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EDITED BY
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BATTERY C, 130TH FIELD ARTILLERY, IN ACTION NEAR VARENNES, FRANCE SEPTEMBER 27, 1918.

THE FIELD ARTILLERY JOURNAL

VOLUME XXV JULY-AUGUST, 1935 NUMBER 4

THE LIAISON PROBLEM

BY MAJOR JOHN S. WOOD, Field Artillery

SINCE the war the floods of ink loosed in the discussion of infantry-artillery liaison seem to have carried no one to a definite and satisfactory solution; but they have served to emphasize the difficulty and the importance of co-operation between the two arms and the need for thorough understanding between their officers. Of primary importance in this co-operation is the problem of close support in the attack. Hence a study of recent foreign thought on the subject may be of interest and benefit to both artillerymen and infantrymen of our Army.

THE FRENCH VIEW

In the *Revue d'Artillerie* for August, 1934, Colonel Buchalet of the French Artillery discusses the application of fire on demand from infantry or from forward artillery observation posts. He considers that conditions of observation are similar in both cases (danger from machine gun and artillery fire, lack of precise observing instruments.* difficulty of communication with batteries) and that both must use very simple methods of handling fire. He rightly likens the situation of these observers to that of air observers, with the added disadvantage of inability to see the terrain as a whole. Like the air observer, the forward observer must be the eye of the artillery, transmitting to the guns all that he sees. He indicates the nature of the target, the location of its center, and its front and depth when possible. He may also indicate the urgency of fire; the possibility of observation; and, if he happens to be the commander of the firing unit, the number of rounds. This is all—the choice of means to carry out the mission must be left to those in charge of the guns. In fact, in any well trained unit, the indication of certain missions calls for certain known reactions which have only to be applied with discernment

*Periscopic aiming circles are suggested as equipment for these observers by a German commentator in the *Militär-Wochenblatt*, March 11, 1935.

and decision by those in rear. Hence these indications can be made in very simple terms—the simpler the better, in view of the precarious communications of the forward observers (visual signalling or radio telegraph most often).* The voluminous codes of the regulations must be shortened and simplified.

Colonel Buchalet sees no practical way of reporting targets other than by rectangular coordinates. He assumes that the observer will have a map and be able to locate himself on it, tying in the targets with this location by means of polar coordinates in the usual artillery fashion. He recommends a small range finder sufficiently accurate for ranges of 2 to 3 kilometers as part of the observer's equipment. With this, the errors in location would not be greater than those of the map, i. e., 1/1,000 of the scale or 50 meters for the 1/50,000 map.

For his study of artillery support on demand from front line infantry, the author considers the case of contact during the approach march and that of the advance after gaining the initial objectives.

In the first case, an infantry regiment is moving forward on a wide front, say 1,500 meters per battalion. It suddenly finds itself under distant machine gun fire sufficiently heavy to cause considerable losses and to stop the advance. Its 37's and mortars go into action and its observers search the distant crests for signs of the enemy. Within the regimental zone of advance the supporting artillery, one *groupe* of 3 batteries, is moving forward by bounds. Two batteries are in position and the third is hastening to join them. The *groupe* observation post has been selected; and the *groupe* commander proceeds there, leaving his liaison officer with the infantry colonel. The infantry battalion commanders have as liaison agent an artillery non-commissioned officer with one mounted messenger (motorcycle or horse).

In order to obtain artillery support in this situation, the infantry battalion commander must first locate the objectives. For this he has his map and the observation section of his machine gun company with its instruments. He must then get the information back to the batteries. He is in communication with his regimental command post by radio, runner, and perhaps visual

*Two radio telegraph-telephone sets are soon to be issued to each French artillery *groupe* of three batteries.

signalling; while his only direct communication with the artillery is by messenger. The call for fire is therefore sent through the regimental commander by radio; for example: "Request fire on enemy machine guns at 75-25." The liaison officer then passes the call on to the artillery by messenger, or perhaps by telephone. A zone fire is prepared from the map and the artillery *groupe* observation post is notified to observe if possible. About all that can be expected from observation at this time will be control of the zone fired on. Such fire will at best be delivered after a delay of not less than 30 minutes and will entail errors of 200 to 300 meters—a point to be remembered well by the infantry.

After the first phase of the attack, which in the French conception is made by time table, further artillery support must, in the author's opinion, consist of zone fire: concentrations of fixed duration immediately ahead of the infantry or box barrages around advancing tanks. The most important information to be supplied the artillery at this stage is the exact location of its own front line infantry—a difficult task for the lone artillery non-commissioned officer with the infantry battalion. Calls for fire will be less difficult—simply the designation by letter of concentrations fixed in advance.

Colonel Buchalet concludes that the basis of all liaison is the map, no matter what the situation; and he recommends much attention to its study by non-commissioned officers as well as officers of both arms. He makes the usual recommendation for combined exercises by infantry and artillery battalion commanders and staffs.

THE GERMAN COMMENT

The *Militär-Wochenblatt* of March 11, 1935, gives a detailed review and discussion of Colonel Buchalet's article. After recommending its study by German infantry officers as well as by those of the artillery, the reviewer remarks, "It is interesting to note that no satisfactory solution of this problem in the attack has been obtained by the French in spite of their self-acknowledged pre-eminence as masters of the methodical advance and as artists in the organization of fire."

In discussing the French conception of supporting fire during the meeting engagement, the author says, "In our doctrine, requests for fire support at this stage will not have to pass through such channels. Premature deployment of the mass of the artillery in the approach march may result in lack of support in the real fight later on. We consider that proper use of air and ground reconnaissance will give the necessary information as to the locations of main defensive organizations against which our artillery must be deployed in mass. Furthermore, with carefully trained troop leaders of infantry and artillery, I do not foresee as many difficulties as Colonel Buchalet predicts."

He continues, "In this age of radio communication the renunciation of observed fire must be very exceptional. * * * The use of unobserved fire entails the covering of large areas, but Colonel Buchalet, unfortunately, does not tell us how to accomplish such a distribution of fire."

"In every line of the article," he remarks, "there speaks the war experience of the French artilleryman who has personally seen so many carefully prepared offensives with reinforced artillery support come to grief in the deep nets of the German defenses. In view of his tactical doctrines, it is not surprising that the Frenchman finds no remedy except in a series of lesser attacks on such fronts and to such depths only as the artillery can cover and support effectively. Without artillery or tank support the attack—*the fire which advances,* as the French see it—cannot progress."

The reviewer notes with satisfaction that the difficulties of liaison appear as great to the French as to the Germans, "if not more so." In comparing the French artillery doctrine with that of the German combat regulations, he emphasizes the fact that the French pay particular respect to the fire power of heavy infantry weapons. "From this fact arises their methodical treatment of the attack. However, they have arrived at no satisfactory solution of the artillery support problem after the advance beyond the first objectives. They seem sure that the advance can continue according to their preconceived fire plans. But to accept this as a principle appears dangerous, for it can hardly fail to paralyze the initiative of subordinate commanders and prevent the rapid exploitation of a lucky break (*Zufallscrfolge*). In future wars when the devastating fire of machine guns must be mastered in zones beyond the definitely located fieldworks of the enemy, unforeseen situations will arise which, under the prompt handling of resolute front line commanders, may lead to a great success. Under such conditions, only that artillery which has been given free rein and which, without awaiting further orders, will come promptly to the aid of the *man who advances* with the observed fire of its guns can be said to have established real liaison with its infantry."

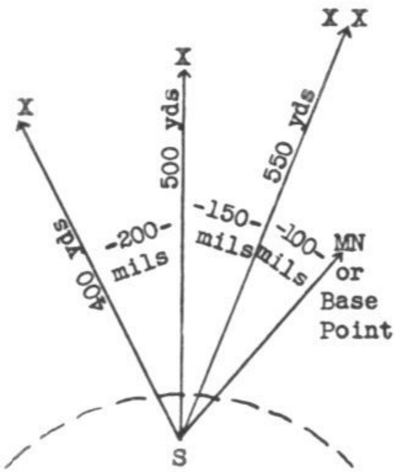
THE BELGIAN VIEW

The *Bulletin Belge des Sciences Militaires* devotes a portion of its April number this year to a study of liaison by Lieutenant-General Grade. This officer considers the problem mainly in its relation to training.

He begins by emphasizing the need for a well defined idea of maneuver in each tactical situation which serves as a basis for the liaison exercise. The commander of each echelon, while keeping to the main lines of his mission, must always be ready to stage a maneuver in aid of his elements whose advance has been halted. This maneuver may be made by infantry action alone or with the aid of supporting artillery. The author agrees with the Belgian combat regulations that, in principle, the right to bring artillery fire into action during an attack cannot be delegated to echelons lower than the infantry regiment. Front line battalion commanders have an artillery non-commissioned officer with them as liaison agent, but they must address their demands for fire to their colonel, who then makes the necessary arrangements directly with the commander of the supporting artillery.

The infantry must locate the objective, indicate its position on a map or sketch together with the position of its own front line elements, and then bring it to the attention of the artillery. Precise map locations of targets can hardly be expected from infantry platoon or company commanders under fire in the front lines. Even approximate map locations of their own positions will be difficult. They must be trained, therefore, to give clear indications of the objectives on the terrain itself for identification by more distant observers, in particular by their battalion commander. A form similar to our field message blank is suggested for transmitting such information. The form requires a sketch showing the sender's position, the location of his front line, and the polar coordinates of objectives.

Unit ....
Date ....
Time ....



Message

Advance stopped by infantry weapons as shown.

S—My position
X—Machine guns
XX—Infantry cannon
........—Our front line

(Signature)

The sender's station is indicated by rectangular coordinates and angular measurements to objectives are made from the north or preferably from the line to a known reference point.

The battalion commander is responsible for transforming the information for use by the artillery. In this he has the assistance of his artillery liaison agent. In such a situation the battalion commander must decide whether or not artillery fire is needed in his maneuver against the enemy. Undoubtedly, an ineffectual attempt with the means at hand will react unfavorably on the fighting power of his battalion. On the other hand, a call for artillery intervention means delay under fire for a considerable period.

The errors in location of enemy weapons may be as great as 150 yards, and not all the dangerous ones will be located in any case. Under these conditions, unobserved supporting fire must cover excessive zones, in view of the limited ammunition at hand and the need for prompt exploitation by the infantry. Observed fire must be the rule, and the time required for establishing proper observation must be allowed.

When the battalion commander deems artillery support necessary, he must request it from his regimental commander. This done, he sees that the objective is identified by the artillery liaison agent. The latter transmits the necessary information to the artillery observer who is covering the sector. At times, in flat or wooded country, the observer may be compelled to go to the position of the front line company commander to see his target.

The colonel arranges his maneuver after consulting the supporting artillery commander. He then informs the battalion commander of the time of opening fire and of its duration. In this connection, General Grade emphasizes the importance of signalling to the front line the exact moment when a concentration is completed. He believes that it can be done best by an increased cadence of fire followed by a brusque cessation of all pieces at the same instant. Smoke or high bursting shell in the final volley may be useful. He also emphasizes to the infantry the difficulty of cancelling calls for fire once the arrangements are made.

General Grade concludes that the grave inconveniences resulting from the slowness and difficulty of infantry-artillery liaison have led to the system of preconceived concentrations on suspected localities, lifting by schedule or by infantry signal. He realizes the imperfections of this method but, like Colonel Buchalet, he finds no better solution.

In his annex on fire and observation, the author cites the regulation requirement for rapid mass concentrations of 100 to 150 rounds of 75mm per hectare (10,000 square meters) of not more than 5 minutes duration. Since a *groupe* of 3 batteries can cover only about 5 hectares at one time and since the defensive zone to be neutralized may often be much greater (200 to 400 meters wide and 150 to 300 meters deep), the offensive maneuver must either be made in two or more phases or aid must be obtained from the artillery in general support. This again requires time.

