheltered places, four or five miles in the rear of the front line, and cooked food and hot coffee were carried forward from them at night in large cans loaded on mule-drawn ration carts. Only one hot meal was served during the twenty-four hours and it was frequently cold by the time it reached the men in the front line. This continued during the entire forty days in which the division held the front line.

We received the French ration, a part of which was canned beef shipped from Madagascar. It had a peculiar taste which our men did not like. They called it "Monkey Meat" and it soon became known by that name throughout our army. On June the 6th, in the afternoon, the Marine Brigade began the attack on the Belleau Wood and Bouresches. The Belleau Wood extends for a distance of two kilometers in length, from north to south, with an average width of more than a kilometer. It is very broken, and at this time was covered in many places with a thick undergrowth. The Germans had seen its value for the assembly of infantry and machine guns to continue their attack. They had occupied it with a regiment of infantry and numerous machine guns and trench mortars. It had the protection of their artillery,

placed in concealed positions to the north. As long as they held it, it would be an ever present menace to our line.

General Pershing had taken every occasion to teach his army the spirit of the offensive. His teaching was now bearing fruit. Every American officer and soldier knew that the best way to hold our own line was to attack that of the enemy. General Degoutte, who had his Corps Headquarters at Champigny, a town on the Marne some distance to the rear, saw the importance of taking it as soon as possible. Bouresches was also important, as one of the strong points of the German first line.

Under the orders of General Harbord, the Marines went forward to the attack, after a short artillery preparation. More ammunition at that time could not be spared.

June 12th, the firing battery took up a position in a large wheat field for the first time under a camouflaged screen in plain observation of numerous sausage balloons about 500 meters N. E. of our first position at Copru. This was done in order to get a better position for the final attack on the Bois de Belleau and Bouresches and Torcy. The enemy shelled us at short intervals the whole time of our stay in this position. We would shoot craps beside the guns under the camouflage and, when we would hear the whistle of a shell, we would take cover in a small trench we had dug a few feet in rear of our gun. At one time I saw $200 lay on a blanket while everybody had taken cover. At this time everybody had plenty of money as there was no way of spending it. We had by this time became so used to the whistling and bursting of shells that we were quite at home when Jerry was sending them over. We had a dummy battery on our left that we constructed to fool the enemy, and it succeeded, for the enemy wasted much ammunition trying to destroy what they thought was a real gun.

June 15th, our forward echelon, about 500 meters to the left of our positions, was shelled heavily and the 2nd Section lost six horses of their gun team. One of the shells dropped right among them. The people who were driven from their homes left much cattle and fowls behind. Champagne, Vin Rouge, Vin Blanc and hard cider could be found in great abundance. A detail

was sent out each day to round up and bring back all the cattle and fowls that could be found.

Our battery was lucky. We found and butchered four heifers and one cow.

June 23rd, 11:55 A. M. The men were in the ravine about 100 yards to the left of our guns, where our kitchen was camouflaged in the heavy woods. Without warning, the enemy opened up a sweeping barrage that covered an area of about 300 meters. The positions we were now in was discovered without a doubt. We had a number of casualties, two killed, Private Kennedy and Private Cominskey, who were two of the smallest and youngest men in the battery. The wounded were Cook Wencew, Corporal Gunner Ott had his left foot blown off, Private De Loreto had his right leg blown away. Private Staub was hit in the stomach. Corporal Burley, a runner, was seriously wounded. A scene we will long remember, that we saw from the trench where we were concealed, was Corporal Gunner Kelly and Sergeant Newton chased by the sweeping barrage to the top of the hill. They sure did run and they sure did burst on their heels. While in this position, we were paid while under shell fire, one man going to the Captain's dugout at a time.

It was useless to stay in this position any longer, for Jerry had our number down pat, and to stay any longer would have meant a long list of casualties. June 25th we took up position just south of Copru, between Copru and Dompton. They were difficult positions to get in. This position was on the base of a steep hill and we had to wait till daylight to put our guns in position. We had to build a gun pit directly over a small brook, and we had plenty of hard work on our empty stomachs. To get our guns in position, we had to lower them down the hill with ropes, dodging around trees and vines, and being careful not to destroy anything, for we realized that camouflage was an important factor. A French battery took up a position about 100 meters directly in front of us. A few days later the enemy discovered them and immediately set in to destroy them. They sent over many six-inch shells and all the overs dropped into our position.

We had three men wounded during this shelling, Corporal

Gunner O'Driscoll, Corporal Gunner Kelly and Private Welsh. July 1st, the Third Brigade (9th and 23rd Infantry) launched an attack on Vaux. There was a big artillery preparation for this attack. The whole Second Artillery Brigade concentrated their fire on Vaux and Hill No. 204, which was the key to that part of the line and Chateau Thierry. The enemy had been fortifying the crest of Hill No. 204 for a month, and had well occupied with machine guns the woods on the southern slope near the French line, and with a full realization of its importance, had held this hill against repeated French attacks. We started our bombardment July 1st at 1:00 P. M., and we fired 1400 yperite special No. 17 gas shell, and all of the men of our gun crew wore gas suits to handle this shell, for it was said to be the deadliest gas used by the Allies. After the gas bombardment, we started a rolling barrage, followed closely by our infantry. In this barrage we fired 1520 rounds of H. E. Shell. The guns were about red hot, and we could have easily cooked a meal on their muzzles. The men were about all in but felt happy at that, for word was received immediately that Vaux and Hill No. 204 were in our hands. The number of rounds fired by our battery at Chateau Thierry was 22,700 rounds of H. E., shrapnel and gas shell.

July 8th, we were relieved by the artillery of the 26th Division and we joined our echelon. July 9th, we made a night march, the firing battery taking up a reserve position near Bezu and the echelon being established one kilometer northeast of the town of Chamigny. In this position General Petain of the French Army visited our sector and left a number of souvenirs to be given to the men. The 15th Field Artillery received two.*

*Sergeant Cone was one of the two recipients.

KOLEKOLE PASS

A letter from Maj. James A. Gillespie, F. A. (DOL), on duty at the University of Utah, was recently received by THE FIELD ARTILLERY JOURNAL which contains the following statement:

"On opening my FIELD ARTILLERY JOURNAL I was very much surprised at the frontispiece and the article on page 548, in which the claim is made that the first battery to cross Kolekole pass was Btry E, 8th F. A., on July 3, 1930.

"Of my own knowledge I know that Btry. E, 13th F. A., a tractor-drawn battery under command of Capt. B. M. Sawbridge, crossed Kolekole pass sometime in 1922 and that Btry. A, 8th F. A., under Capt. (now Major) Wm. Clarke, crossed a few days later. I have always heard that a horse-drawn battery of the 1st F. A. crossed this pass prior to the World War."

Investigation has brought out the fact that Btry. C, 13th F. A., crossed the pass along with Btry E, 13th F. A. The only official record of the crossing referred to by Major Gillespie seems to be contained in the gun books of Btry. E, 13th F. A.

TYPE PROBLEMS

These four gunnery problems, fired at the Field Artillery School, are examples of procedure in conduct of fire approved in the New T.R. 430-85, Field Artillery Firing.

Precision Axial Problem

Target Description: Abandoned enemy tank. *Mission*: To destroy. *Matériel*: French 75 mm. Model 1897. Visibility: Excellent. Wind: Direction R. to L. Initial data obtained. Deflection: Aiming Circle Range: Range finder.

Initial Commands:

No. 1 Adjust
Compass 4650
Shell Mark 1
Fuze short
No. 1
1 rd.
Quadrant.

Commands		Elev.	No. Rd.	Sensings	Remarks
		108	1	?	13 mils Rt. of target.
Lt. 15		108	2	+	
		100	3	–	
		104	4	?	
Rt. 2		104	5	+	
	3 rds.	102	6	+	
			7	–	
			8	?	
	4 rds.	102	9	+	
			10	+	
			11	+	5 Overs, 1 short Fork=4
			12	+	Adj. elev.=102–(4/12×4)=100.7
	6 rds.	100.7	13	+	
			14	–	
			15	–	
			16	–	
			17	+	
			18	–	2 overs, 4 shorts.
					Adj. elev.=100.7+½ (2/12×4)=101
		101 C. F. End of Prob.			

SUMMARY

Errors in initial data: Deflection 13 mils. First shift in deflection: 2 mils. Range=146 yards or 4.2%. Time from identification of target to announcement of first range=1 min. 45 sec. Average sensing and command: 10 sec. Ammunition expended: 18 rounds. Classification: Satisfactory. General Comments: An excellent problem correctly handled throughout.

Precision Lateral Problem

Target Description: Eenemy gun emplacement. *Mission:* To destroy. *Type:* Precision lateral (Small T); Guns to the right rear. *Matériel:* French 75 mm. Model 1897 Wind: Direction L. to R. Initial data obtained: Deflection: BC telescope. Range: Range finder. T=185 mils. Observer on left. c=4 s=4 d=4 s/c=1 r/R=5/6

Initial Commands:

No. 1 adjust.
AP. Steel Tower to the right rear.
Pl. 4 Drum 160
Shell Mark 1
Fuze Short
No. 1
1 rd.
Quadrant.

Commands	Elev.	Rd. No.	Deviations	Sensings Rn.	Sensings Def.	Remarks
	120	1	18 R	?		
Lt. 15	120	2	7 R	–		5/6×7=Lt. 6 to get on line.
Rt. 10	136	3	3 R	?		Rt. 16 to stay on ∴ (Rt. 10)
Lt. 2	136	4	2 L	+		Mean of 120 and 136 is 2½ right.
Lt. 6	128	5	Line	–		Def. bracket is 8 mils. ∴ (Lt. 4+Lt. 2 =Lt. 6)
Rt. 4	132	6	Line	+		Def. bracket 6 mils. (Rt. 3+R 1=R 4)
Lt. 2, 3 rds.	130	7	(1 L)	?	?	Over on rule; appeared short on terrain.
		8	(Line)	–	–	
		9	(Line)	–	–	
Rt. 1, 1 rd.	130	10	(1 R)	–	?	
2 rds.	132	11	(3 L)	+	?	2 overs, 4 shorts assumed fired at 131 Fork=5.
		12	(Line)	–	–	Adj. elev.=131+ (2/12×5)=131.8
6 rds.	131.8	C. F. End of Problem				

SUMMARY

Error in initial data: Deflection 10 mils. Range: 225 yds. or 5.5%.

Time from identification of target to announcement of first range: 2 min. 15 sec. Average sensing and command: 22.3 sec. Total time for problem: 11 min. 15 sec. Ammunition expended: 12 rounds. Classification: Satisfactory. General Comments: Although a range finder range was obtained at the OP the officer firing properly made an initial elevation bound of 4 forks, because of considerable difference between O.T. and G. T. The problem was well handled.