Observation in the Belgian artillery is organized like that of the French, with one advanced post for each supporting *groupe* or groupment. In general, all three batteries are handled from this post which moves forward by bounds as the attack progresses. General Grade emphasizes the necessity for additional advanced observation, either one post per front line battalion or one per company. In the first case, the observer remains with the infantry battalion commander unless sent out to one of the front line companies for closer observation. General Grade prefers this because he sees a chance of added confusion with additional observers and additional telephone lines deployed in the fire-swept forward zones of action. The forward observer will locate himself on the map and make his position known by telephone to his groupment commander through the liaison detachment at the infantry regimental command post. In designating a target he reports as follows:

Nature of target
Front covered (in mils)
Distance from OP
Distance of own troops from target
Axis of observation (OT line)

The center of impact of each salvo or volley and the nature of the sheaf are reported as in our service, deviations being given in mils from the OT line.

For an example of zone fire conducted according to this method, the author imagines a supporting groupment of 2 *groupes,* each *groupe* being assigned half the zone to be attacked by a single groupment concentration. Each battery of the first *groupe* fires three rounds of rapid fire, ten seconds interval being allowed between batteries. The observer then reports his sensings for each battery. The time required for firing is 35 seconds and for the observer's report 45 seconds. The second *groupe* then fires and receives the observer's sensings, giving 170 seconds for the groupment adjustment. General Grade estimates that the remaining preparations will take 2 or 3 minutes and that a 3-minute concentration will be fired (zone of 6 hectares). The total elapsed time will be about ten minutes—a minimum under perfect conditions of observation and communication. In any case, there must be no delay in the fire for effect which must not last more than five minutes. No estimate is given of the total time between the first demand for fire and its execution.

COMMENTS

1. The limited liaison personnel and equipment in the French and Belgian artilleries result from their basic conception of the attack rather than from lack of funds. There is no lack of appreciation in the French army of the importance of forward observation. Only one paragraph of the French combat regulations for artillery is emphasized in italics. It consists of one sentence: *"Observation is of supreme value in the artillery, and every possible effort must be made to obtain it."* Nor is there any lack of conviction that close support of the infantry is needed. It is their manner of supplying such support that differs from ours

and from that of the Germans. They consider the matter of forward observation and communication only a minor, though extremely important, feature of the entire problem of concerted thought and action between infantry and artillery. The French attack after initial contact with organized defenses is a corps operation, controlled and carefully timed. Reliance is placed on maps and map data because excellent maps of the whole area of possible conflict are available. Single observation posts for groups of batteries are used because the concentrations of fire on enemy zones are *groupe* rather than battery affairs.

2. Even with this understanding of the French conceptions, it is likely that most of us will agree largely with the German criticism of Colonel Buchalet's article. To people of our temperament, their close control of maneuver appears too confining and restrictive of initiative. We rely more on the happy chance and the resolute action of subordinate commanders, and our organization of liaison naturally conforms to this idea. I am convinced that it is the only system for us, that our present liaison detachments are none too large, and that we are right in giving them as complete an equipment as possible for communication and observation. In this connection, the suggestions as to periscopic aiming circles and small portable range-finders are of interest. Of interest, also, is an article on the close support of infantry by Colonel Ricard in the *Revue d'Artillerie* for February, 1935, in which he suggests small, cross-country, armored vehicles for the transport of front line artillery observers and their radio equipment—in my opinion, an essential development for our artillery.

3. The similarity between the situation of front line artillery observers and that of air observers, as emphasized by Colonel Buchalet, is worthy of note. Not only should all our artillery officers be trained as air observers, but the general procedure should be the same for both front line and air observation. The front line observer will, in many cases, be ignorant of his own position as well as that of the batteries. At such times, use of a procedure similar to the air control described in Section XX of TR 430-85 will often be the means of rapidly bringing fire to the support of the infantry. The installation of directing batteries within battalions, directing battalions within groupments, and a judicious selection of base points well within the enemy

lines will facilitate effective and rapid support. One or two volleys on the base point or other known target will give the observer his center of impact with respect to the new target, deviations and range errors both being estimated in yards.

There is no reason why all infantry company officers, as well as artillery observers, should not be able to call for and adjust fire by this method. The technique of fire and its tactical application to the target are left to those in rear—the observer merely tells what the target is, gives its front and depth in yards if possible, and then reports the center of impact of the salvos or volleys fired in response to his call.

I agree with Colonel Buchalet that communication between the front lines and the guns will be by radio or visual signalling most of the time, as the operation of telephones in this zone is a precarious affair. Therefore a very simple but comprehensive control code should be provided. The air-fire control code of TR 162-5 is entirely too voluminous. A front line-fire control code which has been found effective in practice problems is as follows (the letters are given somewhat in the order of their use):

T—target
OT—last target fired on
B—base point
E—enemy
OFL—our front lines
IN—infantry
MG—machine guns
TK—tanks
AR—artillery
CV—cavalry
F—front
Z—zone
CA—can adjust
R—right
L—left

Numerals from 0 to 9
SH—sheaf
W—wide
N—narrow
A—air
G—graze
O—over
S—short
OK—correct
V—verify or repeat
VB—verify base point
(2 salvos—200 yds. apart)
VT—repeat fire on target
CF—cease firing
H—fire high bursts

Such a code lends itself to rapid transmission of simple messages by any means of communication. With a very few additional signals, it could be adapted for air-fire control. A type problem for one battery under this procedure is as follows:

Narrative	*Message*	*BC's Commands*	*Remarks*
Infantry is stopped by machine gun fire. Approximate location is pointed out to artillery observer. He reports and calls for fire on base point giving position of own front lines with respect to target.	TEMG F 100 Z 200 OFL 800 S VB		Observer has not identified base point and does not know location of battery firing nor his own exact position. Bn Commander assigns battery to target.

Narrative	*Message*	*BC's Commands*	*Remarks*
Battery is laid on base point.		BD, Si 305, Shell FL BR AMC 3600	
B. C. fires and commands:		Fire 3800	2d verifying salvo. Observer gets line of fire and senses on this salvo.
2d salvo, fired 10 seconds after first.		Fire	
Observer senses.	200 L 400 O		
BC makes corrections and fires.		R 55, BR 3400	$\frac{200}{3.8}=53$
Observer senses.	35 L 200 O		
BC makes correction and fires.		R 10, 3200	35/3.4=10
Observer senses.	S		Sheaf and deflection correct.
BC goes to fire for effect.		B, 2 rounds, zone 3250 - 3450	Fire to continue for five minutes, rate as rapid as possible or Battalion concentration for 2 or 3 minutes.

With our organization for liaison and a procedure of this sort, we should be able to provide effective artillery support with considerably less delay than the half-hour or more needed under the French or Belgian systems.

ORGANIZATION, ARMAMENT, AMMUNITION AND AMMUNITION EXPENDITURE OF THE GERMAN FIELD ARTILLERY DURING THE WORLD WAR

BY LIEUT. GEN. VAN ALFRED MUTHER, Retired

During the war Chief of the Field Artillery section and director of the Department of troops of the Royal Prussian War Ministry

Translation by Captain Arnold W. Shutter, Field Artillery, National Guard Bureau

(Continued from the May-June issue)

IV

AMMUNITION OF THE GERMAN FIELD ARTILLERY

1. THE AMMUNITION SITUATION AT THE BEGINNING OF THE WAR

AT the outbreak of the war, the German Field Artillery was equipped with an all-purpose ammunition, such as had been ordered by the various armies of the larger powers in peace times, but which had not yet come into universal use. This was available for both field guns and light howitzers. Both projectiles could be used either as shell or as shrapnel. Each type of weapon therefore carried with it only one type of ammunition, which afforded any desired type of effect. This ammunition was in consonance with the latest specifications and presented the best type of ammunition for the light artillery in accordance with the opinions in vogue at that time, since it afforded an adequate effect, while presenting the simplest possible handling in practical use and appreciably simplified the question of supply. It necessitated bringing up only one type of ammunition for each type of gun, since it was possible to use the projectile against infantry and similar targets, or as shell against artillery and covered positions. The previous necessity of having two types of ammunition carriers for the double purpose of providing both shell and shrapnel was no longer necessary. The ammunition of the German light artillery was superior to that of the other countries, since they only dealt with high explosive projectiles while the hostile artillery was provided with both shrapnel and shell. As a matter of fact, the all-purpose projectile for both types of weapon answered all requirements in warfare of movement, both in its shell and shrapnel effect, according to the universally expressed opinion of the troop and artillery commanders.

Since, at the outbreak of the war the matter of providing the field gun 96 n/A with the all-purpose projectile was not a completely accomplished fact, as there were available in war reserve, in addition to the all-purpose projectile, also shrapnel 96 and shell 96. In the case of the field howitzer 98/09, the all-purpose projectile project had already been pushed to completion.

2. THE DEVELOPMENT OF AMMUNITION DURING THE WAR. PROJECTILES.

In spite of the simplicity of ammunition supply and the high point to which the construction of projectiles had been developed with which the light artillery was provided in peace times, conditions developing shortly after the beginning of the war made it necessary to abandon this ammunition equipment and to introduce new projectiles. The circumstances under which these far reaching changes were forced into the realms of ammunition may be considered under three main headings:

(a) Covering the extraordinarily large demands of the troops for munitions and equipment, the total of which brought into question the capacity of Germany's private industries for mass production ammunition.

(b) Influence of the supply of raw materials. The export material which could be depended on in peace time for preparation of projectiles was growing constantly more restricted, so that substitute material had to be drawn upon for the manufacture of projectiles, which in turn made mandatory a thoroughgoing revision of factory procedure.

(c) Heightening of the effective radius of projectiles which were forced by the requirements and changing conditions of the war.

These three requirements, which did not complement each other, but rather stood out in sharp opposition one to the other in increasing degree as the war went on, presented the High Command and the material industries with an exceptionally difficult problem which had to be solved in a short space of time by adequate construction with the means at hand, if the prosecution of the war was not to fall down because of a lack of ammunition.

The consideration under groups (a) and (b) which led to the remodeling of approved types of ammunition cannot be dealt with in detail in this place. It was, however, clearly indicated that the "auxiliary ammunition" (gun shell 14, and howitzer shell 14) already under construction in peace times, would have to be prepared during the war in order to cover the enormous ammunition expenditure.

With respect to increasing the effective radius of projectiles (c) the observation is in order that the shrapnel had given a good account of itself during the warfare of movement, but that with the initiation of position warfare, the shell had come more into the foreground. The demand for a greater effective radius for individual rounds of the shell could not be fulfilled by reconstructing the individual all-purpose projectile. It was therefore necessary to drop the manufacture of the all-purpose projectiles and to revert to the construction of separate projectiles. This expedient was further forced by the circumstance that the complicated fuze of the all-purpose projectile could only be turned out in the governmental munitions laboratories. Thus it could not be produced in sufficient quantities and there was the further necessity of making out with limited metal.

In the case of the field gun we fell back directly on the field shell 96 and in the case of the howitzer on a highly efficient projectile, already tried out in peace times, which went under the designation of the "long field howitzer shell." By increasing the bursting charge (from 1.37 kg. to 2.00 kg. in the howitzer shell 05) an excellent effective radius was obtained. Cutting out the all purpose projectile for the howitzer made necessary the new construction and introduction of a shrapnel, the "howitzer shrapnel 16." For the gun the "field shrapnel 96" was re-adopted.