Precision Lateral Problem

Target Description: Concrete machine gun nest. *Mission:* To destroy. *Type:* Precision lateral (Small T); Guns to right of O.P. *Matériel*: French 75 mm. Model 1897. Wind: Direction L. to R. Initial data obtained: Deflection: BC telescope. Range: Range finder. T=200 mils c=5 s=7 d=5 s/c=7/5=1.4 r/R=1

Initial Commands:

No. 2 adjust
Aiming Point Triangulation Station on highest peak to direct front
Pl 12 Drum 170
Shell Mk 1
Fuze short
No. 2
1 round
Quadrant

Commands	Elev.	Rd. No.	Deviations	Sensings Rn.	Sensings Def.	Remarks
	96	1	25 L	?		(r/R=1 R 25)
Rt. 25	96	2	2 L	+		(Rt. 2 to bring to line) (1.4×6=8.4, Lt. 8 to stay)
Lt. 6	90	3	2 R	+		(Lt. 2 to bring to line, Lt. 8 to stay)
Lt. 10	84	4	2 L	+		(Rt. 2 to bring to line, Lt. 8 to stay)
Lt. 6	78	5	Line	–		(8 mil. deflection bracket)
Rt. 4	81	6	Line	+		(4 mil. deflection bracket)
Lt. 2, 3 rds.	80	7	(2 L)	+	?	
	or	8	(5 L)	+	?	
	79	9	(3 L)	+	?	
2rds.	78	10	(3 R)	–	?	
		11	(1 R)	?	?	
1 rd.	78	12	Line	–	–	(2 mil. deflection bracket)
Rt. 1, 6 rds.	79		C. F. End of Problem			

SUMMARY

Error in initial data: Deflection 6 mils. Range: 395 yards or 13.4%. Time from identification of target to announcement of 1st range: 4 minutes and 42 seconds. Average sensing and command: 20.8 seconds. Total time of problem: 11 minutes, 9 seconds. Ammunition expended: 12 rounds. Classification: Satisfactory. General Comments: The officer firing operated the range finder himself which increased the time from identification of target to announcement of 1st range. The handling of the deflection was excellent. Since data were not obtained by plotting four fork range bounds should have been made initially.

Percussion Bracket Problem

Target Description: Machine gun fire coming from the vicinity of a bushy green tree. *Mission:* To neutralize. *Type:* Percussion bracket lateral (Small T). *Matériel:* French 75 mm. model 1897. Wind: Direction L. to R. Initial data obtained: Deflection Prismatic compass: Range estimated. Observer on the left. T=200 R=4000 r=3000 r/R=3/4 s=20/4=5

Initial Commands:
Compass 4870
Site 0
Shell Mk. 1
Fuze long
No. 1
1 rd.

Commands	Range	Rd. No.	Deviations observed but not announced	Sensings Rn.	Sensings Def.	Remarks
	4000	1	(20 L)	?		¾×20=15
Rt. 15	4000	2	(Line)	+	+	
Lt. 20	3600	3	(5 L)	–	?	Est. range 400 yd range jump to stay on line use 4 S or 20 mils.
Rt. 10	BR 3800	4	Sheaf Parallel	–	–	
		5		–	–	
		6		?	?	
		7		?	?	
Rt. 5 Btry 1 rd. Zone	4000 3800		C. F. end of Problem			Open sheaf (100 y d s. between flank bursts) is desired, should have opened 3 on an interior piece.

SUMMARY

Error in initial data. Deflection 20 mils. Range 100 yds. or 2½%.

Time from identification of target to announcement of 1st range: 1 min. and 10 sec. Average sensing and command: 15 sec. Total time of problem 4 min. and 20 sec.

Ammunition expended: 7 rounds. Classification: Satisfactory.

General comments: Would have been better to start with an interior piece.

Failure to open sheaf when going to zone fire reduced the effectiveness of fire.

"SPIT AND POLISH" AT FORT MYER

BY CAPTAIN WARD H. MARIS, 16TH F.A.

SOMEONE has said that service at Fort Myer depends entirely on "corrections of the moment." This is a good estimate of the situation, for, though "normal data" is always chalked on the shield, the situation is frought with doubt and uncertainty and subject to rapid change.

The 1st Battalion of the 16th Field Artillery, which occupies the artillery section of this post, must be ready to turn out on a moment's notice for a funeral, a parade, a riding hall exhibition or a firing demonstration, or it may be called upon to stand an inspection of quarters and stables by military representatives of various foreign powers. Fortunate indeed is the battery commander who can follow his drill schedule one day out of the week.

The calendar year starts with the riding hall season which lasts through March. During this period exhibition rides are given in the hall every Friday afternoon by the Cavalry and Artillery units of the post. Two batteries appear each week, one with an exhibition driving drill and the other with a firing demonstration. Each battery has its own distinctive exhibition drill which lasts from twelve to fifteen minutes, all movements being executed at the trot and gallop. They are always a popular feature of the show. Headquarters Battery frequently presents a communications demonstration in which all lines are hooked to the loudspeaker so that the spectators can listen in with the switchboard operator.

Batteries alternate in putting on the firing act, which was dubbed the "Magnum Opus" by its designer, while Headquarters Battery always provides the scenery crew. The props consist of a framework covered with beaverboard on which duplicate landscape scenes are painted on both sides of the structure. There is sufficient room inside for the operating crews to function. This scenery is lowered from the rafters in the center of the hall, after which the battery enters at "Route Order," producing an effect which brings back vivid memories of hikes in France. Firing from an enemy battery is the signal for action, at which time one platoon goes into position at each end of the

hall. The enemy gun is represented by flashing a light, blowing smoke through a hole and beating a base drum. An artillery duel is then presented. The stage crew produces bursts on the painted beaverboard landscape by firing specially prepared smoke blanks from .45 calibre revolvers, through small holes in the scenery. The 75s fire primers only. Observation balloons ascend from the scenery and are shot down, presumably by machine guns mounted on the caissons, actually by the stage hands. An airplane appearing from above provides another target for the machine guns. A tank begins its trek along a road and the guns fire at will, finally blowing it up. The tank is charged with black powder and actuated by a hidden wire running along the track. When it reaches a certain spot, a shot from the scenery crew, timed with a shot from a gun, blows it up.

The "Society Circus" closes the riding hall season. Debutantes and children from Washington augment the drills on this occasion and an admission is charged. The profits go into the post recreation fund, from which a fine swimming pool, concrete tennis and hand ball courts and a new hostess house have largely been constructed.

This year the idea was conceived of reviving the old American Army uniforms, as a result of which the Sixteenth presented a colorful artillery pageant which proved to be one of the striking features of the circus. A study was made of records in the files of the Library of Congress and the War Department, and a set of Continental uniforms tailored, correct in detail, for Battery "A." Battery "C" was equipped similarly with replicas of the uniform worn by the artillery in the days of the war with Mexico. The battalion thus presented a kaliedoscopic effect of 1776, 1847 and 1918. It is intended to provide Headquarters and "B" Batteries with uniforms of other periods.

Additional research produced the details for a Medieval Tourney of the 14th Century. In this event Battery "C" assisted by buglers of the 3rd Cavalry, Army Band, 13th Engineers, 12th Infantry together with 30 children as pages, presented a jousting tourney in costume before the royal party consisting of a king, queen and ladies-in-waiting which made its entrance to the stirring notes of fifty trumpets. Appropriate costumes were both

made and rented. It is remarkable what a clever tailor can do with salvaged bed sacks, target cloth and paint.

Gunners' instruction and examination take place in April and May which leaves two weeks to get ready for the 250-mile hike to Tobyhanna, Pa., for summer camp. The battalion frequently stages exhibition drills and reviews along the march in various cities, which in turn reciprocate with dances and other entertainment for the men.

Returning to Fort Myer the first of September all batteries immediately clean up and paint matériel in preparation for their appearance at fairs, horse shows and the Army Relief Carnival at the War College. Exhibitions are also scheduled with the 3rd Cavalry and the 12th Infantry on the Washington Monument grounds in Potomac Park, for the entertainment of tourists visiting the Capital. Meanwhile everyone is getting ready for the next riding hall season. In the midst of all this comes the call for Corps Area Maneuvers at Fort Meade.

Military funerals take precedence over all other activities at all times. Requirements for these ceremonies vary from a detail of six body bearers and a firing squad for a private, to an escort of all arms including the entire battalion and the caisson, such as for the funeral of the late Mr. Taft. The 3rd Cavalry furnishes the band and the firing squad, the 16th Field Artillery the escort, caisson and body bearers.

The average funeral calls for an escort of 4 N.C.O.'s and 32 privates, a caisson, and six body bearers and the band. Each battery furnishes the caisson and body bearers by roster for periods of one month. Since there are usually from one to six funerals per day in Arlington it can be seen that much time is required of the men for this particular duty. During 1928, 543 burials were made in the cemetery, requiring 117 officers and 13,643 men. In 1929 the funerals increased to 594, requiring 352 officers and 14,841 men.

Participation in the numerous parades, drills and exhibitions necessitates keeping a special set of equipment in constant readiness. For this purpose each battery has four extra sections of matériel and harness. The harness is colored a rich mahogany and treated with lotion cream to give it a high luster. All brasses

are shined each time it is used. The trace chains are removed daily and burnished in a tumbler which is operated by an electric motor. The toggle chains are fitted with detachable links which allow them also to be removed and burnished. One set of chains is nickle-plated, but it is used only when a battery leaves the post for a week or more for exhibitions such as the National Horse Show in Madison Square Garden at New York. Red brow bands and saddle blankets give a touch of color which adds much to the general effect. Officers saddle cloths are enameled red and trimmed with gold. The horses' hoofs are painted with black duco.

Funeral caisson teams receive special attention in preparation for each formation since they are subject to observation not only by relatives and friends of the deceased, but also by the thousands of people who visit Arlington Cemetery each year. The black and bay teams are equipped with canvas-covered traces which are blancoed white. The gray team uses full length chain traces which are burnished. Since the horses must be immaculately groomed, the drivers for this team are placed on special duty each month the caisson is in service. The appearance and condition of these animals afford striking evidence of what might be accomplished throughout an entire battery were it only possible to keep drivers assigned to the same teams at all times. This utopian situation is probably further from realization at Fort Myer, however, than at any other post.

The show matériel is kept highly varnished at all times. The straps are treated with lotion cream, while the paulins and tool rolls are covered with white sheets and pillow cases. The picket ropes are neatly wound and painted white. The tool handles are given a snakewood appearance by sanding smooth, burning rings with a blow torch and finishing with a clear varnish. The aiming stakes form a ladder on the rear of the caisson chest. The ends are inserted in wooden blocks which are covered with polished brass and clamped to the chest handles. Nickle plated pole yokes, double trees, single trees and mogul springs which are polished by wheels on a motor driven lathe, practically complete the special touches.

For riding hall drills additional color is obtained by attaching

a three-quarter size guidon on a short staff at each corner of the carriage. When exhibitions are presented at night the carriages are effectively set off by red flares placed on the limbers, caissons and guns. One battery uses electric lights on the carriage wheels while another has a set of small red lights which are fastened to the crown pieces of all bridles. Switches and batteries strapped to the collar pad on each horse enable the driver to turn them on during the movements through burning stakes at which time the hall is darkened.

Color scheme in horses is maintained within the battalion by assigning all bays to Battery "A," blacks to Battery "B," grays to Battery "C" and chestnuts to Headquarters Battery. Training regulations frown on the practice of washing animals, but in the case of the gray battery, it has been found not only advisable but absolutely necessary to indulge in the judicious use of castile soap and water. Nothing looks worse than a bunch of dirty gray horses, but give them a bath, dress them up with polished harness, red blankets and a coat of black duco on their feet and the effect is striking. We have yet to see the threatened "scratches." All horses, of course, are clipped twice a year. Their tails are trimmed "Yorkshire" fashion.

Whenever the battalion turns out for a parade, each battery takes along the light wagon to carry coffee and sandwiches, the white halter ropes, grooming kits, a supply of cleaning and shining materials, two men with fatigue clothes to assist the battery in the final preparations, and a cook. The final policing enables the outfits to present the best possible appearance.

Although much effort is expended on matériel, horses and harness, even more attention is given the men. The special measurement uniforms and riding gloves are used only for ceremonies. An extra overcoat is provided for this purpose as well as set of raincoats sufficient to equip an entire funeral escort. Quartermaster buttons and insignia will not pass inspection at this post; neither will issue leggins and caps. Each man buys from the post exchange a Pershing cap, one pair of tailored leggins, a set of ornaments, uniform and overcoat buttons.

Before any detail leaves barracks for a special formation each man is inspected for personal cleanliness and condition of uniform and equipment. The uniform must be cleaned and pressed,

with all buttons, ornaments and leather highly polished. The belt must be freshly blancoed and each eyelet polished. Many ingenious methods have been developed for shining these eyelets, ranging from prehistoric fire making machines to modern hand drills. The recruits are required to buy a set of cleaning and polishing material when they first join, and are immediately taught what to do with it. The quick transition in the appearance of these men is remarkable.

One might think after reading this brief narrative of the activities of the Fort Myer battalion of the 16th Field Artillery that these batteries are show outfits only. It is a pleasant surprise, however, to officers reporting here for duty to find that the battalion hikes with the greatest of ease over concrete roads and through heavy traffic. Every animal except a few required for duty at the post went to camp last summer, and every one came back from the 500-mile hike under its own power. It is also learned that the men are as much at home firing among the rocky hills of Tobyhanna as in marching up Pennsylvania Avenue in a presidential inaugural parade in the Capital. Furthermore it is interesting to note that since the Knox Trophy test was changed a few years ago to include all departments of the battery, the representatives from this battalion have always stood uniformly high. While they have never won the trophy, they have been second several times and never lower than fourth. The standard within the battalion is such that last year the Battalion Commander did not announce which battery would take the test until 36 hours before it began.

If you are interested in the column conducted by the *Recruiting News,* entitled "Things the Army Does Besides Fight," you can obtain much additional first-hand information. Just come to Fort Myer. But bring along a broad sense of humor.

A FORT MYER FUNERAL CAISSON

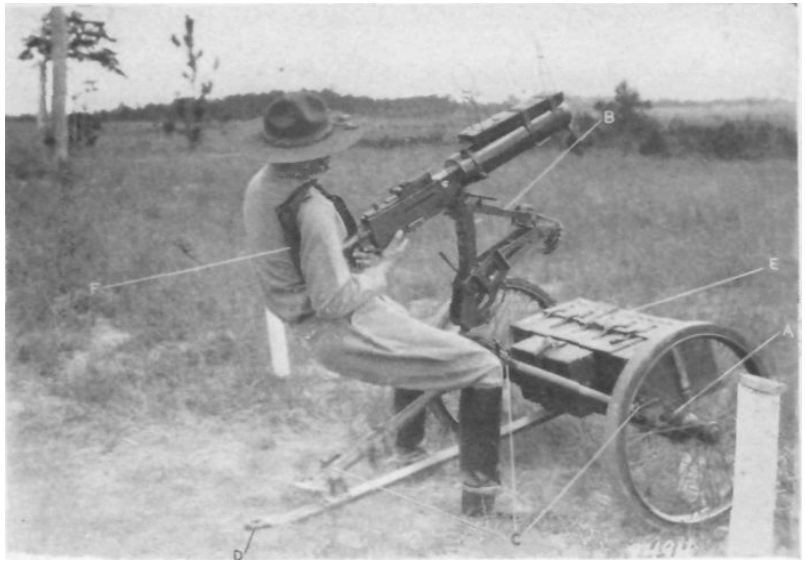


FIGURE No. 1: A—WHEELS DETACHABLE IN THREE SECONDS FOR GROUND USE.
B—ANTI-AIRCRAFT ADAPTER FOLDS UP IN FIVE SECTIONS.
C—TRIPOD CAN BE REMOVED INSTANTLY FROM MOUNT.
D—LUNETTE WHICH ENABLES GUN AND MOUNT TO BE TRAILED IN ANTI-AIRCRAFT FIRING POSITION, LOADED
E—AMMUNITION, RESERVE LOAD.
F—TANK SHOULDER REST. (THIS IS UPSIDE DOWN TO NORMAL TANK USAGE.

FIGURE 2: MATTHEWS MOUNT

ANTI-AIRCRAFT DEFENSE

BY LIEUT. R. C. OLIVER, F. A.

THERE is a tendency for artillery officers to overlook the importance of the problem of anti-aircraft defense within their own commands. This attitude is due to several natural causes. In the first place, no one has ever had to undergo an attack by the latest type of land attack airplanes using the new highly developed air corps tactics. Officers are prone to remember only the "strafing" of World War days, in which one or two separated enemy pursuit planes attempted to worry the ground troops by clumsy maneuvers overhead, the while discharging haphazardly a few machine gun bullets in the general direction of our positions. Inasmuch as this type of "attack" usually accomplished nothing more than to bring forth a new high-powered Yankee oaths, the feeling grew up that an air attack was not worth bothering about in comparison to so many other more dangerous enemy activities.

In the second place, no "Experience Tables" have been made public as to the number of hits on a given area to be expected by a plane firing from a given altitude at a given rate of speed. No statistics are available on which to base a decision as to the seriousness of an attack made by, say, three attack planes. (At least three planes will be used in this type of attack, according to present air corps tactics,—and will fly in a V-shaped formation with about five yards between wing tips.) No data is available as to the size or location of the "vulnerable area" on a modern plane, or as to the result to be expected from getting direct hits from .30 calibre machine gun bullets on the engine or gas tank.

In spite of the obstacles, both psychological and actual, which lay in the way of squarely facing the problem, a crying need exists for a thoroughly worked out system for defense of ground units against air-craft attack. This job cannot be turned over to the Corps Anti-aircraft Artillery—for there will never be sufficient of the latter handy to defend the entire zone of advance against air attacks.

Another point to be considered is that the American method

of warfare (i. e., "open" or active as distinguished from "position" or passive) presupposes much movement of troops in column behind the front lines, no overhead cover, and little or no camouflage in battle positions.

To show the seriousness of the threat from the air to the artilleryman, let us assume an attack upon a battalion of light horse-drawn artillery on the march in section column. For the purpose of arriving at some definite conclusions, let us assume ideal conditions for the attacking planes. We will use three attack planes in perfect parallel flight in attack formation with all their guns functioning properly and no anti-aircraft fire to disturb them. The battalion is marching along a straight road on level ground with the airplanes defiladed by trees until they come into attacking range.

Now these three planes flying at a speed of 150 miles per hour can deliver 9000 machine gun bullets and 30 thirty-pound delayed fuze fragmentation bombs into a strip 75 feet wide in 30 seconds. At 150 miles per hour, the planes travel 210 feet per second. In 30 seconds they travel 6300 feet.

At any given moment the length of the beaten zone for the machine guns of the planes is 1500 yards, or 4500 feet. Hence the total length of the terrain upon which the bullets fall is 6300 + 4500 = 10,800 feet; and the *area covered* is 10,800 × 75 = 810,000 square feet.

From a flying altitude of 75 feet (the average attack altitude) the average angle of fall or striking angle of the machine gun bullets is around 4 degrees.

Compute the danger space for one horse as follows. Height of horse = 6.5 feet. Danger space therefore is $\frac{6.5}{\tan 4^\circ} = \frac{6.5}{0.0699}$ = 93 feet in length. Width of horse (average) = 18 inches = 1.5 feet. The *danger area* made by each bullet is therefore 93 feet × 1.5 feet = 140 square feet. 140 square feet × 9000 bullets = 1,260,000 square feet of *total danger area*.

We see that this danger area is greater than the area in which the buuets fall. (1,260,000—810,000). Hence, all of the area in which bullets fall is danger space and each horse in the strip 75 feet wide by 10,800 feet long has a high probability of being

hit. In fact the probability is, that a horse will be hit $\frac{1{,}260{,}000}{810{,}000}$ = 1.55 times in a single attack.

So far we have not considered the bombs. Ordnance data gives the following: One thirty-pound, delayed fuze fragmentation bomb explodes into approximately 15000 fragments capable of killing a man or animal within a radius of thirty-five yards. 30 × 150 = 450,000 fragments are therefore dispersed in our theoretical attack. The number of fragments divided by the number of square feet in the area covered by the attack will give us the probability of the number of hits in this area:— $\frac{450{,}000}{810{,}000}$ = 55% hits.

From the above example several conclusions may be drawn:

First: That an air attack is extremely effective, even if anti-aircraft fire is sufficient to separate the attack formation slightly or cause the planes to fly at slightly higher altitudes, and even if some machine guns jam and some of the bombs fail to detonate.

Second: That for a ground unit to remain in column is fatal while on the other hand, deployment of carriages will be useless unless they can separate by over thirty yards in irregular formation.

Third: That, at least for the light artillery, offering targets of many teams of horses and riders, there must be evolved an active means to stop aerial attacks rather than depend upon a passive defense as deployment, which might prove to be effective in an easily deployed Infantry unit.

The Infantry Board through its Department of Experiment has started the ball rolling towards arriving at a satisfactory counter attack on aircraft. For some time the Infantry had used a system of rapid deployment from marching columns with the men running at will to any cover they could find, such as trees, declivities, etc., and throwing themselves prone and motionless.

The Infantry Board called upon the Air Corps unit at Maxwell Field, Alabama, for three attack planes to fire upon targets of several hundred prone silhouettes scattered as the men would scatter under similar conditions, and found that although the number of hits or casualties were reduced to a great extent by deploying,

still each man in the scattered formation ran an 18% casualty risk or, to state it differently, 18% of a command would become casualties. This casualty rate was too high to consider simply deployment as the solution to the problem.