The increased production of the field shell 96 could only be regarded as an emergency measure as its limited bursting charge (0.190 kg.) was incapable of fulfilling the demands for a shell with a larger effective radius. Along with the introduction of the gun shell 15, turned out principally for feasibility of construction, there came into being the "long field gun shell" (lange Feld Kanonengranate, lg. F.K. Gr.) with a bursting charge of 0.900 kg. Both of these "long projectiles" were fitted with a bore-safety, double-action (in the case of the howitzer, triple-action) fuze, respectively designated as Az, Az m.V., and Bz*,

* Az.—Aufschlagzünder—percussion fuze.
Az.m.V.—Aufschlagzünder mit Verzögerung—percussion fuze, delayed action.
Bz.—Brenzünder—time fuze.

with a detonator safety device, and became, because of their high efficiency, the chief projectiles of the field artillery.

The long field gun shell, when fired at the longer ranges, developed an unstable flight, producing shorts, particularly when propelled through older and worn out tubes and in the presence of a head wind.

This maladjustment, which had its source chiefly in the introduction of inferior rotating bands (substitute metal instead of copper) could be overcome only by shortening the projectile. The abbreviated form came into production under the designation of gun shell 16 (K.Gr. 16). The projectile had a bursting charge of 0.700 kg. but was still regarded as an efficient shell.

The other requirement, raised as a result of war time demands: namely, increased range, could be achieved only to a limited extent, by increasing the initial velocity. This question could be solved only in proportion as the projectile could be shaped to give it less wind resistance than its predecessor had. In February of 1917 the manufacturers were successful in producing a model for a long range projectile for the war guns of the field artillery which attained good results under test, for the field gun 16, the light field howitzer 16, and the light field howitzer Krupp, which came out under the caption of "C" projectile. This projectile was characterized by a slender point and a boat-tailed base. It carried a bursting charge of from 0.550 kg. to 1.500 kg.

The following enumeration illustrates the progressive increase of effective radius introduced during the war:

Field gun 96 n.A. and Field gun 16.

	Weight of bursting charge in kilograms
F. Gr. 96 (field shell 96)	0.190
F.K.G. 11 (field gun shell 11)	0.250
K. Gr. 14 (gun shell 14	0.180
K. Gr. 15 (gun shell 15)	0.380
lg. F.K. Gr. (long field gun shell)	0.900
K. Gr. 16 (gun shell 16)	0.700
("C" projectile)*	0.550

* For use only with the field gun 16 and the light field howitzer Krupp.

Light field howitzer 98/09, light field howitzer 16, and light field howitzer Krupp.

	Weight of bursting charge in kilograms
F.H.G. 05 (field howitzer shell 05)	1.370
H. Gr. 14 (howitzer shell 14)	0.300
H. Gr. 15 (howitzer shell 15)	1.400
lg. F.H. Gr. (long field howitzer shell)	2.000
("C" projectile)*	1.500

The increase of effective radius for shell by the introduction of chemicals in place of a bursting charge will not be enlarged upon here as it falls outside the scope of our present study. It was a road that had to be traveled during the course of the war, as the project of increasing the effective radius of high explosive projectiles had reached the limits of its possibilities, and by this means, still greater success was not to be achieved. During the course of the war gas proved itself to be an effective weapon. By the termination of the war the standard of construction for gas projectiles was technically developed to a high degree and a definite conclusion had been attained.

In the realm of special projectiles it had been found necessary to introduce armor-piercing projectiles for anti-tank defense; tracer ammunition for special missions in night firing as well as case shot for purposes of close defense.

FUZES

Much more difficult than the development of projectiles for the field artillery was the problem of preparing, during the war, for the mass production of fuzes, not only in the matter of their construction, but in making alterations, and setting up new installations in order to fit them into war's constantly changing demands.

The considerations which influenced the development of the fuze manufacturing industry and the preparation of fuzes were the same as in the case of the projectiles.

(a) *Questions of manufacture and raw material.*

The private industries which were drafted into the manufacturing of fuzes during the war were not in a position to produce fuzes which presented a complicated structure as they lacked the

* For use only with the field gun 16 and the light field howitzer Krupp.

special machinery and experience necessary for their fabrication. There were introduced, therefore, along side the standard fuzes of the field artillery, simple, easily manufactured, bore-safety percussion fuzes, the so-called auxilliary fuzes, the details of which had been worked out in peace times. Gradually the all-purpose fuzes (K.Z. 11 and H.Z. 05)* along with the all-purpose projectiles were given up and a simpler fuze construction undertaken in which the shrapnel time fuze effect was discontinued and only a time shell fuze effect was possible.

Field artillery fuzes were made principally from aluminum and, in the case of the howitzers, from brass. Thereafter brass was replaced by zinc. Even though it presented no proper substitute for the highly useful brass in the manufacture of fuzes, nevertheless it may be regarded as adequate for this purpose because of its exceptional maleability. Later on, zinc or electron was likewise used to replace aluminum. Finally even these metals had to be declared on the proscribed list on account of the lack of raw materials and iron took its place. This brought about a materially backward step in the administration of the fuze factories because the working of iron is by its nature inseparable from great inherent difficulties. Drillings for the fuze bases could not be made except by the installation of new machinery. In addition they still had to be equipped with a brass lining in order to avoid disturbing the primers by direct contact with the iron.

In spite of these terrific difficulties in the planning, preparation and working up of the raw materials on which the production of fuzes depended, all of which made necessary a thoroughgoing reorganization of the facilities, the German fuze industry succeeded in a relatively short time in delivering at the front practicable fuzes in suitable number to meet the needs of mass production.

(b) *Increased Effectiveness. Percussion Fuzes*.

With the initiation of position warfare, percussion shell assumed the significantly important position that had been vacated by shrapnel, although the latter had rendered yeoman service during the warfare of movement. The troops were demanding more efficient shells with percussion fuzes. Along with other

* Gun fuze 11 and howitzer fuze 05.

peculiarities of position warfare, the dissatisfaction with shrapnel was enhanced by the fact that the fuze ring for time fuzes was getting worse all the time because of mass production and lack of raw material, which in turn caused an increasing dispersion in time fire. Moreover the poor storage facilities necessitated by the war, the destructive influence of climatic conditions, as well as the enforced skimping of the time trains, made a successful time fire problem almost impossible and contributed to this disfavor. There was the added fact that the private industries were far from being in a position to cover the mass demands for time fuzes. The need for fuzes, therefore, could only be met if industry supplied a basically simple percussion fuze, capable of being rapidly produced.

The development of percussion fuzes during the war may be divided into three periods:

1st period (1914-1915)—mass production of auxilliary fuzes (K.Z. 14 and H.Z. 14).

2nd period (1916)—construction of bore safety and percussion safety fuzes with mechanical safety devices (K.Z. 16 and H.Z. 16).

3rd period (1917)—construction of super sensitive fuzes.

FIRST PERIOD

The models for these auxilliary fuzes for the field artillery had already been set up in peace time, so that quantity production could be started at once on the outbreak of war. They were simple, bore-safety percussion fuzes and easily produced even by factories that were without experience in the field of fuze manufacture. The safety element lay in the stable powder grains themselves, which were in general use in the German Army. In peace, these had proven entirely satisfactory. Their usefulness had been proved in rather long storage tests under the most unfavorable conditions. In war, this type of safety device gave a poor account of itself. In consequence of an unavoidable thinning of the time train and a lack of protection for the powder grains, these deteriorated very rapidly due to the penetration of moisture. Duds, bursts in the tube and premature bursts were the result. The remedy was found in new construction perfected during the war which equipped the fuzes with mechanical bore and detonator safety devices.

The first part of the development of fuzes during the war presents itself as a war time emergency measure, to offset the terrific lack in the quantity of ammunition which developed shortly after the beginning of the war and which was a proposition to which neither ourselves nor our opponents had attached sufficient weight during peace time. Just as was the case with the auxilliary projectiles, so also with the auxilliary fuzes, mass production became an urgent necessity, if a lack of ammunition was not to ensue which would have made the further prosecution of the war absolutely impossible.

SECOND PERIOD

With the building up of the bore-safety and percussion safety fuzes the powder grain safety scheme with which we had such disastrous experiences early in the war, and which showed an ever-increasing number of bursts in the gun, fell into disuse. These latter were replaced by the mechanical safety devices, which were unconditionally to be regarded as suitable for field service. There is no question but what great progress was made with the construction of these fuzes. The mechanical safety devices proved themselves to be free from deterioration, even under the most unfavorable storage conditions so frequently encountered in war. The unfortunate experiences which characterized the powder-safety devices disappeared. The number of muzzle bursts was materially reduced with the introduction of the mechanical safety devices. Whereas in the year 1915 the field gun 96 n/A developed a burst in the tube for every 5,000 or 6,000 rounds, such an occurrence with the new fuzes could not be counted on under 30,000 to 40,000 rounds.

THIRD PERIOD

Since shrapnel had lost its importance with the beginning of position warfare, and shell had come to the forefront of the picture, even as a projectile for use against living targets, there came the demand for a greater fragmentation for shells to be used against living targets. The heretofore useful non-delay fuze, which detonated on the moment of impact of the projectile with the ground was not able to cope with this demand. A transition was therefore made to a super sensitive fuze which acted before the tip of the projectile entered the ground. With this type of fuze, the fragments were not swallowed up by the ground, but exerted their principal effect in a lateral direction and at a lesser altitude. The supersensitive fuze introduced by the French had a very primitive and inadequate bore safety. The French fuze had no percussion safety device at all. The French also appear to have had a goodly number of bursts in the tube when using this fuze, for in the January number (1920) of the "Revista d'Artiglieria e Genio"* we read: "The present supersensitive fuze is not satisfactory, and it will have to be changed in order to give protection against premature bursts in the gun," and in another place we observe the remark: "In the late war the losses of the artillery reached considerable numbers because of premature bursts. In this connection, the French supersensitive fuze was particularly faulty."

In the American periodical "Army Ordnance" the point was raised that, during the war, very limited success was enjoyed with the French sensitive fuze without detonator safety and that the Allies had suffered a great number of bursts in the tube. About one burst in the tube for every 12,000 rounds had occurred. The French Colonel Wilmet expresses himself during the war as follows in the course of the firing instruction at Amiens: "The German fuzes did not become armed until after they had traveled about three hundred meters from the muzzle of the gun, from which circumstance it follows that they had nothing to fear from their use in the way of bursts in the tube. The Germans apparently would have had just as many accidents as the French, if they had not gone to extremes to avoid it by changing their fuze." These expressions of opinion are sufficient evidence that the French sensitive fuze was a bad investment. The German one was appreciably superior to it.

In Germany the first sensitive fuzes arrived at the Front in the Spring of 1917. The first fuze had a good mechanical bore safety provided by a centrifugal bolt, the second had in addition a percussion safety device.

The sensitive fuzes gave a most excellent account of themselves during the war. The time shell, which stood in the highest favor with the Field Artillery in peace was almost completely superseded by the introduction of the sensitive fuze.

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* Italian: "Artillery and Engineer Review."

TIME FUSES

In spite of the revaluation which time shell experienced with the light artillery for terrestrial warfare, the time fuze was still required for shrapnel, which was even yet considered in position warfare, and for the shell used by the anticraft artillery. The time fuze of the light artillery had, at the outbreak of the war, a range scale of from 200 to 5,000 meters in the case of the field gun 96 n/A and from 300 to 5,300 meters in the case of the light field howitzer. These ranges were more limited than those of the hostile army. France had, with their shrapnel, a time fuze range of 6,800 meters; Russia a range of 5,500 meters for the field gun and for the light field howitzer, according to type, 6,400 meters or 6,000 meters; England, 5,600 meters for the field gun and 6,000 for the light field howitzer

The reasons why Germany placed no significance on the greater time fuze range have already been explained.