Similar tests were conducted on targets representing wagon trains and machine gun batteries and it was definitely decided that the amount of lead that three planes can put upon the ground is too much for any unarmored, non-deploying unit to withstand.

The possibility of developing anti-aircraft fire from the unit attacked, to the point of effectiveness where it would stop an air attack before it had time to inflict much damage, seemed the only solution. To accomplish this enough lead would have to be thrown into the air to be absolutely certain of either detonating the bombs carried by the planes before they were released, killing the pilots, or stopping their engines before their attack reached our column.

The Infantry Board had to start at rock-bottom. First: it accepted a crude but feasible invention of a young Infantry officer for a mobile machine gun mount for the heavy Browning machine gun and developed it so that with a suitable adapter-arm for high angle fire, and an inverted tank shoulder rest attached to the pistol grip of the gun, a highly satisfactory anti-aircraft weapon resulted. (See Illustrations 1 and 2, Matthews mount).

Second: It developed an anti-aircraft sight for the Browning gun. Several pilot models of this sight, called the Boyd-Greene sight, are now being manufactured by the Ordnance. A description of it and of its use will be made later.

Third: It determined after exhaustive tests, the following:

(a) That the fire of four machine guns (equipped with the new sight, adapter and mount) upon one enemy plane for 15 seconds will give average results of 100 hits on the vulnerable area of the plane. This vulnerable area was considered to be the front half of the fuselage in lieu of any positive data on this item. Tests were conducted using sleeve targets 3 feet in diameter by 15 feet in length, towed from planes at an altitude of 100 feet, at 110 to 120 miles per hour. On these targets an

average of 6% of shots fired were hits. The target being smaller than the front half of an airplane, the number of hits to be expected on the latter can be worked out as follows:

Sleeve target: $\Pi r^2 = \Pi \times 1.5^2 = 7.08$ square feet.

Front half of plane: $6 \times 4 = 24$ square feet (vulnerable area).

Hence $\frac{24}{7.08} \times 6\% = 20\%$ hits to be expected on the front half of a plane.

Four guns firing 15 second at 10 rounds per second = 600 rounds, 20% of 600 = 120 hits. However, as these tests were all made under ideal conditions, it would be safer to count on 100 hits under actual conditions.

(b) That the fire of less than four machine guns upon one plane will produce erratic results, and, at best, not enough hits to warrant the concentration of less than four guns on one such target. Thus twelve guns would be needed effectively to stop a typical aerial attack of three planes.

Fourth: It developed a course in anti-aircraft gunnery for riflemen. After a two weeks' course in anti-aircraft firing using the methods and targets developed by the Infantry Board, one rifle company was able to fire 1440 rounds of rifle amunition in 15 seconds at three sleeve targets towed at 110 miles per hour at an altitude of 100 feet, and obtain an average of 100 hits on each sleeve.

The effects of this experimentation and development work of the Infantry Board done in the interests of anti-aircraft defense, already have been felt throughout the Infantry. Tabulation of tests made and results obtained have been circulated to all Infantry units and various phases of the development work have appeared in articles in the Infantry Journal. A realization of the importance of the problem has come to nearly all Infantry officers and new ideas and helpful suggestions have been sent to the Infantry Board by many of them. Through the office of the Chief of Infantry the interest of the War Department has been awakened and funds have been authorized by the War Department to conduct further tests in conjunction with the Air Corps and the Ordnance Department.

The problem of anti-aircraft defense, or shall we say, of

counter-attack from the ground against aerial attack, is essentially the same for the Field Artillery as for the Infantry. Its solution, if anything, is more important to the Artillery than to the Infantry as the former is much more vulnerable to the aerial gunner.

At present, the Artillery has only a hazy idea of what it would do in case of an air attack and has only the poorest equipment with which to do it.

Two heavy Browning machine guns are a part of the equipment of each battery, with three in the combat train. No type of mount is manufactured or authorized by which to adapt these guns to high angle fire. It is true that individual organizations have in some cases made up make-shift affairs such as pivot mounts bolted to the rear corner of caissons, or simply extra long legged tripods strapped to the caisson footboard and trail. None of these gives complete all-round high angle fire. They are unsatisfactory from many other causes also, such as non-flexibility and because they are in the way and cut down the efficiency of the gun squad in the firing of the battery.

Tables of Organization provide for no personnel in Artillery units to operate the machine guns. Consequently Training Directives allow no time for the training of artillerymen in the use of this weapon. As a result, the machine guns can be found in most batteries disassembled and safely packed away in the battery store room.

In a chapter of the Field Artillery School Notes* there does appear a suggested method for picking extra men here and there from each section of a war-strength battery in order to make up machine gun squads. An excellent basic thought is brought out in this same pamphlet in stating that the best method of placing the machine guns when the battery is in position is in pairs, and with pairs mutually supporting each other in the battalion. Any reference to training, anti-aircraft marksmanship, or firing technique is discreetly omitted. A general statement refers to the aerial attack upon a battery while in column on the march: "In case of attack, the 5th Section, which carries the machine guns, halts, off the road where practicable, and the carriages are unlimbered.

*F.A.S.N., Book I, Chap. I, Part E.

An officer of the battery, designated as the machine gun officer of that unit, has charge of the machine guns when on the march. In cases where he can get information of an airplane attack in advance he makes the necessary disposition of the guns." Instructions do appear, however, for alternate carriages to oblique to the right and left off the road. But it seems that throughout the pamphlet the tremendous speed of an air attack is overlooked. The time from first to last sight of the enemy planes will not be over two minutes and they will not remain within effective range more than 45 seconds. There will surely be no time for pulling off the road and unlimbering or for setting up the machine gun tripods, after the planes are sighted. And no aerial attack will be made unless it can be a surprise attack, for surprise is the first requirement of a successful aerial attack according to Air Corps land attack tactics.

In 1928 and 1929 the writer was fortunate in that he was able to observe the work of the Infantry Board in its experiments in connection with its plans for Infantry anti-aircraft defense. While observing this, several definite ideas came to mind in connection with the application of these Infantry anti-aircraft tactics and technique to the Light Artillery. Based upon these ideas, the writer respectfully submits the following suggestions, hoping that they will prove of some benefit and interest:

1. Adopt the Matthews mount for the Field Artillery antiaircraft machine guns. (Illustrations 1 and 2.) Modifications will be necessary in the construction of the trail and lunette as follows: Since it must be hooked to the pintle of a caisson it must have a stronger and larger lunette, and due to the heighth of a caisson pintle from the ground, the trail of the machine gun cart must be made approximately one yard longer. As the downward thrust on the end of the trail with gun in traveling position is zero, the addition of a yard in trail length will increase this downward thrust to only about 5 or 10 pounds.

Advantages of the Mathews mount:

(*a*) When the trail is dropped to ground, it provides a sturdy rigid three point support (wheels and trail) for all types of firing.

(*b*) Due to small diameter of wheels, all-round fire can be obtained.

(*c*) Wheels are instantly and easily detachable (in 3 seconds) for the use of the gun either as a position defense against aircraft or for close defense against ground attack.

(*d*) Carries six boxes of ammunition (9000 rounds) and a steam condenser can, on the tray bolted to the front of the cart. This amount of ammunition is considered sufficient for normal uses of the gun as an emergency weapon in the Artillery. Extra ammunition would be carried in the combat train.

(*e*) The anti-aircraft adapter (Illustration No. 1,-B) folds down or up in 5 seconds, thus making it easy to change from an antiaircraft weapon (normal use) to a ground weapon.

(*f*) The inverted tank shoulder rest provides a firm support for the gunner in high angle fire and permits him to have his hands free while he traverses the gun by moving right or left on his feet, without having to move his upper body or take his eyes off the target.

2. Adopt the Boyd-Greene anti-aircraft sight (See picture of one of first models attached to gun in Illustration No. 1. The Ordnance model will be riveted to water jacket and of more durable construction.) This sight places the line of sighting parallel to, but at a distance of about one foot from the barrel of the gun, thus raising the line of sighting to the level of the gunner's eyes when he is firing at high angles using the shoulder rest. The sight and its use are fully explained in an article in the December, 1929, issue of the Infantry Journal. It will suffice here to state briefly that the principles involved are:—to furnish a large circular rear sight with double crosshairs (see Figure 3a and b) and a smaller circular front sight. The front circle is placed on the airplane target so that the target will cross the rear circle in either the vertical or horizontal lane between crosshairs. The amount of lead is obtained by placing the front circle and target at a certain relative position in the rear circle and keeping it there as the gun is traversed (as, say, tangent to left edge of rear

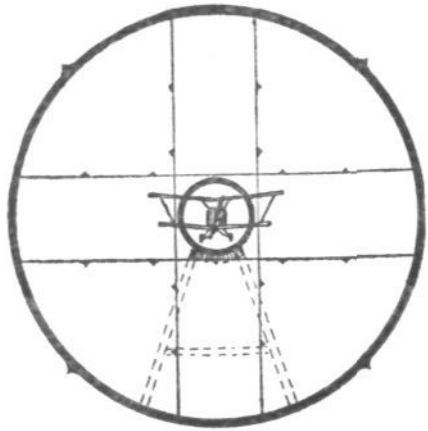


FIGURE No. 3A: ALIGNMENT OF SIGHTS FOR USE AGAINST AIRPLANE DIVING STRAIGHT AT GUN

circle if plane is traveling across the field of view from right to left.)

Advantages of the Boyd-Greene sight:

(*a*) It is the only anti-aircraft sight out of many tested by the Infantry Board that is simple enough to be practical for use

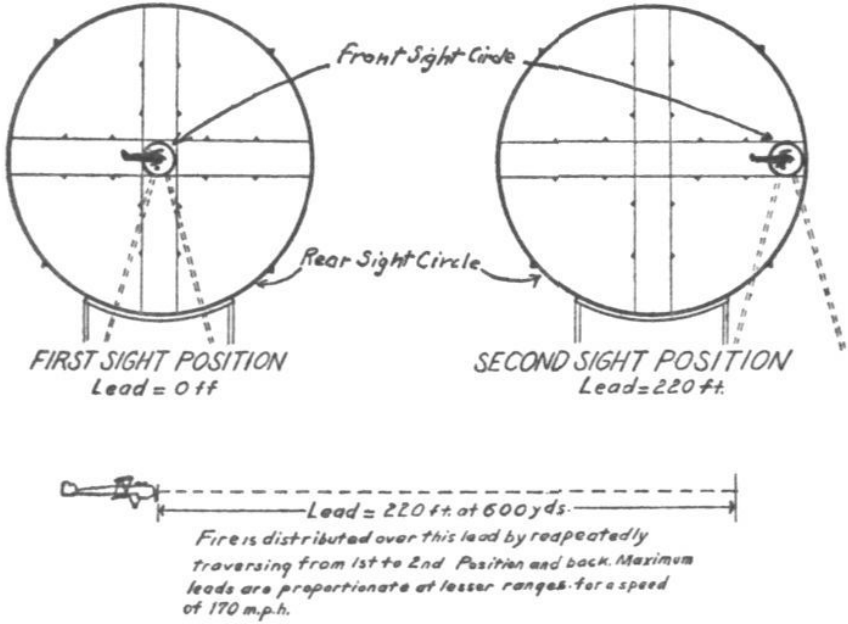


FIGURE 3B

by a machine gunner of limited education under stress of an aerial attack.