As a matter of fact, early in the war, the range of our time fire projectiles had proved itself inadequate and the troops were demanding an increase of this range. By the use of a slowly burning fuze powder, the range, in 1915 was increased to 7,000 meters for the field gun 96 n/A and the light field howitzer 98/09. The result: namely, that the slow burning powder is difficult to produce in uniform lots, and that atmospheric conditions and barometric pressure influence the burning of the fuze even more than is the case with quick burning powder, had to be considered as part of the bargain.

Attempts at improving the dispersion and combustion of the time fuzes led to a better form and arrangement of the gas escape vents as well as better machining of the fuzes. A thoroughgoing success, however, was never attained.

And thus transition to mechanical time fuzes became mandatory. The first to make its appearance was the double fuze 16, a mechanical time fuze by Krupp actuated by a watch spring as well as the mechanical gun fuze 17, by Junghans, which was actuated by a centrifugal weight. These were for antiaircraft guns, and with their introduction, time effects at altitudes of 5,000 to 6,000 meters, hitherto impossible, were introduced. The introduction of the Junghans fuze for field guns had been approved at the close of the war. These fuzes, which were not subjected in any way to atmospheric conditions or barometic pressure proved to be efficient in every respect

FUSES FOR SPECIAL WEAPONS

For tracer ammunition for field guns and light field howitzers the time-fuze S/24 came into use.

For anti-tank purposes the gun shell m.P. (steel point) was equipped with the Krupp percussion fuze with safety jack and delayed action. It was built into the projectile under the armored head, and was not outwardly visible.

FIELD AMMUNITION, SHELL CASES, PRIMERS

Propelling charge containers and shell cases for field artillery were made from brass in peace times. These cases proved their worth in time of war. But soon after the beginning of the war, the need for copper forced the reduction of the peace time formulae. Proper results did not follow the adoption of these means. The constantly increasing lack of copper led to replacing the brass cases with another metal.

Transition to substitute cases made from steel was attempted. Although we gradually succeeded in producing efficient steel cases for the field gun 96 n/A and for the light howitzer 98/09, nevertheless when these were used in the field gun 16 and the light field howitzer 16, the relatively high gas pressures resulted in jams.

The steel case, in mass production, is difficult to turn out with the requisite degree of hardness. The production of good raw material, as well as its preparation in the smelting and casting processes is difficult. The steel cases could not, therefore, be regarded as a successful substitute for the brass cases.

Since more useful material was hard to obtain, substitute cases of iron were attempted. Successful cases of this material were produced. The casting of the iron cases is simpler than steel cases.

PROPELLING CHARGES

The charge for the field gun 96 n/A consisted, at the beginning of the war, of nitrocellulose powder, while the case for the light field howitzer 98/09 was provided with seven partial charges of nitroglycerin powder. The several approved types of powder had been found satisfactory in every respect. As to the direction that the development of powder took in the course of the war, the question of available raw materials immediately at hand was the deciding factor. To go into the details of this is a matter that lies outside the limits of this study, just as it was impossible, for the same reasons, to give a resumé of the development of bursting charges, a question which is intimately associated with it. In regard to the powder question, it may be briefly suggested at this point that the great need for powder in the war and the lack of raw materials, particularly gun cotton and acids, made it necessary, in providing for the field gun, to fall back on ammonia powder, a mixture of carbon and ammonia salt peter, raw materials which could be quickly gotten up from the interior. This emergency measure had the advantage that the inactive black powder factories could be turned over to the manufacture of powder, a fact that initially subjected the field artillery to difficulties and set backs, which were however, in the course of time, overcome.

In order to reduce the gun flashes at night which betrayed the position to the enemy, it became necessary with the field gun 16 and the light field howitzer to introduce a salt preparation of Düneberger calcium chloride that came packed in bags. In the case of the field gun 16, this resulted in an increased dispersion and an increased gas pressure, while in the case of the light field howitzer a decrease in muzzle velocity and in range took place.

In order to conserve powder a case with reduced charge had to be prepared for the field gun 96 n/A, which was to be fired with a special range table and was for use only in position warfare.

What German technique accomplished for the field artillery in the realm of new construction for projectiles and fuzes, needs no apology in any way when compared to the efforts of our former opponents. On the contrary, German production of projectiles and fuzes during the war may well serve as a model. The tremendous service of the highly developed German armament industries in the preparation of field pieces and their ammunition, and what the spirit of German inventiveness accomplished in the midst of a difficult war, in supplanting a failing supply of raw material with other means, were without parallel in any other country and will remain for all time for the admiration of mankind.

V

AMMUNITION EXPENDITURE

For the Field Artillery of the mobile units contemplated in the plan inclusive of Reserve and replacement troops there was set up as a munitions reserve for the mobilization year 1914-15:

for each field piece (gun) 987 rds.
for each light howitzer 973 rds.

For mobilization supply there was established:

200,000 rds. for field guns
70,000 rds. for light howitzers.

This amount of ammunition, which in time of peace had been predicted as sufficient, failed shortly after the beginning of the war by a wide margin of being adequate to cover the front in the face of a demand for projectiles never before dreamed of. But the same situation confronted our opponents, who, after the Battle of the Marne, had an even scantier supply than we did. All of the embattled countries had deceived themselves in regard to munition requirements. Without further comment, it must be admitted that the stocks of ammunition in Germany for which provision had been made, as well as the mobilization supplies, were inadequate as viewed from our present day standpoint. In spite of this there would not have arisen such an acute lack of munitions as we experienced in the Autumn of 1914 had not circumstances intervened which increased the use of ammunition in ways that were quite unforeseen. These were:

(a) The increase of Field Artillery through reorganization over and above all plans and expectations, and the transformation of immobile units at the front.

(b) The diversion of weapons to missions which they were not designed to undertake.

(c) Insufficient supervision of the employment of ammunition.

An acceleration of munitions production had been placed in effect with the beginning of the war. This precaution however, could not carry with it an immediate solution since aside from the state owned and private factories whose use had already been anticipated, and which had already been producing the ammunition as scheduled in times of peace, and therefore were charged with its preparation, there had to be diverted to this purpose of munitions manufacture even factories of private ownership that had never before manufactured and produced ammunition. These industries, however, were not in a position to cope with the difficulties of producing the approved types of ammunition in view of their inherent construction for other purposes, and they were therefore able to produce only projectiles whose preparation was consonant with the means they had at hand, such as casting facilities, lathes and the like. It was therefore necessary to revert again to projectiles of cast iron with simple percussion fuzes in lieu of drawn steel shells. The entire undertaking in fact bespoke a backward step in the technique of projectile manufacture, but there remained no other means of assuring ourselves of fulfilling the terrific demands for munitions. Already in peace times these so called auxiliary projectiles and fuzes had been subjected to test and the drawings for them prepared, and so these projectiles with their simple percussion fuzes came into production. The bursting charge, in view of the strength of the walls of this latter type of projectile, had to be reduced so that the effect, both as to penetration and effective radius was materially reduced. The normal effect lagged far behind that of the drawn steel projectile.

*This war time expedient might have been avoided entirely if, in times of peace, an industrial mobilization plan had been prepared.** This event, however, failed of accomplishment, both in our own case and in that of our opponents. In Germany, during peace times, the project was mentioned but beyond that no further measures were taken. The reasons for this may be sought in the fact that no one had properly envisaged the munitions requirements of a possible future war, and it was generally hoped that the preparations which had been inaugurated would suffice. But the cost of all this has been staggering, for the private industries should have been provided in peace times with mechanical equipment and in order that they acquire adequate experience for war in the province of munitions manufacture. They should have received in times of peace commensurate orders for munitions. Since munitions retain their stability in storage only for a certain number of years, the surplus ammunition should have been expended in peace times; that is to say, the allowance of ammunition to the troops for service practice, would have had to be appreciably increased. This would naturally have resulted in appreciable

*Italics by translator.

expenses, but the authorization of these expenditures would most assuredly have been richly rewarded.

In a relatively short period of time we succeeded in surmounting the principal difficulties in the preparation of ammunition. Thus as early as the autumn of 1914 the munitions output for the field piece had been increased four fold and that for the light howitzer five fold.

The consumption of ammunition during the war varied according to the individual theaters of operations. Whereas in general in the East a lesser consumption of ammunition was indicated, on the Western Front the needs were the greatest.

The following table gives a general resumé of the approximate monthly expenditures of ammunition for the several years of the war.

Year	Weapon	Maximum Monthly Consumption	Minimum Monthly Consumption
1915	Field piece;	2,562,720	584,640
	light how.	825,000	189,000
1916	Field piece;	4,744,320	960,960
	light how.	1,944,000	540,000
1917	Field piece;	5,664,960	1,357,440
	light how.	2,634,000	588,000
1918	Field piece;	7,842,240	1,081,920
	light how.	3,792,000	531,000

The munitions which were placed at the disposal of the Field Army, was divided into munition trains. This embraced:

1 K Zug (Field gun train) 26,880 rds.
1 F Zug (Field Howitzer train) 12,000 rds.
1 KF Zug (Combination) total 19,440 rds.

Divided as follows:

For field gun 13,440 rds.
For light howitzer 6,000 rds.

During the war there were sent into the field approximately:

6,000 field gun trains,
5500 light howitzer trains, making

161,000,000 rds. for field guns
66,000,000 rds. for light Hows.

Total, 227,000,000 Rds.

In this enumeration, munitions for mountain artillery, infantry weapons, anti-tank and anti-aircraft have not been included.

The O.H.L. (Commander in Chief) had, in October, 1918, an additional Reserve of 725 munitions trains, and at home depots there was another such (reserve) of approximately 500 munitions trains. A lack of ammunition therefore did not exist.

The foregoing figures on guns actually delivered and munitions placed at the disposal of the troops establish the fact that the war was not lost through a lack of guns and ammunitions.

Translator's Note: It is difficult to visualize the significance of this tremendous ammunition expenditure without some slight analysis. Taking the maximum monthly expenditure for the war, and recalling that this table shows only the field guns and light howitzers it means that during this month, German Field Artillery projectiles were falling on the Allies at the rate:

per month, of	11,634,240 rounds;
per day, of	387,808 rounds;
per hour, of	16,150 rounds;
per minute, of	269 rounds;
per second, of	4½ rounds.

SPECIAL NOTICE

U. S. Field Artillery Association Prize Essay, 1936

An annual prize of $300.00 is offered by the United States Field Artillery Association for the best essay submitted by any Field Artillery officer of the Regular Army, National Guard or Reserve Corps on any subject of current interest pertaining to the Field Artillery.

The following rules will govern this competition:

(1) The award of prize to be made by a committee of three members to be nominated by the President of the Field Artillery Association voting by ballot and without knowledge of the competitors or of each other's vote.

(2) Each competitor shall send his essay to the Secretary-Treasurer of the Association in a sealed envelope marked "Prize Essay Contest." The name of the writer shall not appear on the essay, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary-Treasurer, with the motto on the outside and the writer's name and motto inside. This envelope will not be opened until after the decision of the committee.

(3) Essays must be received on or before January 1, 1936. Announcement of award will be made as soon as practicable after that date.

(4) The essay awarded the "United States Field Artillery Association Prize" will be published in the FIELD ARTILLERY JOURNAL as soon as practicable. Essays not awarded the prize may be accepted for publication in the FIELD ARTILLERY JOURNAL at the discretion of the editor and the writers of such articles shall be compensated at the established rate for articles not submitted in competition.

(5) Essays should be limited to 8,000 words, but shorter articles will receive equal consideration.

(6) All essays must be typewritten, double spaced, and submitted in triplicate.