(*b*) It is rugged of construction and can be let down on the barrel out of the way of the ground sight when the latter is used for close defense.

3. Change the Table of Allowances so that four Browning machine guns (equipped as indicated above) will be furnished each battery of Light Artillery and four in each combat train. This will make each battalion of Artillery a self supporting unit in so far as anti-aircraft fire power is concerned, and will allow one battery on a detached mission at least a fighting chance to hold its own against an air attack, considering that the normal air attack will be made by three planes. Such an armament properly handled would imbue the enemy air corps with a wholesome respect for our Artillery's air counter offensive. After several planes had been shot down in each attack attempted, the desire of pilots to seek out Artillery targets might wane, if not vanish altogether.

4. Change the Tables of Organization so as to provide in a peace-strength organization two additional privates listed as members of one machine gun squad, and one additional corporal listed as Machine Gunner Corporal. This would provide one complete artillery machine gun squad (no ammunition servers, etc., being necessary as in the case of the Infantry) for operating one of the four guns in the battery for peace time training and would serve as a nucleus about which to build up the remaining three squads in the war time organization. Change the war-strength organization tables to provide for one Machine Gun Sergeant (mounted), four privates 1st class, machine gunners, and eight privates in the machine gun section. This would give a sergeant as Chief of Section of the four guns with one private 1st class, as gunner and two privates for each gun.

5. Adopt tentatively the following tactics for anti-aircraft machine guns of the battery:

(*a*) On the march: Machine guns numbers 1 and 2 hooked to the rear of the caissons of the first and second sections respectively. Machine guns numbers 3 and 4 hooked to the rear of the

two caissons of the fifth section. When action is eminent, machine guns to be kept loaded and with adapter set for anti-aircraft fire. Every member of the machine gun section to be equipped with the old style, battalion commander's siren whistle and to be on the lookout at all times for approach of enemy aircraft. Upon the sighting of an enemy plane, the siren will be blown by the first one seeing it, and will be the signal to drop the trails of the four machine guns, instantly, on the road or wherever they are and commence firing as soon as plane is within range—and for all other material with animals and personnel to deploy at the fastest possible gait in a fan-shaped formation. (See Figure 4.)

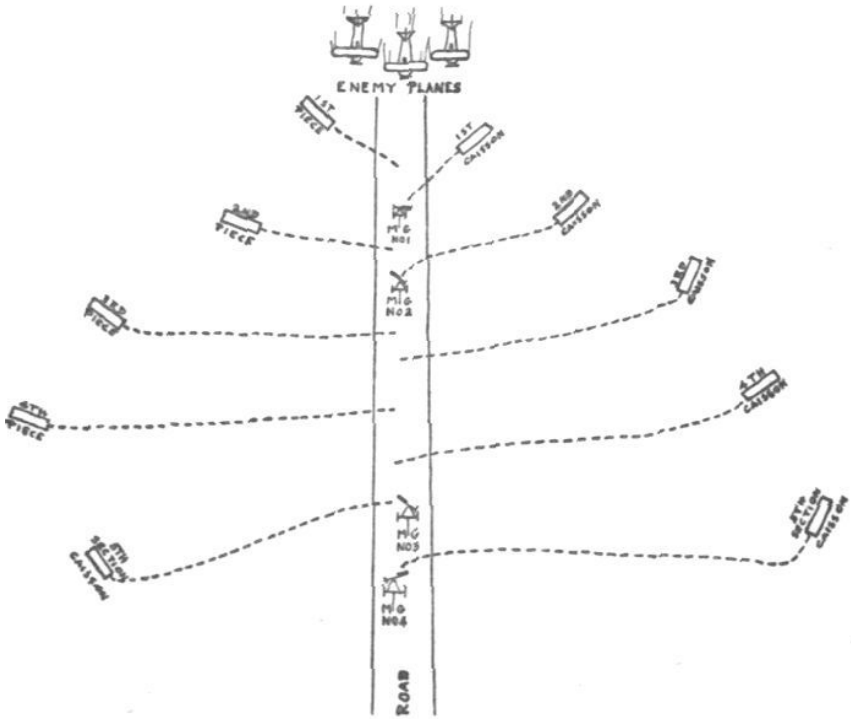


FIGURE 4

(*b*) In position: The four machine guns of a battery to be placed at the four corners of a rough square, about 25 yards apart and not more than 100 yards in rear of the gun position. For the battalion groupment, the machine gun groups of all

batteries should be placed close enough together to be mutually supporting and a pre-arranged plan should be worked out for the entire group, as to fire direction. Such a plan might follow the general rule that the machine guns of one battery will concentrate on that particular enemy plane of a formation which is nearest to their machine gun position. In general, each machine gun should be placed so as to have an all-round field of fire and, wherever possible, so as to be protected from the enemy's ground weapons, such as on a reverse slope. (See Figure 5.)

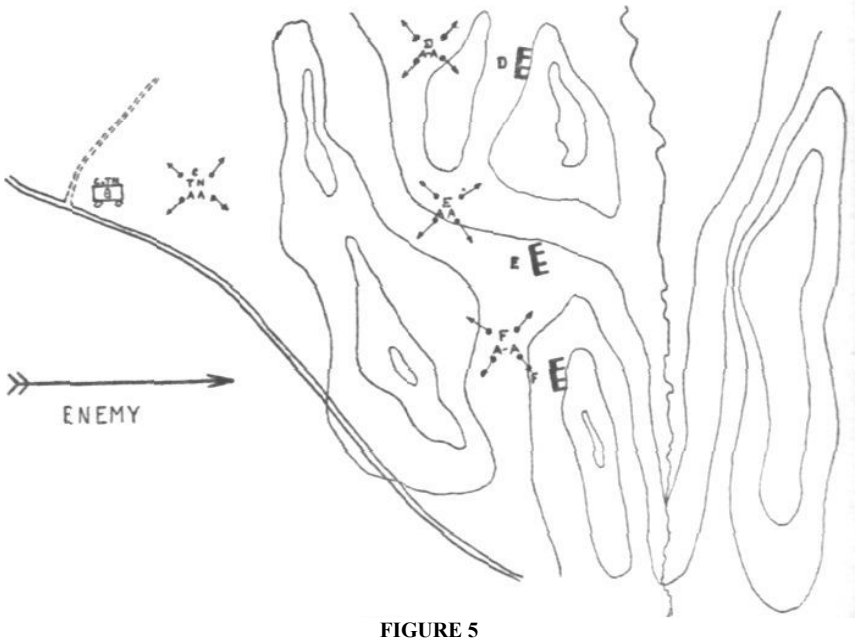


FIGURE 5

6. Include in the peace time training schedules of all batteries, the training of the machine gun squad as such.

Give extra pay and badges for qualification in anti-aircraft machine gunnery. Require in Training directives from higher headquarters attainment of certain standards in the use of this weapon in each subordinate unit, comparable to the standards required of units in the use of their primary weapons, the light Field Artillery gun or howitzer. Include in the Annual Knox Trophy Competition a test to determine the efficiency and proficiency

of the anti-aircraft machine gun section in each battery and combat train.

There has recently been appointed by the Adjutant General of the Army at the instigation of the Chief of Infantry, a board of officers consisting of two Infantry, two Air Corps and one Ordance officer for the purpose of conducting tests to determine the vulnerability of aircraft to all kinds of small arms ammunition and to the 37 mm. shell. The writer would respectfully recommend that one or two Field Artillery officers be added to this board or at least that permission be obtained for the Artillery Board to be sent a summary of the results obtained by this board.

As a final suggestion on the part of the writer it is recommened that liaison and co-operation be established at once between the Artillery and the Infantry in regard to anti-aircraft work, to the end that, when war does come, an efficient counter-offensive may be launched from the ground upon the enemy's first attempt at attacking Artillery and Infantry from the air.

FIELD ARTILLERY NOTES

F. A. Experimental Prime Mover Makes Extraordinary Run

The 3½-ton 6-wheel Garford truck which is under test as a prime mover for the 75 mm. all-purpose guns left Watertown Arsenal, Mass., at 4:00 A. M. October 4, and drove to Aberdeen Proving Ground, arriving at 8:30 P. M. the same day. The distance is 391 miles and the truck had an average speed of 27 m.p.h., with a maximum speed of 50 m.p.h. The total elapsed time was 16½ hours; total driving time, 14½ hours. The driving was done entirely by one man, Walter Fadely, Ordnance Department, Aberdeen Proving Ground. The gasoline consumption was approximately 65 gallons, or an average of six miles per gallon. Only two quarts of oil were added during the run. No water was added and there was no trouble of any nature with the truck. The truck had all the mount of the T3 gun on it except the tipping parts (gun and recoil mechanization). Illustrations of this truck are on pages 667, 668 and 670 of this issue of THE FIELD ARTILLERY JOURNAL.

Army Horse Show Team (F. A. Section)

The horse show team at the Field Artillery School, after almost making a clean sweep of the Oklahoma City Show, will appear in the Akasarben Horse Show at Omaha, Nebraska, from November 1 to 7, from there will proceed to the Wichita (Kansas) Show from November 10 to 14, after which it will perform at the American Royal Horse Show at Kansas City, from November 17 to 24.

Lieut. Edwin Y. Argo, team captain, was a member of the Olympic team in 1928 and is also a graduate of the Italian Cavalry School. Other members of the team are: Capt. Horace Harding, Lieutenants J. M. Callicutt, LeRoy Stewart and R. L. Taylor. They have some splendid jumping horses, chiefly Timber Cruiser, Wop, Drummer Boy, Southern Gold, Verdict, Ali Baba, Barrage, Jack, Murray Wilson, and Chandler.

Army to Participate in World's Fair, Chicago, 1933.

The War Department has started preparation of a plan for

participation in the World's Fair to be held in Chicago in 1933.

The plan contemplates certain troop participation and a series of exhibits which will cover the last hundred years in the Army, and demonstrate its military and civilian activities during that period.

The details of these will be worked out in the near future. To this end each Chief of Arm and Service has been called upon to submit, at the earliest practicable date, complete data for the exhibits which should be included to cover the activities of his Arm or Service. These data will consist of a list of items for exhibition, required floor, wall and ceiling space, the cost of the assembly of the proposed exhibits and an estimate of the required civilian and military personnel for installation, care and maintenance of the exhibits.

Secretary of War at Fort Sill.

For the first time since 1905 when the late William Howard Taft inspected Ft. Sill, the local post entertained a Secretary of War on October 14 in the person of Patrick J. Hurley. Secretary Hurley came to Oklahoma from Washington to receive an honorary degree at the A. & M. college in Stillwater and after spending the morning at Ft. Sill and attending a luncheon tendered by Brig.-Gen. Wm. M. Cruikshank returned to the city of Lawton, where he made several speeches and attended a dinner given in honor by the local citizens.

105 mm. Howitzers Issued to Troops.

Four 105 mm. howitzers have been issued to "A" Battery, 1st F. A., as secondary armament in connection with the work of the Field Artillery school. They will be observed also to determine their suitability as divisional light howitzer, as to whether any weakness in materiel developes and as to whether there can be improvements made in design.

Another battery of 105 mm. howitzers has been sent to Fort Bragg and issued to troops for extended service test. This 105 mm. howitzer has been designated as standard for some time.

F. A. Tests With Mechanized Force

In order to experiment with the tactics and matériel for a

mechanized force, the War Department has arranged for several mechanized elements of different arms to assemble at Fort Eustis, Va., for extended maneuvers and tests. Among other problems will be the study of what kind of Field Artillery is most suited for operating with an independent force consisting largely of fast tanks and armored cars. For this purpose Btry. A, 6th F. A., Capt. W. S. Egan commanding, has been temporarily stationed at Fort Eustis, where it will operate principally as a portée battery. In addition to portée artillery, there will be two self-propelled 75 mm. guns and a pack Howitzer mounted on a T2 experimental carrier chassis, and special bogies by means of which the 75 mm. guns can be trailed at high speeds behind trucks. Experiments will be made with these different types of artillery to determine which type is best to support fast moving tanks and armored cars using tactics somewhat similar to those employed by horse artillery when operating with cavalry.

The following Field Artillery officers who have had considerable experience with motorization or mechanization have been ordered to Fort Eustis: Capts, C. R. Toy and A. R. Wilson, 1st Lieut. E. A. Niblack and 2d Lieut. W. J. Latimer, Jr.

Horse-Drawn Battery Makes Excellent March

Btry D, 7th F. A., commanded by Capt. R. J. Sothern, F. A., marched from Boonville, N. Y., to Pine Camp, N. Y., a distance of 54 miles, on August 21, 1930, leaving at 6.40 A. M. and arriving at 6:30 P. M. The weather was fair and warm, the roads mostly concrete with wide dirt shoulders and the gait consisted of trotting wherever practicable up to 20 or 25 minutes per hour. No draft animals were less than 11 years old, ten being over 18 years and seventeen between 15 and 18 years. Of the drivers only five had more than 1 year's service and eleven had less than 6 months. Condition of men and animals upon arriving at Pine Camp: rather tired, but otherwise excellent. Condition of animals the following morning: excellent. Abrasions, lameness, etc.; only one—an old collar sore than had re-opened.

Salt water solutions had been used in massaging shoulders, necks and backs daily for three weeks previous. Animals were

conditioned for several weeks while working as demonstration for the reserve regiments.

Fort Sill Dramatic Club

At a well attended meeting of the Field Artillery School Dramatic Club held this week officers were elected for the school year 1930-31 and plans for the Club's activities were tentatively made. According to the present arrangements there will be three plays given during the school term and it is probable that the first of them will be staged during the last part of November. The officers elected for the ensuing year are: President, Brig.-Gen. Wm. M. Cruikshank; 1st Vice-President, Lieut.-Col. Rene E. de R. Hoyle; 2nd Vice-President, 1st Lieut. Roger M. Wicks; Secretary and Librarian, Mrs. J. F. Brittingham; Treasurer, 1st Lieut. Stuart M. Bevans, F. A.; Technical Director, 2nd Lieut. Frank M. Steadman, 1st F. A.

Field Artillery Officer Receives Training as Motion Picture Director

The Field Artillery is making three moving picture training films at Fort Sill for the instruction of officers and enlisted men. The pictures are entitled: "Harness and Harnessing," "Driving and Draft" and "Observation of Fire."

In order that these films should be up to date as regards technique of motion picture production, Lieut. Eleazer Parmly, 3d, of the Field Artillery School at Fort Sill, was brought to Washington and given a special course by the Signal Corps in the production of moving pictures. During his stay in Washington he was given technical instruction in the various Signal Corps laboratories which deal with photography. He spent considerable time in the Motion Picture Laboratory, Still Photo Laboratory, Engineers' Reproduction Laboratory and in the study of scenarios of our own and foreign military training motion pictures.

After completing this course in Washington, Lieutenant Parmly has returned to Fort Sill, where he will direct the shooting of the three films referred to above. When these pictures have been taken they will be sent to Washington for cutting, editing and finishing, after which they will be approved or corrected

by the Office of the Chief of Field Artillery and later issued to the regular civilian components of the Army for instruction purposes. It is believed that they will be available in their final complete form in about five months.

Chemical Warfare Training in the Army

The following are extracts from a lecture recently delivered at the Chemical Warfare School to the graduating class by Major William N. Porter, C.W.S., Executive, Chemical Warfare Service. The graduating class consisted of officers from the various arms, two of whom were Field Artillerymen:

"This Service is attempting to do something which it is charged with by law, but which is unique in a military way. Not only do we perform the necessary research and development work for our matériel, but we produce it, issue it to the army, and are charged with the training of the Army, and of our own troops, in its use both offensively and defensively. Ours is the only Chief who is specifically charged by law with carrying out the specialty throughout the entire Army, including the Organized Reserves and the National Guard. While the law and Army Regulations interpreting it are clear enough, we have found that it requires a very great amount of tact to carry out this unusual provision, and also all the assistance we can get from those controlling the training policies in the various corps areas, the Army schools, and in the War Department iself."***

"It is worth while to remember that, had the Germans opened gas warfare with chlorpicrin instead of with chlorine, it is very probable that methods of defense could not have been perfected against it in time for defeat to have been prevented."***

"There are in the Chemical Warfare Service some 92 officers. This is a smaller number than in any other branch of the Army, but even this little handful must be distributed over our technical, supply, administrative and training duties.

Concerned in the training end of the game there are two officers in Washington, the School personnel here (Edgewood Arsenal), an instructor at each of the service schools, one officer on duty with the National Guard, one with each of our two

Organized Reserve Regiments and one at the headquarters of each corps area and department. Each of the three mobile divisions now has a Chemical Officer, and one is assigned to the 1st Cavalry Division. The National Guard has a Divisional Chemical Officer for each Guard Division. We have, then, exclusive of officers on duty with our own small troop detachments, less than 30 officers of our own, and 8 officers of the National Guard whose duties are largely concerned with training. This is the little crowd who attempt to carry out for the Chief of our Service his duty under the National Defense Act of supervising the Army in its training in chemical warfare, both offensive and defensive."***

"A couple of years ago an officer from the General Staff was in my office attempting to belittle our figures as to gas warfare in the World War. His argument was to the effect that hardly one man out of three in the unit which he commanded who claimed to be gassed and who went to the rear, was in fact suffering from the wounds caused by chemical agents. He did not see that the power of these substances is greatly heightened by the fact that they could make vacancies in his unit by their mere existence."***

"We find considerable opposition to the setting aside of sufficient money for the manufacture of training masks. This opposition is effective because it comes from the minds of senior officers. The result has been an almost complete lack of knowledge of the gas mask which would be issued today to troops in case of emergency, and of the effect of its wearing on the tactical handling of those troops. Most of our high ranking visitors do not even know that the dear old mouth piece and nose clip have been missing for many years."***

"Except for the reservation on which we now are, no Chemical Warfare Officer commands anything, and the General Staff assignments from our very limited personnel will always be proportionately small. The power then to enforce the training which we advocate, must lie with you and others like you who study with us here. It is my special mission here this morning to ask your help on the part of the Chief of the Chemical Warfare Service."

ARTILLERY PANORAMA IN 1930

By LT. COL. E. L. MARRAS, G. S. ROYAL ITALIAN ARMY

Translated from REVISTA MILITARE ITALIANA, September, 1930

Artillery studies and tests since the war have dealt principally with the employment of artillery in open warfare and with improving its co-operation with the infantry.

Matériel

In general, the experience gained from the war has brought out the importance of three factors as regards matériel:

High angle fire;
Long ranges;
Strategical and tactical mobility.

The present trend of thought demands progress be along these lines.*

The usefulness of **High Angle Fire** is becoming more and more apparent. Increased range for howitzers gives them a greater sphere of action and their various propelling charges permit a more diversified employment and greater adaptability to various kinds of terrain and targets.

The necessity for a light howitzer is not disputed even in France where it is not assigned to troops for economical reasons.

Longer Ranges are the answer to modern ideas on eschellonment of troops in great depth, and they enable fire to be brought to bear on the enemy's rear installations. Longer ranges also enhance manoeuver of fire and guarantee more accurate fire at medium ranges. Longer ranges for light artillery enable these guns frequently to be used instead of medium caliber weapons, especially since in many situations medium caliber weapons are no longer so necessary because neutralization fire has to a great extent taken the place of destruction fire.

There has been some doubt as to the usefulness and necessity of increasing the range of division artillery in view of the fact that its present ranges are sufficient to manoeuver its fire in its division sector, and increasing the range would tend to divorce

*It may be stated that ranges for new designs of matériel are as follows: light gun—13 kilometers; light howitzer—12 kilometers; medium field gun—16 kilometers; medium field howitzer—14 kilometers; heavy gun—20 kilometers; heavy howitzer—18 kilometers.

the division artillery from its infantry by making the problems of liaison and co-operation more difficult. It is claimed that present ranges are sufficient especially in mountainous country where, as a rule, sectors of fire are small and greater ranges cannot be used to advantage. These arguments, to be sure, have considerable weight. However, they do not refute the argument that increased range, provided mobility is not sacrificed, is advantageous to division artillery for the following reasons:

a. Increased range allows greater fire manoeuver, particularly where sectors are large, as in open warfare and on the defensive.

b. Weapons with greater ranges have more accuracy when firing at medium ranges, than shorter range weapons when the latter are firing at their extreme ranges.

c. Greater ranges give more freedom in selection of positions because one is not so bound down by terrain considerations, particularly in mountainous country.

Since the war, naturally the desire for **Mobility** has been intensified. Here we may note a peculiar phenomenon: during a war everybody is trying to get more power for his artillery, yet in peace-time everybody becomes worried about mobility.

During the World War the 'power-versus-mobility' argument took on a peculiar aspect. The increase in power of artillery brought about by position warfare was accompanied by a development of startegical mobility of artillery which was obtained by means of mechanical traction.

Since the war great progress has been made in mechanical traction for artillery, especially for cross country movements; tactical mobility has thus been enhanced. So we see that the mobility requirements of matériel with greater ranges can thus be fulfilled even in open warfare.