LUZON CANNONEERS

BY CAPTAIN JOHN P. ECKERT, FIELD ARTILLERY

EIGHT thousand miles west of the Golden Gate, on the typhoon-caressed island of Luzon, where the sun rises in the Pacific and sets over the China Sea, flies the scarlet standard of the Twenty-fourth Field Artillery. The constructive effects of Uncle Sam's military methods have nowhere better been demonstrated, than in this remote organization, so far removed from the attention of the American public.

Around the red guidons of the Twenty-fourth are assembled natives from every province and walk of life in the archipelago—Malays who ancestors have been separated for centuries by barriers of water and mountain, tongue and creed, by tribal blood feuds—a raw material which has been and continues to be fashioned into loyal, resourceful and efficient fighting men, welded by army training and discipline, a common language, and a thorough infusion of that most remarkable quantity, the Spirit of the Field Artillery. It is a lesson and an inspiration for Americans to witness the outward manifestation of this morale, when every evening as retreat is sounded, brown skinned men in khaki salute the Star Spangled Banner with genuine respect and devotion—men who have never seen, and will probably never set foot upon the shores of the United States of America.

Our oriental artillerymen enjoy as a theater of operations what is in many respects the finest military reservation under the American flag. Ft. Stotsenburg. From an elevation of about

LOOKING TOWARD CHINA SEA FROM BIRNIE'S LOOKOUT seven hundred feet, one looks out to the east and south across the great central valley of Luzon, where a long extinct volcano, Mt. Arayat, holds the center of the stage. To the west, at one's very doors, begin the hills, sloping up to the majestic backdrop of the Zambales Mountains. Northward and westward extends a vast rugged region of tropical forest, broken by rock-strewn grassy plateaus, deep canyons and swift streams. In that area, inhabited by only primitive Negrito tribes and game, service practice is continuous practically the year around.

In panorama, the sandy terrain reminds one of some of our Western posts, but distinct local differences manifest themselves at once. Sugar cane replaces corn; rice paddies must be visualized instead of wheat. Maneuvers limbered is perfected among patches of tall cogon grass, not of brier or mesquite; cover from aerial observation is secured under arbors of feathery bamboo or broad leaved banana, not amid the oaks and pines. The temperature never gets below sixty; it is usually between seventy-five and eighty-five degrees. Barracks buildings are all doors and windows. But the routine of garrison schools, service of the piece, gunners' examinations, pistol marksmanship, guard, fatigue and inspections, goes on about as it does at Ft. Sill or Ft. Bragg in the summer months. Annual maneuvers away from the post takes the place of training with civilian components. The rainy season handicaps cross-country marching, as does snow in the States.

CROSSING THE AGNO

Perhaps the chief difference between the life of the Philippine Scout and his American comrades is family responsibility. For after retreat, unless on guard or barracks duty, our average soldado goes off to one of the barrios at the edge of the post, where he has his own nipa hut, his pigs, chickens and camotes, a little brown wife and a dozen or so rollicking youngsters, happily free of shoes, leggins and breeches until they are old enough to join the army too. Soldiering is a profession for these men. Many hash marks are to be seen on the sleeves of buck privates; a corporal usually displays enough blue stripes to lend dignity to the arm of a sergeant major.

The Scout soldier is celebrated for his attention to "spit and polish." He takes a mighty pride in keeping equipment shined and brightly painted. If not restrained, he will wear away the threads of the breechblocks with excess elbow grease, and paint the kitchen firewood olive drab, with red artillery trimmings. A carriage halted on the road is at once beset by cannoneers, on top, around and under it, examining, servicing and polishing.

In the field, our Scout is a tireless worker. He is always up and fed before reville; if you are not careful, he may, with the greatest respect, strike your tent and roll you up in your own bedding roll while you are still asleep. His meal consists of an enormous helping of boiled rice, flavored with slum or fish. With a bolo, a few sticks of bamboo and a strip of rattan, he fabricates the most wonderful devices to make one comfortable in the jungle. And he can handle himself equally well in a muddy rice paddy, on the rocky volcanic uplands, in the thorny thickets of the forest, or on the paved streets of Manila.

It cannot be said that he is not adaptable, for within the short space of three years, his regiment has been successively metamorphosed from a mountain howitzer outfit with mules and aparejos, to a roaring tractor-drawn unit of caissons and British 75's, and again into the latest style of truck-drawn organization. In the meantime, he has done some experimenting and marching as portee artillery. The present personnel can therefore pack mules, ride horses, drive tractors and trucks. During transition periods the regiment has never lost mobility, nor skill in serving its material. A large percentage of the men are expert gunners and expert pistol shots. At any time of the night or day this regiment has been able to assemble its personnel and within two hours move out, bag and baggage, for extended field service.

Recreation is taken quite as earnestly as work. The Twenty-fourth goes in for everything in the way of sports. Athletes are developed by a sort of intramural system, which supplies abundant material for regimental teams. Victories during the past season in the field and track meet, gymkhana, in polo, boxing, swimming, baseball, basketball, volleyball and soccer, are accepted as normal. And when there comes along no typhoon rehabilitation or wholesale building campaign, the regiment must needs expend its surplus energies in sundry special feats and accomplishments.

One of the most celebrated of these in the past was the construction of the famous Artillery Trail, a pack route of scenic beauty which winds westward for about forty miles through canyons and tropical forests of the Zambales Mountains to the China Sea. It was a pioneering and engineering feat of vast proportions, not only to build, but to maintain. Recently, that portion of the trail extending about ten miles from Ft. Stotsenburg to Camp Hand has been widened and improved for the passage of motor vehicles.

Near the top of the divide, in a beautiful forest-inclosed meadow 3,500 feet above the sea, the regiment maintains a small Baguio of its own, called Camp Sanchez. The natural advantages

A WEDDING PARTY AT CAMP SANCHEZ

of the site have been improved by the construction of stone cabins and a running water system. Trails and bridle paths have been cut to waterfalls and other picturesque places; lookouts have been cleared which present panoramas of unsurpassed magnificence. Towering above the camp to a height of six thousand feet is the loftiest peak in that part of Luzon,—Mt. Pinatubo. To scale the old volcano on foot is nowadays considered a major accomplishment, successfully achieved by less than five per cent of campers. Yet, in 1926, the indomintable Twenty-fourth Field Artillery dragged six mountain guns to the very top of the mountain and fired a salute to the morning sun. An account of this remarkable feat may be read in the September-October issue, 1926 of the F. A. JOURNAL. Since then, nothing has been considered impossible. A tradition of "Can Do" was created and has remained in all ranks.

In 1932, having solved the mystery of the five ton tractor, the regiment tested its mobility by marching to the Lingayen Gulf. Following a short period of encampment among the cocoanut trees on that ten mile beach, a return route was attempted involving the crossing of the broad and deep Agno River, at a point where there were no bridges. After a night march, in the early hours of the morning, a record passage of the stream was effected, utilizing only three small native hand ferries. All men, tractors, guns and caissons were floated across without mishap.

Through the years 1932, 1933, and 1934, the regiment was seriously handicapped by an insufficiency of motor transportation, especially in light trucks, and reconnaissance cars. Only by means of the most ingenious expedients and improvisations was it possible to transport itself in the field, yet on all maneuvers and tactical tests it was able to execute its missions with distinguished success. That it was able to accomplish its reconnaissance missions was due to the wise retention of a horse and pack mule element.

With such a flowering of past achievement, the Twenty-fourth must have been considered ripe for the extraordinary test in store for it this year. In January, practically all its trucks were taken away, without replacements. It was then given orders to proceed overland to a given point in a given time. For sixteen miles of the distance there were no roads, nor ever had been any since mother nature heaved these islands out of the sea—only dense forest and jungle traversed by innumerable deep ravines and rivers. The only existing trails were narrow paths, hardly passable for a man on horseback without clearing with axe and bolo. Experienced officers outside of the regiment ventured opinions that at last the mighty Twenty-fourth was stopped.

The regiment accepted the challenge with its traditional spirit. Old escort wagons, long discarded, were withdrawn from storage; others were assembled from parts and from salvage. They were reenforced, fitted with drawbars, greased and painted. Bamboo superstructures were erected on caisson trails and water carts for the carrying of packs and rolls. On the appointed day, looking like a gypsy caravan, but complete for the job in hand, the regiment moved out. Each tractor was towing at least a couple of vehicles, some three. Almost on the spot where it has been inspired. Colonel Gruber's immortal song was rededicated. The caissons did not fail to roll.

Plows, scrapers, explosives, and smaller tools had been requisitioned in wholesale quantities. When our heroes arrived at the place where the road petered out, they proceeded without hesitation to create a road. Like a pair of gimlets, the two battalions bored into that wilderness. When one paused for breath, the other leap-frogged and went ahead. Bivouacing in its tracks, the column moved steadily toward its goal. No supply trucks

DIFFICULTIES OF TRAIL MAKING IN LUZON

could at first keep up with the troops. Two trips of the tractor-drawn wagons were required to move tools and equipment from one camp to the next; long treks back to the base had to be made for necessary water and supplies. All available horses and pack mules assisted, and contributed materially to the advance.

Tangled miles of bejuca and bamboo had to be boloed away, hundreds of huge hardwood trees felled and their stumps pulled out, mountain sides dug and blasted to make footing, valleys filled up, fords constructed and bridges built. Sundays and holidays were forgotten. Working parties often stayed out until late at night. But a full day before the appointed time, tired, dusty, but supremely happy in its triumph, the band proudly playing the Caisson Song, our regiment reported at its destination. Behind it lay not a mere tractor trail, but a well graded road negotiable for passenger cars and light truck transportation.

Compliments and commendations were liberal. The powers that be were highly gratified that their estimates as to the possibility of the enterprise had been verified. After recovering from the first astonishment, they must have decided that the job was easier than it looked. To show their unbounded confidence in the Twenty-fourth Field Artillery, they forthwith assigned a new task, of equal or greater difficulty. The regiment whistled, took a hitch in its suspenders, and pitched in again.

In this second phase, only one battalion could be employed, the other being detached on a separate mission. Its place was partly filled by a regiment of infantry and a battalion of engineers.

CONSTRUCTION OF A BRIDGE

More weeks of chopping, digging, blasting and bridge building followed, and again one day sooner than the zero hour, the report was radioed, "Mission Accomplished."

During the entire period just described, lasting considerably over a month, the regiment constructed about twenty-five miles of road on its own account, built three large bridges, six fords, numerous smaller bridges and culverts, felled a forest of trees, and excavated incalculable tons of earth and rock. It supplied itself for over half that period. It might have been considered in itself a major accomplishment to take those five ton tractors and heavily located escort wagons over the route and bring them back without serious accidents or damages. Just as a final switch of the tail, so to speak, the outfit effected a forced march back to Ft. Stotsenburg. One battalion returned in three days over a distance which was normally a five day march, demonstrating the excellence of the road that had been constructed. The other battalion made sixty-five miles in a single displacement.

Back in garrison again, a reorganization into its latest transportation phase has begun. The first increment of new light trucks and reconnaissance cars is here. Construction and remodeling of motor sheds proceeds apace. Past performances are forgotten; new exploits are being planned. Some pangs of regret will accompany the turning in of the stout hearted tractors which made the late impossibility an accomplished fact, just as was the case when the faithful old jug-heads were given their despidida in 1932. But the real power and driving force remains and will make a success of the future as it did of the past—the spirit of the officers and men of this fine regiment.

The Twenty-fourth welcomes the unfurling of a new scarlet guidon beside its own at Ft. Stotsenburg, Battery "A," Twenty-third Field Artillery, P.S., (Pack). To this lusty baby it bequeathes a full complement of its best personnel, with hearty good wishes for future success. The pack mule in the quarter of its coat-of-arms will never be forgotten by the Twenty-fourth, and when the Mountain Battery Song, which was its own so long, is wafted up the breeze with the perfume from the stables, it will bring tender memories of the past. The Twenty-fourth knows and loves them all—howitzers, guns, horses, mules, tractors, and trucks.

AS TO ADVANCE GUARDS

BY MAJOR HARRY B. HILDEBRAND, INFANTRY

FOR many years we have been teaching a formation for advance guards which envisages a point, advance party, support and reserve marching down a road naively exemplifying the motto on the American dollar—"In God We Trust." Various quarters have advocated changes from time to time to meet modern conditions. A brief study of recent training literature from the Command and General Staff School and of the Infantry School indicates that a radical change in the march formation to be employed by advance guards is being contemplated. As Artillery is forced to conform to the movements and plans of the force which it is supporting, this change is worthy of note by the officers of that branch.

Briefly stated, this change brings about two different formations for advance guards; one to be employed when there is little or no probability of encountering hostile forces; the other to be employed when contact may reasonably be expected and readiness for combat becomes imperative. The two types may be classified as. "The Advance Guard When Contact is not Imminent" and "The Advance Guard When Contact is Imminent."

One immediately asks "When is contact considered imminent?" No set distances can possibly be laid down on this point. The capabilities of the enemy due to conditions of terrain, roads, transportation, mobile equipment, etc., must govern in each case. It is believed sufficient in general to consider "contact imminent" whenever the probabilities are that the enemy will be encountered within the day's march.

The advance guard employed when contact is not considered imminent adheres closely to the conventional ideas of advance guards previously taught at our schools (the point, advance party, support, and reserve, marching on a road) and requires no further explanation. The formation for the advance guard to be employed when contact is considered imminent has little resemblance to the conventional type, but is more of an approach march formation. It can be very descriptively called a semi-deployed formation.

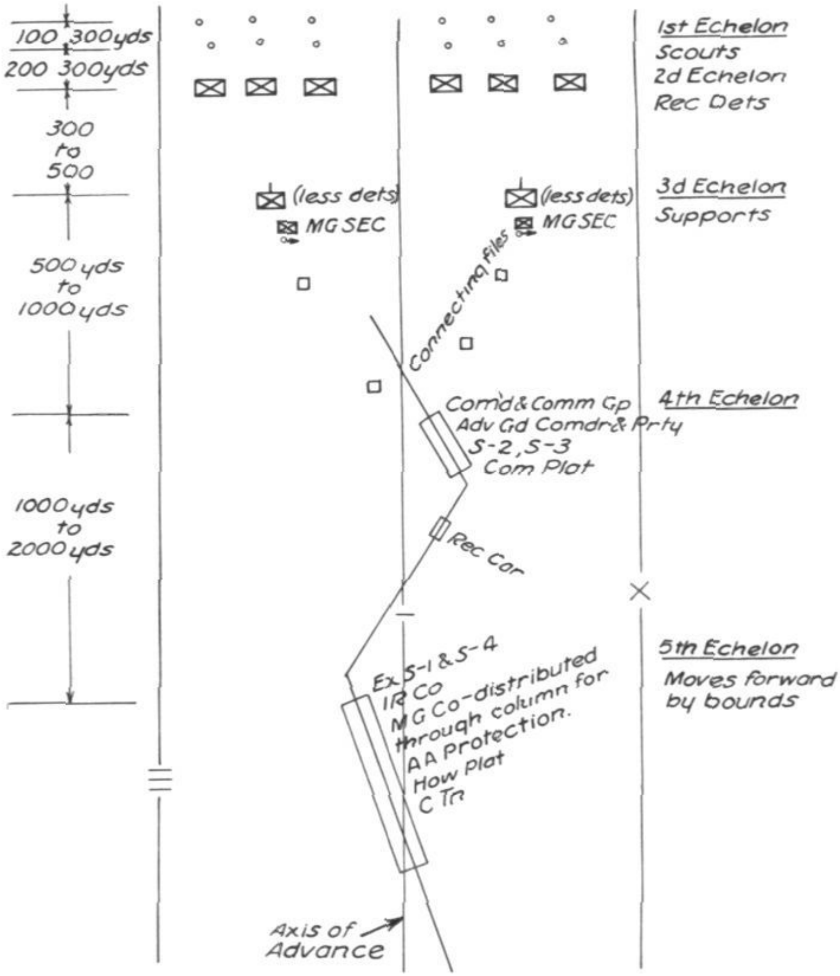


FIGURE 1. SEMI-DEPLOYED FORMATION OF ADVANCE GUARD

The semi-deployed advance guard formation for a battalion would appear something like Figure 1. By reference to this figure, it can be seen that the old point is replaced by a line of scouts working in pairs with large intervals between individuals. Their function is to draw fire and thus definitely verify the presence of hostile troops. Some distance behind this line of scouts is a line of reconnaissance detachments. Their function is to back up the scouts by driving off small enemy parties which prevent the movement of the scouts or by developing the general contour of any enemy position whose garrison is too strong to drive off. These reconnaissance parties will vary in strength from a squad to a section. Behind these reconnaissance parties will be found the line of supports. These supports reenforce the action of the reconnaissance parties, clearing out any minor resistance or preparing the way for the action of the reserve in case a strong enemy force is encountered. The commander of the advance guard and his party will be found in the area between the supports and the reserve at a point from which he can control the movement of the reserve or move quickly to influence the action of one of his supports if the need arises. It should be noted that the distance from the scouts to the head of the reserve varies between some 2,100 to about 4,100 yards according to the figure. These distances have been inserted merely to give some idea of the area covered by this formation and should not be regarded fixed or "regulation" distances.

Considering the efficiency of reconnaissance facilities available today, a large force of all arms moving toward contact with the enemy in a given theater of operations can be reasonably expected to have a fair knowledge of the strength, dispositions and movements of any major forces of the enemy for a considerable period prior to actual physical contact between major combat elements. A careful estimate of the situation will indicate the probable general area where major combat will take place. Movements of the force as a whole will be preceded by small, mobile screening and reconnaissance units. Marches of large forces will be conducted in several columns, more or less parallel, until the leading elements of the combat units approach the probable area of combat. As this area is approached, the commander of the force as a whole will have made basic plans for the employment of his force. Based on these plans, the force will be prepared for action. This preparation involves the breaking down of the force into a greater number of small columns and the closing up of rearmost combat units and preparation for their entry into action with the least practicable delay.

At this stage of operations we will find that advance guards of the several original columns which have been marching in the conventional formation are replaced by advance guards utilizing a semi-deployed formation.

Orders for advance guards will prescribe general phase lines.

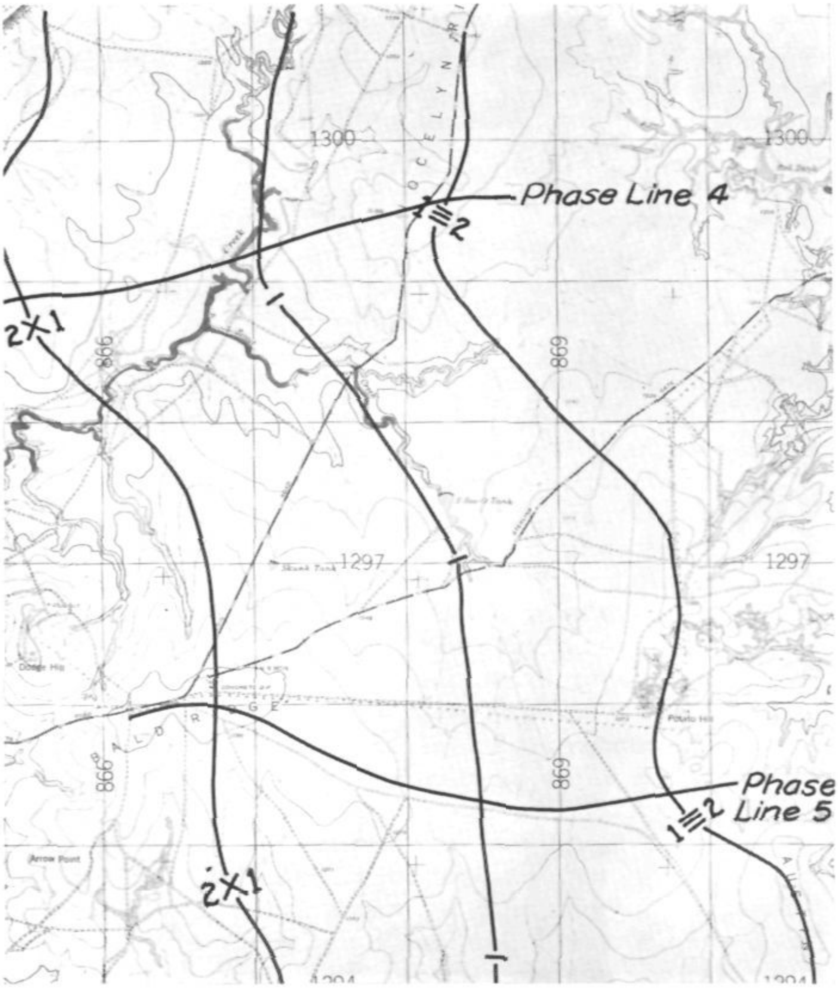


FIGURE 2. ZONE OF ACTION FOR ONE BATTALION

dictated by the terrain, which are to be used for coordination laterally along the front. Zones of advance for subordinate units will be indicated. Action to be taken by subordinate columns within their respective zones of advance will be outlined as far as probable contingencies may be foreseen.

Thus, for example, in Figure 2 assume that the 1st Infantry is moving south in the zone of action shown. It is one of the several columns in which the 1st Division is moving. Note that the boundaries of the 1st Infantry zone of action conform to the boundaries of natural compartments of the terrain where possible. Note the phase lines prescribed conform to natural ridge lines which are adaptable either for use as a defensive position or as a suitable line of departure for an attack towards the next phase line. If the formation outlined in Figure 1 were placed on the terrain shown in Figure 2, the line of scouts would be approaching Phase line 5 and the supports would be near I-See-O Tank when the reserve was beginning to move forward from Phase line 4 along the creek line generally in the center of the zone of action. In the semi-deployed formation, the attack by the leading elements of an advance guard will take place much more rapidly than has been the case in the past as they are already developed for combat. This will allow much less time for the reconnaissance and occupation of position by artillery after contact has actually been made. More efficient support would follow if the artillery would so arrange its march that it might engage the enemy as soon or before the leading infantry units have come under rifle fire.

This advance guard marching in a semi-deployed formation is so radically different from existing ideas that it is thought that its proper support by light artillery should be the subject of considerable thought on the part of Field Artillery officers. It must be realized that in the meeting engagement the infantry units of a semi-deployed advance guard will be committed to action within a minimum of time. Field Artillery units with or supporting the advance guards must be prepared to deliver effective fire upon a moment's notice if efficient support is to be given.

The question for the Field Artillery to answer now is how will light artillery support the infantry in the opening phases of this type of action.

THE DEVELOPMENT OF THE FIELD ARTILLERY RESERVE OFFICERS' TRAINING CORPS

BY MAJOR EDWIN P. PARKER, JR., FIELD ARTILLERY

PREVIOUS to the establishment of the R.O.T.C. under the Act of Congress of June 3, 1916, there had been no specialized training in Field Artillery in the civilian educational institutions of this country with the exception of three, namely, Yale University, Virginia Military Institute, and Culver Military Academy. At the two last named institutions such training had been given in addition to that of other arms, and only a small amount of time and effort had been spent on Field Artillery.