It is hardly necessary to state that the experimental work which has been done towards fulfilling new artillery requirements has not been put into effect as far as transforming existing artillery armament of the leading armies is concerned. The financial burden of a change in armament is too heavy and the amount of matériel on hand from the World War is too great to take advantage of developments in artillery matériel in such a

TABLE A
SOME DATA ON POST-WAR MATERIEL

Name of Weapon	Weight in Btry. Kg.	Weight in Draft Kg.	Weight of Projectile Kg.	Muzzle Velocity m/s	X=Max. horz. Rn. Y=Max. vert. Rn.	Traverse	Elevation
75 mm. gun 35 Cal. (Schneider)	1510	. . . .	7.25	. . . .	X=13,000	50°	. . . .
75 mm. gun 40 Cal. (U. S. A.)	1450	. . . .	6.8	725	X=13,800	. . . .	. . . .
75 mm. gun 46 Cal. (Bofors Project)	1500	. . . .	6.5	700	X=14,000	60°	–10°+45°
84 mm. gun 30 Cal. British (Vickers)	1567	2305	7.5	505	X= 9,900	50°	– 5°+37°30′
85 mm. gun-how. 35 Cal. (Schneider)	1970	2310	10 8.8	635 550	X=14,000	. . . .	. . . .
90 mm. gun-how. 40 Cal. (Bofors)	1675	. . . .	10	625 215	X=14,000	56°	–10°+45°
105 mm. Dutch how. 22 Cal. (Haiha)	1540 1635	. . . .	15.8	440	X=10,350	6°	– 6°+40°
105 mm. Spanish how. 23 Cal. (Vickers)	1577	2480	12	457	X=12,000	9°	– 5 +37 30′
105 mm. how. 22 Cal. (U. S. A.)	1450	. . . .	15	457	X=11,000	. . . .	. . . .
105 mm. Greek gun 31 Cal. (Schneider)	3215	3775	15.65	660	X=15,000	80°	– 3°+60°
150 mm. 43 Cal. gun (Bofors)	10,200	2 loads 6200 8300	46	775	X=22,000	40°	– 2°+42°
155 mm. Jugoslavo gun (Schneider)	18,000	. . . .	50	900	X=26,000	. . . .	. . . .
155 mm. 45 Cal. gun (U. S. A.)	10,900	. . . .	43	. . . .	X=23,700	60°	0°+65°
76 mm. Anti-aircraft gun (U. S. A.)	1950	5300	. . . .	730	X=11,000 Y= 7,700	360°	0°+80°
75 mm. 40 Cal. AA gun (Schneider)	1980	. . . .	6.5	700	X=14,500 Y= 9,500	360°	0°+90°
80 mm. 50 Cal. AA gun (Bofors)	3100	4000	8	750	X=14,500 Y= 9,700	360°	– 3°+80°
105 mm. 60 Cal. AA gun (U. S. A.)	. . . .	. . . .	14.9	850	X=17,400 Y=10,400	. . . .	. . . .

short period of time. However, much has been done in tactics about new trends of development which undoubtedly will be heard from more in the future when re-armaments take place. For the time being, and probably for some future years, improvements in the artillery armaments actually issued to the troops will be confined to perfecting the shape of projectiles* and improvements which can be made on existing matériel. Perhaps the greatest progress has been made in matériel especially designed for anti-aircraft and anti-tank purposes.

Special attention has been given to the study of weapons for armored and self-propelled cars, particularly of small caliber. Some officers see the solution of accompanying artillery in this direction.

Thus we come to the problems of motorization and mechanization, which from an artillery point of view would seem to have somewhat the following aspects:

a. Motorization: a great spread of mechanical traction, particularly for heavier calibers of artillery, within limitations imposed by use in mountainous country, financial considerations and the advisability of taking advantage of the animal and forage resources of the nations.

b. Mechanization: the limitation of self-propelled artillery to accompanying artillery, and possibly to part of the supporting artillery, anti-aircraft and anti-tank artillery.

Table A shows some data on the latest types of artillery.

In conclusion it may be stated that in the various foreign armies artillery development is along the following lines:

a. Propelling charges which will cause less erosion.
b. Relining of light artillery tubes.
c. Improvements in fuses.
d. Mechanical data computing devices.
e. Sound ranging devices.
f. Listening devices, search lights and other subsidiary means for anti-aircraft defense.
g. Equipment for improving liaison.

*Here it should be noted that the experiments in increasing ranges by improving the shape of projectiles have been very disappointing in some countries because of the increased dispersion which accompanied the increase in range. *e. g*. the French 75 mm. gun firing new shaped projectiles had a probable error of 204 meters at 10 kilometers or a dispersion pattern more than 800 meters long.

ORGANIZATION

The general trend of thought towards warfare of movement has brought about reconsideration of the matter of assigning and distributing artillery to appropriate commands.

It appears that on the whole the quantity of artillery assigned to organizations is less than during the war.

The Italian division artillery consists of guns and light howitzers, as in Germany, and also pack howitzers. In France division artillery consists of light guns and medium caliber howitzers. However, it should be remembered that the lack of light howitzers in France is greatly deplored. On the other hand it should be noted that the Italian lack of range in her heavier field howitzers necessitates their decentralization. Italy has been very logical in assigning to a division organically the artillery which is considered necessary for supporting action. Other missions can probably be given to re-enforcing artillery which may be attached to first line divisions in large quantities, particularly for the attack.

It is evident that the amount of artillery employed in war of movement is less than that seen in the big battles of the World War, not only as regards numbers of guns, but also as regards allowances of ammunition.

In view of the well founded doctrine of the inviolability of the divisional organization, and in view of the fact that it appears that it will only be possible to bring forward artillery of reserve divisions in special cases, it appears that there will be a real necessity for a general reserve of artillery, particularly of light and medium field artillery. This general reserve must have great mobility, both strategic and tactical. In this connection one should note the decided tendency to push forward large masses of artillery and attach them to divisions. The Italian regulations forsee that even in approach marches the division will have attached to it, in addition to its organic units, the following:

a. Long range artillery accompanying the advance guard, but under the orders of the Division Commander who uses it on missions assigned him by the Corps Commander.

b. Light artillery for re-enforcing purposes.

c. Medium and heavy artillery.

d. In some cases, usually in the last phase of an approach march and in the attack, light artillery from the division in rear.

This tendency is quite the opposite from the ideas prevalent during the World War, especially in France and Italy, to the effect that during these phases the artillery should be under centralized command in the major units (Corps, etc.). On the other hand it should be remembered that decentralization was always practiced by the Germans who had a tendency to confine the subject of employment of artillery to the division.* The Germans normally assign counterbattery missions to the division, whereas in other armies counterbattery is a corps function and distant interdiction is an army function.

In concluding these remarks on artillery organization, two points which have come up recently should be noted:

a. The assignment of artillery organically to infantry regiments. This idea coincides with the tendency to have within the division mixed units composed of infantry and artillery.

b. The organization of artillery into 6-gun batteries, in order to economize personnel and equipment. It is true that the overhead of a battalion of 12 pieces of artillery would be sufficient for an 18-piece battalion, but the effectiveness of three battalions of 12 pieces each, would certainly be greater than two battalions of 18 pieces each.

CONDUCT OF FIRE

The adoption of new methods of procedure, based on accurate topographic and ballistic preparation of data, has been included in the training regulations which have been published since the war. This is natural because the lessons of the war showed the usefulness and even the necessity of the new methods particularly because they were the only means of obtaining surprise and manoeuver of artillery fire. Thus the post war period has confirmed and diffused these new methods, but at the same time has kept and put into effect again the rapid methods of preparation of data, in view of the fact that the latter are the only way to meet certain urgent or special situations.

*Except on the defensive in warfare of position where the corps often became a sort of reserve of artillery and directed the activities of the long range and heavy artillery of its sector.

Particular importance has been given to rapid organization of fire and rapid topographic preparation in view of forseen wars of movement. All this means that the normal operations for obtaining data in stabilized conditions will be done more expeditiously, yet with sufficient precision for open warfare. The essential element is the amount of time available.

However, it appears that in open warfare division artillery will rarely be called upon to manoeuver its fire to any great extent during the approach march phase, but it will most decidedly have to do so from the moment the advance guard has been launched into combat. But this combat would be preceded by a deployment of all the artillery at hand and a bringing up of the heavier calibers. This in turn would give plenty of time for the necessary topographic work.

Present ideas about warfare of movement have had considerable effect on the assignment of fire missions. The necessity for surprise and limitations in the number of organic artillery weapons and ammunition have brought about a complete conversion to neutralization operations. Neutralization proved itself effective in the last years of the World War. Furthermore, in assigning fire missions certain procedures which use up a lot of ammunition have had to be discontinued, for example, systematic employment of both fixed and moving curtains of fire (barrages).

The use of barrages, although they have not been entirely ruled out, has become very limited nowadays even in countries like France where World War procedure is still to a great extent in vogue. Instead of barrages the idea at present is to have brief and intense concentrations.

TACTICAL EMPLOYMENT

Preparation for warfare of movement has caused us to review our ideas on employment of artillery in meeting engagements, especially since the World War did not give us many lessons in this respect. The principal new ideas are on the following subjects:

a. The employment of artillery in the approach march and in advance guard actions.

b. The simplification of procedure in the attack and defense.

The school of thought that flourished during the World War which subordinated infantry action to that of artillery has been abandoned. It is now well established that the infantry is supreme as regards operations. However, one must also take into consideration the needs of the artillery in order that the latter may operate to better advantage in assisting the infantry. For this reason it is necessary that the decision as to the direction of the main effort be based upon the ability of the artillery to function properly in assisting it. German training regulations are the most explicit in this connection. They state that the lines of resistance should be determined largely by the location of artillery O.P.'s.

As regards approach marches there are now two prevalent ideas. According to the Italian idea, which in principle is the same as the French, approach marches are made in bounds both by advance guards and by the main body. Advance guards do not normally contain artillery, but their operations are assisted by artillery in position belonging to the main body.

According to the German idea, advance guards should be assigned long range artillery and they should proceed with more freedom, subordinating their movements only to the mission assigned them as regards initiating combat. The German advance guards would be quickly supported by the artillery assigned to them. On the whole it may be said that this latter procedure is conducive to great drive and vigor within the limitations established by the commander of the whole force. The artillery of the main body is held in readiness to intervene promptly as a result of rapid reconnaissance and deployment. According to the Italian and French doctrine the main idea is to co-ordinate the operations of the advance guard and main body, and to hold the artillery under centralized control under the commander of the main body who is thus able to control operations in the earlier phases of combat by means of the action of his artillery. On the whole this procedure is safer and more methodical, but perhaps slower and more laborious. The artillery is thereby enabled to initiate and to carry on its reconnaissance and occupation of position in an uninterrupted manner. According to

the German doctrine the approach march is conducted in a looser manner, but with greater speed, particularly in wooded or broken terrain. But the German method does not insure such a continuous domination of the terrain over which the fighting is to take place, especially as regards the operations of division artillery. Both doctrines have their advantages and disadvantages. The German procedure would in many cases be very proper, but in mountainous regions it would appear that the Italian method is better in most cases.