But at Yale University all military instruction was given for the purpose of developing potential field artillery officers. As a result of the interest shown in the training camp for civilians at Plattsburg, N. Y., in 1915, Yale became interested in military training and, with the aid of General Leonard Wood, late in 1915, commenced training students in field artillery. Since at that time there was no law providing for the issuance of the necessary matériel to a civilian institution, the students in military training were organized into batteries of the National Guard of Connecticut. Four such batteries were organized during the winter of 1915-16, and the necessary Regular Army instructors were detailed for duty therewith.

In June, 1916, due to the trouble on the Mexican border, the men of the Yale batteries of the Connecticut National Guard were called for active duty. After being recruited up to full strength, these batteries were sent for training to Camp Tobyhanna, Penn., where they remained for about two months. Upon the opening of college in the fall of 1916, these men were returned to New Haven.

A field artillery unit of the Reserve Officers' Training Corps was established at Yale University during the winter of 1916-17, being authorized by a War Department Bulletin under date of January 29, 1917. However, the declaration of war by the United States in April, 1917, interrupted the training of the R.O.T.C. at Yale and this unit was not reestablished until 1919. Although the Yale students who had undergone military instruction during 1916-17 received only limited training in field artillery due to the lack of time, nevertheless they were of inestimable value to the Field Artillery at the outbreak of war. Most of these were commissioned early and were soon busy training men in the technique of field artillery.

Besides the Yale unit, field artillery units of the R.O.T.C. were authorized, before this country entered the war, at two other institutions, namely, Virginia Military Institute and Culver Military Academy. However, little opportunity for specialized training in field artillery was offered before April, 1917, at these institutions. Our entrance into the World War delayed indefinitely the establishment of additional R.O.T.C. units due to the lack of officers as instructors and the shortage of matériel. However, during the War a Student Army Training Corps (SATC) was established at many institutions but this organization was short-lived.

After the Armistice, the War Department once more took steps to carry out the provisions of the Act of Congress of June 3, 1916, with respect to the establishment of the Reserve Officers' Training Corps. This Act of Congress provided that the R.O.T.C. consist of the units of the various branches of the service established by the President in those universities, colleges, and schools which shall have applied for admission of such units to membership in the Corps, and shall have agreed to the regulations prescribed by the Secretary of War for the Government and training of said units.

It also provided that units of the senior division of the R.O.T.C. may be organized at civil educational institutions which are duly authorized to grant academic degrees, including state universities and those state institutions that are required to provide instruction in military tactics under the provisions of the Act of Congress approved July 2, 1862, donating lands for the establishment of the colleges where the leading object shall be practiced instruction in agriculture and the mechanical arts, including military tactics, and at essentially military schools not conferring academic degrees but especially designated by the Secretary of War.

The few R.O.T.C. units established before our entrance into the World War, operated under War Department General Order 49 of 1916. However, these regulations and instructions did not prove satisfactory, so they were revised in 1919. Also, Congress was asked for modifications of the Act of 1916 in order to increase the efficiency of the Reserve Officers' Training Corps, and this was accomplished in 1920.

Originally, the R.O.T.C. was directed and administered by the Committee on Education and Special Training which functioned as a part of the General Staff. This committee was authorized to represent the War Department in its relations with the civilian educational institutions of the country. For the purposes of administration and control of the R.O.T.C., the country was divided into twelve districts with respect to the geographical location of educational institutions. A district headquarters was established in each district under an officer called the District Inspector. The district headquarters was used as a channel of communication between the Professors of Military Science and Tactics and the Committee.

In addition to the above, an officer of each arm and service was designated to assist the Committee in Washington in the work of the units of his arm or service. The Field Artillery was represented by an officer in the Training Section of the Office of the Chief of Field Artillery in Washington who spent his entire time on R.O.T.C. affairs. The functioning of the R.O.T.C. under the direction of the Committee on Education and Special Training and the districts lasted until the formation of the nine corps areas in September, 1920. At that time this training was placed under corps area commanders and was directed in Washington by the General Staff with the assistance of the offices of the chiefs of arms. This is the system followed today.

For several years after the installation of the R.O.T.C. units the rating of "Distinguished College" was given yearly to certain institutions having senior units. This rating was given as the result of two inspections; first, the one by the corps area, as a result of which selected colleges were recommended to the War Department for inspection; second, by a board of officers from Washington, which designated certain institutions as "Distinguished." This rating was prized highly and entitled the institutions receiving it to designate "Distinguished Graduates," a few of whom were given commissions as Second Lieutenants in the Regular Army.

In 1928 the system of inspecting R.O.T.C. units by a board of officers sent out from the War Department and the designation of "Distinguished" institutions was abolished. As a substitute, all R.O.T.C. units in each corps area have been inspected yearly by a board of officers selected by the Corps Area Commander. Subsequently, each unit has been designated "Satisfactory" or "Unsatisfactory." This system prevails today.

Late in 1918 and in 1919 the Chief of Field Artillery took an active part in the establishment of field artillery units. Due to the expense of matériel and equipment and the limited number of officers available for this duty, the number of field artillery units had to be restricted. In selecting universities and colleges the factors of large enrollment, local adaptability, and broad geographical distribution was considered.

Early in 1919, field artillery units were either established or in the process of being established at the following named institutions:

Yale University, New Haven, Conn.
Princeton University, Princeton, N. J.
Cornell University, Ithaca, N. Y.
Harvard University, Cambridge, Mass.
Leland Stanford University, Palo Alto, Calif.
University of Nebraska, Lincoln, Nebr.
Purdue University, Lafayette, Ind.
Texas Agricultural and Mechanical College, College Station, Texas.
Alabama Polytechnic Institute, Auburn, Ala.
University of Wisconsin, Madison, Wis.
Carnegie Institute of Technology, Pittsburgh, Penna.

Within a few months, field artillery units were established also at these institutions:

University of Chicago, Chicago, Ill.
Colorado Agricultural College, Fort Collins, Colo.
Culver Military Academy, Culver, Ind.
University of Illinois, Urbana, Ill.
Iowa State College, Ames, Iowa.
University of Missouri, Columbia, Mo.
Ohio State University, Columbus, Ohio.

University of Oklahoma, Norman, Okla.
Oregon Agricultural College, Corvallis, Oregon.
University of Utah, Salt Lake City, Utah.
Virginia Military Institute, Lexington, Va.

Of the institutions listed above, all have field artillery R.O.T.C. units today with the exception of Carnegie Institute of Technology, University of Nebraska, and the University of Wisconsin. The units at Carnegie Institute of Technology and the University of Nebraska were withdrawn at the close of the 1919-20 school year. The unit at the University of Wisconsin continued for several years, being withdrawn at the end of the academic year 1927-28. One institution not listed above, namely, the University of Florida, has a field artillery unit which was established in 1928, at the time of the discontinuance of the unit at the University of Wisconsin.

Thus, there are a total of twenty field artillery R.O.T.C. units at the present time. Of these, all except those listed below, have required military training for students during the first two years:

University of Chicago
Harvard University
Princeton University
Stanford University
University of Utah
Yale University

The enrollment of students in the field artillery units during 1919-20, the first complete academic year of R.O.T.C. instruction is given in Table I on page 341.

For comparison, the enrollment ten years later, at the beginning of the 1929-30 academic year, is shown in Table II on page 341.

Thus it will be seen that within ten years the total enrollment in the Field Artillery R.O.T.C. had increased by 8,226 students.

The enrollments in the Field Artillery R.O.T.C. units at the beginning of the past school year (1934-35) are shown in Table III on page 342.

Table IV on page 342 shows the number of commissions and certificates given by the institutions for the school year 1922-23 (after four years of operation), for the school year 1933-34, and the total as of August, 1934.

The installation of R.O.T.C. units in the educational institutions of this country after the World War brought a new era of military training in such institutions. The old system of having only a limited amount of close order drill and ceremonies was discarded and in its place, particularly so in field artillery units, was inaugurated an excellent system of theoretical instruction augmented by varied drills and other practical instruction.

Today, in the field artillery units, the program is so planned that the instruction in military science in the institutions over a four year period, supplemented by that in one summer camp of six weeks (usually at the end of the junior year in college), covers all of the subjects needed by a lieutenant of field artillery. Specialized training in field artillery subjects commences in the first year.

In 1919 the facilities in colleges for field artillery training were most limited. Some institutions constructed without delay fine plants for such work, others were not so prompt. However, today, most of the field artillery units have excellent facilities for training prospective reserve officers. Such plants include armories, riding halls, brick or concrete stables, machine shops, saddle shops, shoeing shops, gun sheds, motor sheds, riding pens, barracks for enlisted detachments, houses for senior N.C.O., ample drill fields for both mounted and dismounted instruction, pistol ranges, artillery ranges, and polo fields. Some of the armories have such facilities as offices, class-rooms, laboratories, store-rooms, band practice room, drill hall large enough for several batteries. .22 caliber pistol range, military library, and reading room for students.

Practically all R.O.T.C. matters pertaining to the Field Artillery which originate in the corps areas and are sent to the War Department for decision, and those originating in Washington, are referred to the Chief of Field Artillery for comment and recommendation. Such things as training programs for the R.O.T.C., both at institutions and in camps, and tables of allowances are worked out in detail by the Office of the Chief of Field Artillery in collaboration with other War Department agencies. Furthermore, the officers on duty as instructors at the institutions are selected by that office with the approval of the Adjutant General and the president of the institution concerned. The Chief of Field Artillery is keenly interested in the welfare of the R.O.T.C. and does everything possible to further its interest. An officer in his office devotes a large part of his work to R.O.T.C. affairs.

As the total number of Field Artillery R.O.T.C. units has been limited to twenty for several years by Act of Congress, the Chief of Field Artillery has urged constantly an increase in the number of students enrolled therein in order to augment the yearly production of field artillery reserve officers. This arm has always been short of its quota of reserve officers and it appears impracticable for it to reach its goal in the near future with the small number of units authorized at the present time. However, the War Department Appropriation Bill for the Fiscal Year 1936 carries a considerable sum for the establishment of additional R.O.T.C. units. It is hoped that a few of these will be field artillery units in fine institutions and that yearly a considerable number of reserve officers will be produced therefrom.

Since one-half of the division light artillery is horse-drawn, and, in certain theatres of operations animals will undoubtedly be used by the Field Artillery, it is deemed essential that a large number of reserve officers of Field Artillery be trained in the care and use of the horse. Therefore, it is not contemplated removing any of the horse-drawn batteries from R.O.T.C. units. However, in some of the larger units, it is believed that eventually equipment for a truck-drawn battery will be furnished in addition to that for a horse-drawn battery, thereby facilitating instruction in field artillery transport.

To really know the R.O.T.C., to appreciate the full value of its training, to realize its immense value to preparedness in this country, one must serve a tour with a R.O.T.C. unit. On such an assignment one keeps up-to-date on the technique of field artillery, has the chance of improving his ability as an instructor and has a fine opportunity of developing and displaying leadership with a select class of young men. Such a tour of duty not only will be enlightening to an officer from the standpoint of the value of R.O.T.C. training, but also will be of inestimable value to him in his career.

FIELD ARTILLERY RESERVE OFFICERS' TRAINING CORPS

TABLE I

ENROLLMENT OF FIELD ARTILLERY R.O.T.C. UNITS AS OF OCTOBER 1919.