One characteristic of post-war ideas on employment of artillery is the entry into action of long range artillery at a relatively early moment as compared with the time of entering into action of the light artillery. This idea has received special favor in Italy.

In the past, artillery entered into action by deploying division artillery first, and longer range artillery later. This was due to the position of the artillery units in the march column, also to the targets and fire missions of the heavier calibers and their more limited mobility. Today the idea is to anticipate the missions of the artillery as a whole and to bring into action first the matériel with long ranges. This doctrine is based on the advantage which one may obtain by striking the enemy as soon as possible in his rear zones where ordinarily troops will still be massed. Another reason is that by doing this the enemy's plans of operations may be brought to light at an early moment especially as regards his dispositions in depth. Another point is that the artillery on the defensive always attempts to fire on attacking infantry as soon as possible, whereas the artillery of the attacking infantry naturally tries to operate against the artillery of the defense in view of the fact that the latter is the chief hindrance to the attacking infantry during the early phases of a meeting engagement.

This conception is profoundly different from that of pre-war days. This is because we now have aerial observation and it alone directs the action of long range artillery in the first stages of a meeting engagement. In pre-war days without aerial observation such missions for long range artillery could not be

assigned because they were not known until operations were well advanced.

The last phases of the World War brought out the necessity of short **Artillery Preparations** and there were even examples of omitting artillery preparations altogether, and relying on tanks. In warfare of movement one can not but admit the necessity of a short preparation for the sake of neutralization. This idea seems to be prevalent in all armies although their regulations do consider the possibility of operations without artillery preparation. The Italian regulations, although they lay great emphasis on rapid movement, state that attacks without preparation should be absolutely exceptional: "Only with smothering artillery superiority and absolute air supremacy and with the employment of a large number of tanks, should the preparation phases be reduced to such an extent as to make them of no practical importance." In another place the Italian regulations say, "The employment of tanks or armored cars does not of itself justify doing away with preparation phases, even if they are used in great quantity." And again: "Preliminary counterbattery will always be necessary in an attack, even more so now because as soon as the tanks appear hostile artillery will open fire on them and on the infantry that follows them."

German training regulations likewise insist on the necessity of the preparation, but they admit that in some cases it can be dispensed with in order to obtain surprise, even when attacking fortified positions. In France the use of artillery preparations is normal, but they admit that it can be made very short or even eliminated when using a sufficient number of tanks or when operating against demoralized troops or against forces which are not well protected by obstacles. However, the employment of tanks without artillery preparation does not warrant omitting intensive counterbattery action which must be simultaneous with the advance of the tanks on account of the fact that artillery is the most dangerous enemy of the tanks.

British regulations do not insist so much on the necessity for artillery preparation, and they bring out the importance of the surprise element. "Preliminary bombardment of more than a few minutes should rarely be undertaken. However, a bombardment

may be necessary if the enemy is defended by a wire entanglement or other obstacles and there is no other method of destroying such obstacles except by artillery fire."

On the whole everybody admits the necessity of artillery preparation even in warfare of movement, under the condition that it be as short as possible and that the idea of neutralization be paramount. Due importance is given to the fact that the number of automatic weapons is greatly increased and that the amount of support which can be expected from the artillery is diminished on extended fronts. These facts bring out the importance of artillery preparation, but on the other hand it is argued that the use of smoke would tend to diminish the necessity for artillery preparation.

On the whole it is generally agreed that the essential functions of division artillery during attack are the following:

a. Support of the infantry.

b. Accompaniment.

c. General utility, or what the Italians call in their 1928 regulations "cooperative action".*

Italian regulations do not make the distinction between "general utility" and "support of the infantry" in view of the fact that division artillery during the attack should be used entirely for support. However, a distinction is made between artillery battalions which have liaison with commanders of various attacking columns or first line battalions and with battalions which remain under the direct orders of the Division Commander.

The Italian regulations also omit any mention of accompanying action by the artillery, *the idea being that accompaniment should be carried on by the infantry with its own weapons*. However, it is admitted that artillery units may be put under the direct orders of the commander of a column when it would not be practical to depend upon the artillery support of the main force to support the column.

In the German regulations, which give great importance to

*The general utility function of the artillery is a function of the Division Commander who gives instructions for re-enforcing the support already allotted to the infantry by manoeuvering the mass of fire of his artillery against targets which are of a general interest to the whole command such as counterbattery, interdiction, etc.

the employment of artillery in the division, there still exists the old tradition of artillery for close support and artillery for distant support. These regulations admit, however, that this distinction may have to be omitted at times due to special situations, terrain or the amount of artillery available.

The French regulations make a sharp distinction in this respect. In practice, however, the general support (action d'ensemble") appears not to have developed as much recently as has the idea of direct support. They believe that in some cases general support may even be done away with, for example, in operations with limited objectives in open warfare or in attacks which have been organized quickly. It is granted that this is because when there is not time for making detailed plans the infantry can better be helped by close support, but if time were available more power and more dense concentration would be afforded by general support. The latter however, is slower and does not necessarily answer the real needs of the infantry.

This problem of course is connected with the idea of **Decentralization of Artillery,** a subject which always brings forth hot discussions.

In Germany decentralization is in highest favor especially for warfare of movement. Starting with infantry cannon which are organically assigned to infantry regiments, these guns are decentralized for operations by assigning them to battalions or even companies. Then they forsee the use of light batteries being put directly under the orders of the infantry especially where the terrain does not permit the artillery to support the infantry effectively otherwise.

In the French regulations such decentralization is admitted only to a very limited and temporary extent and for well defined missions.

As already stated, the Italian regulations do not mention accompanying artillery, but they do foresee the necessity of putting some artillery at times under the direct orders of a column commander, a procedure which would occur most frequently in pursuit. Centralization as regards the artillery is also important in respect to economy of ammunition, particularly in warfare of movement.

The tendency in Germany to organize mixed units containing both artillery and infantry, particularly in the infantry regiments, has already been touched upon. Such organic mixed units would certainly give greater service so far as co-operation is concerned, but it is doubtful if on the whole they would be advisable, especially when one considers the relatively small amount of artillery which can be carried by a division. This point alone would make it appear that a somewhat centralized organization of artillery is more desirable. It can also be stated that on the whole it does not appear proper to complicate and weigh down the movements of infantry units which are already complicated enough. Furthermore it hardly seems right to assign organically to infantry units weapons which have greater sectors of fire than the units to which they are assigned. It also would appear improper to impoverish the Division Commander by taking away from him one of his most important instruments for exercising control of operations. Here it should be noted that this instrument will be even more effective in the future as liaison develops along with developments in radio.

There have been noteworthy changes in ideas as regards procedure in **Artillery Support and Protective Fires.** Here the tendency is to give up the idea of the use of continuous curtains of fire, because they eat up too much amunition and the results obtained from them are too uncertain.

In place of curtains of fire (barrages) the tendency today is to substitute concentrations on actual or presumed targets. Italian regulations exclude barrages in support of the infantry and authorize them only for protection against surprise, limiting them to the initial phase, after which fire must be conducted according to circumstances.

The French appear to be more attached to World War procedure, yet they consider rolling barrages exceptional. They would use them only in attacking strongly organized positions. On the other hand they consider successive concentrations on positions to be occupied as normal.

The Germans go so far in the other direction as to consider rolling barrages as a form of support even in meeting engagements and they also would use protective barrages in defense.

Everybody admits, however, that defense primarily is based upon infantry automatic weapons.

Counterbattery has also received considerable attention, for in warfare of movement it presents greater difficulties than in stabilized operations. Meeting engagements require that counterbattery activities start early in the game, notwithstanding the difficulty that exists on account of long ranges, deep echelonment of artillery, difficulty of terrestrial observation, scanty time, few readily available batteries and difficulty of getting ammunition forward. The assistance of aerial observation is absolutely indispensable in locating the enemy's batteries promptly in meeting engagement. Neutralization is the normal procedure.

In counterbattery operations it is claimed that light artillery is very useful and at times necessary; useful, because light artillery has considerable destructive effect; necessary, because corps artillery in certain conditions could not get into action promptly enough or in sufficient quantity.* There is a school of thought in France which believes that in certain phases of a preparation division artillery should be used to assist in re-enforcing the regular counterbattery units.

In the Italian regulations it is stated that division artillery will normally assist in counterbattery against particularly harmful

*Lieutenant-Colonel Buchalet in the July 1928 Revue d' Artillerie (France) calculates that in order to neutralize a hostile battery it would be necessary to put the following numbers of rounds in an area 100 meters square:

100 rounds of 75 mm.
or 80 rounds of 105 mm.
or 50 rounds of 155 mm.

If the area occupied by the hostile battery were 120 meters square and at a range of 10,000 meters, the following number of rounds would be required for neutralization:

240 rounds of 75 mm.=2.4 tons
or 195 rounds of 105 mm.=4. tons
or 120 rounds of 155 mm.=6. tons

In order to fire this amount of ammunition in two minutes (the proper length of a neutralization concentration) the following number of pieces would have to be employed:

8—10 75 mm.
or 10 105 mm.
or 25 155 mm.

The advantage of the smaller caliber for counterbattery neutralization is therefore obvious.

In order to destroy a hostile battery it is calculated that the following is necessary:

800 rounds of 75 mm.= 8 tons
400 rounds of 155 mm.=20 tons

Here also the 75 mm. shows up to better advantage, provided the hostile battery is not under cover, in which case of course the 75 mm. projectile is ineffective.

enemy batteries which can not be silenced promptly by the corps artillery. The same appears in the German doctrines.

On the whole there appears to be a noteworthy tendency towards placing the responsibility for the employment of the mass of artillery on the division. The division seems to be becoming the basic unit as concerns the employment of artillery. This has been set forth explicitly in the German doctrine. This tendency brings out the necessity for rapid organization of counterbattery fire based upon prompt installation of observation activities, principally aerial, prompt obtaining of information and rapid determination of fire missions.

This trend toward making the division responsible for so much of the artillery's operations brings up the necessity for giving an artillery headquarters to the division in addition to the headquarters of the organic division artillery troops. The division artillery headquarters should be made organically able to take on numerous attached artillery units and control their various missions and needs.

In conclusion, the trends of today as regards employment of artillery are as follows:

a. Adoption of procedure in artillery preparations and organization of fire which are suitable for operations in open warfare. In other words, a reconciliation between methodical procedure and rapidity.

b. Simplification of tactical procedure based on great versatility and above all on economy of means.

c. The relatively more important role to be played by the artillery in warfare of movement as compared with pre-war ideas, particularly as regards operations of the artillery in advance guard actions, deployment and organization of the attack.

d. The preparation for early entry into action of long range artillery both in the attack and on the defensive.

e. The great complexity of duties assigned to division artillery.

f. The tendency to solve problems of accompanying artillery by assigning guns organically to the infantry.

g. Great elasticity as regards centralization and decentralization of artillery command.