Institutions:	1st Year Basic	2nd Year Basic	1st Year Advanced	2nd Year Advanced	Total Advanced Course	Total Enrollments
Alabama P. I.	138	75	34	0	34	247
Chicago, Univ. of..........................	75	0	0	0	0	75
Colorado A. C.	*					285
Cornell, Univ. of...........................	0	385	8	0	8	393
Culver M. A.	*					143
Harvard Univ.	125	0	0	0	0	125
Illinois, Univ. of............................	347	0	12	5	17	364
Iowa State College........................	*					255
Missouri, Univ. of.........................	158	0	0	0	0	158
Ohio State Univ.	336	92	12	3	15	443
Oklahoma, Univ. of	187	0	0	0	0	187
Oregon State A. C.	327	0	4	0	4	331
Princeton Univ.	60	52	10	5	15	127
Purdue Univ.	792	454	31	11	42	1288
Stanford Univ................................	42	25	7	0	7	74
Texas A. & M. Col........................	170	0	8	0	8	178
Utah, Univ. of	105	0	0	0	0	105
Virginia M. I.	0	0	0	0	0	0**
Wisconsin, Univ. of	*					156
Yale Univ.	*					129
Total						5063

* The enrollments by courses in these institutions are not known.

** There is no record of the enrollment at V.M.I. in October, 1919. However, the enrollment in June, 1920, was 301.

TABLE II

ENROLLMENT OF FIELD ARTILLERY R.O.T.C. UNITS AS OF OCTOBER, 1929.

Institutions:	1st Year Basic	2nd Year Basic	1st Year Advanced	2nd Year Advanced	Total Advanced Course	Total Enrollments
Alabama P. I.	390	281	80	91	171	842
Chicago, Univ. of..........................	79	33	29	30	59	171
Colorado A. C.	349	215	27	25	52	616
Cornell, Univ. of...........................	400	278	41	56	97	775
Culver M. A.	35	42	20	6	26	103
Florida, Univ. of............................	233	255				488
Harvard Univ.	142	72	43	32	75	289
Illinois, Univ. of............................	479	218	60	40	100	797
Iowa State College........................	564	344	39	51	90	998
Missouri, Univ. of.........................	336	182	40	36	76	594
Ohio State Univ.	703	527	29	32	61	1291
Oklahoma, Univ. of	872	418	127	62	189	1479
Oregon State A. C.	279	197	55	27	82	558
Princeton Univ.	240	191	93	100	193	624
Purdue Univ.	1061	601	116	85	201	1863
Stanford Univ................................	96	83	46	37	83	262
Texas A. & M. Col........................	268	162	59	50	109	539
Utah, Univ. of	291	61	52	43	95	447
Virginia M. I.	139	82	55	47	102	323
Yale Univ.	84	65	42	39	81	230
Total	704	4307	1053	889	1942	13289

TABLE III

ENROLLMENT OF FIELD ARTILLERY R.O.T.C. UNITS AS OF OCTOBER, 1934.

Institutions:	1st Year Basic	2nd Year Basic	1st Year Advanced	2nd Year Advanced	Total Advanced Course	Total Enrollments
Alabama P. I.	433	202	121	121	242	877
Chicago, Univ. of	24	21	20	14	34	79
Colorado A. C.	360	196	21	32	53	609
Cornell, Univ. of	544	422	68	77	145	1111
Culver M. A.	34	23	8	8	16	73
Florida, Univ. of	476	267	100	70	170	913
Harvard Univ.	60	33	31	30	61	154
Illinois, Univ. of	544	315	75	52	127	986
Iowa State College	586	253	52	45	97	936
Missouri, Univ. of	328	159	38	37	75	562
Ohio State Univ.	826	380	55	43	98	1304
Oklahoma, Univ. of	871	423	144	129	273	1567
Oregon State A. C.	246	96	31	35	66	408
Princeton Univ.	173	171	93	95	188	532
Purdue Univ.	854	496	141	155	296	1646
Stanford Univ.	74	64	43	24	67	205
Texas A. & M. Col.	363	149	62	59	121	633
Utah, Univ. of	419	136	64	44	108	663
Virginia M. I.	101	50	42	61	103	254
Yale Univ.	43	57	51	49	100	200
Total	7359	3913	1260	1180	2440	13712

TABLE IV

COMMISSIONS AND CERTIFICATES FOR COMMISSIONS IN THE FIELD ARTILLERY SECTION, OFFICERS' RESERVE CORPS GIVEN TO GRADUATES OF THE FIELD ARTILLERY R.O.T.C.

Institutions:	For School Year 1922-23	For School Year 1933-34	Total to August 30, 1934
Alabama P. I.	41	129	1004
Chicago, Univ. of	8	18	249
Colorado A. C.	18	27	259
Cornell, Univ. of	14	75	504
Culver M. A.	13	15	116
Florida, Univ. of	—	62	146
Harvard Univ.	20	16	356
Illinois, Univ. of	14	57	448
Iowa State College	7	48	451
Missouri, Univ. of	6	40	341
Ohio State Univ.	18	44	393
Oklahoma, Univ. of	10	125	754
Oregon State A. C.	26	25	342
Princeton Univ.	37	74	890
Purdue Univ.	55	167	1231
Stanford Univ.	15	26	344
Texas A. & M. Col.	28	54	498
Utah, Univ. of	13	47	373
Virginia M. I.	39	74	577
Wisconsin, Univ. of	11	—	
Yale Univ.	42	26	373
Other Institutions:			
Univ. of Penn.	—	1	1
Indiana Univ.	—	1	1
Univ. of Calif.	—	1	1
Total	435	1152	9652

CONFESSIONS OF AN EX-HORSEMAN

IN order to spare the cautious reader the consequences of my blasphemy, let me make my point right now so that he may read no further. I, an erstwhile horseman, have become sold, completely and irrevokably on truck drawn artillery. I never made the horse-show team, I merely went riding—not hacking. Nevertheless I played polo, rode whenever possible, took part in horse shows and considered myself a horseman in every way. I knew all the lingo, partook of all the festivities of the home paddock, could give all the proper highsigns and was a member in good standing of the Society for the Propagation of the Cult of the Horse. But now I have relegated all that to the limbo of the dear, dead past. With a "4 by 4 and a 2dt" I make my obeisance to the new gods (Ford and Chevrolet) and greet the dawn of a new day.

In my callow youth I fell for the "Long Island Cult," hook, line and sinker. Verily, a lucky man was I. By the grace of a benevolent government, I, though a lowly Second Lieutenant in the first pay period, was enabled to live as horsey an existence as though I had been born to the Elysian Fields of Meadowbrook or Pinehurst. It took America's aristocracy generations or a lifetime to amass sufficient funds to indulge itself promiscuously in the sport of the horse. I never questioned whether I wanted to do it. Millionaire play boys did it—therefore it must be good. So I played polo, jumped and rode to the hounds and felt the thrill of being able to engage in the same sports as the plutocrats.

Unfortunately I soon found out that it was not only a sport. The horse as well as being an avocation was also the army officer's vocation. This realization put a different aspect on things.

While a delightful animal to ride, the horse must needs be groomed, watered, fed, bedded, shod, pilled, clipped, roached, plucked, exercised, trained, inspected, encouraged, coddled, and protected and all these ceremonious rituals had to be personally attended and supervised by an officer. Being a Lieutenant I was it. It is a toss-up whether my first inkling of rebellion arose during one of the countless painful hours on the picket line or after my thirteenth policing in as many days at the hands (or rather feet) of my recalcitrant B.O. remount.

This rebellion had its mental aspects as well as physical. Surveying the national scene I found most of the world using other means of conveyance, yet I still plodded along on the back of a horse. People anxious to get from one place to another were using the automobile, the train, the airplane—even the bicycle and the roller skate, but along with the milkman and the Grand Marshal of the Elks Parade, I rode a horse. In the most highly developed technological civilization the world has ever known the army was depending on a mode of transportation dating back to the dawn of recorded history.

I did a tour with the tractors, which failed to convert me. These lumbering terrors of the night, snorting loudly across country at four miles an hour, were no improvement. They proved as cantankerous, as snail-like, as perverse, as the horse.

With my faith in the horse already badly shaken, it needed but one view of a modern truck-drawn battery rolling along at 35 miles an hour to give me a new lease of professional life. The speed, the grace, the quietness, the assurance with which this battery went about its appointed task convinced me at once that material progress was not a sham.

With further experience my admiration has ripened into deep respect. I have seen a battery of truck-drawn artillery travel 498 miles in a single run of 18 hours; maneuver shell-torn areas, negotiate heavy mud and loose sand with ease, and march at 2½ miles an hour for 5 hours without overheating. I have noted that after a long march, cannoneers arrive at the gun position, fresh, untired and prepared to move the guns with a full complement of energy.

I'm not blind to the fact that truck-drawn artillery has its limitations, but who can say that a horse has not likewise its limitations. I merely contend that the object of any field artillery prime mover is to place a given gun in a given position at a given time and that the truck will do this with more speed, in greater comfort and with less general all around fuss and bother than the horse. "Romance," say you, "tradition"? What place have these amid the stern realities of modern war. The Field Artillery has sold the romance and glamour of the horse for the speed and comfort of the truck. Let one think twice before mentioning "Birth rights and porridge" . . . Time marches on!

BATTLE TERRAIN DEPTH AND ARTILLERY

(A GERMAN VIEW)

IN the field of artillery, the same as in any other field of military technique and tactics a complete revolution has taken place during the course of the last few years. Motorization, tanks, aerial weapons and the general increase of machine weapons have changed the former requirements of efficiency and grouping of artillery arms. The infantry demands that it be amply supplied with auxiliary weapons. Infantry cannons for defense against tanks and infantry howitzers for immediate assistance of the fighting troops are being constructed. Improvements in the field cannons give a range of 14 km. Records are demanded of every weapon. These records may be desirable for the particular case and the special group; for war purposes, however, they are 90 per cent useless. If one follows the developments which have so far been achieved, it appears that the practical experience gathered during the war is being forgotten more and more and that technique has gone far beyond requirements. The constant increase in range combined with increase in the weight of the arms and the attempt to construct "standard weapons" for all purposes, prove that the technique is following a wrong direction.

It is advisable to ascertain what the actual limits of the troop requirements are. In an article entitled "Survey of Modern Arms Developments," Captain Dr. Ing. Gallwitz drew attention to the importance of tactical economy or applicability and by mathematical calculations he has examined the relation of firing range, maneuverability and effect. This writer comes to the conclusion that the tactical applicability demands a different technical development.

The weight of cannons and guns are too heavy today. In special cases their efficiency can probably be utilized. However, they are unusable for their main purpose on account of their heavy weight and lack of maneuverability. The following are the decisive factors for the technical development and usefulness of a cannon or gun:

The fighting terrain depth, which determines the range;

The fighting effect, which determines the caliber;

The maneuverability, which determines the weight.

These factors have not governed. Increase of the firing range and caliber only have been aimed at, while the fighting terrain depth has been left out of consideration. The calibers, ranges and weights should be determined by tactical requirements. For individual fighting purposes it is possible to ascertain the fighting effects as regards caliber. The fighting terrain depth or space can also be established by the prevailing technical standard so that a development in the direction of maneuverability, i.e., the weight of the weapon is the most important factor left. An improvement in this direction would be much more advantageous and advisable than in the present direction of increasing the firing range and caliber. This does not mean that new guns or cannons are to represent a revolution in the present tactics and change the established fighting terrain depths and fighting effect.

The example of the 7.5 or 7.7 cm. field cannon which has been introduced in most countries will best illustrate what may result from a wrong development of a cannon. At the beginning of the war the German army was equipped with the field cannon number 96 as main fighting weapon for the divisional artillery. Firing range: 7800 meters; weight in firing position: 1020 kg. It was claimed that the cannon did not achieve the shooting capacity of the French field cannon and during the course of the war it was replaced by field cannon number 16, firing range: 10,700 meters, weight 1,325 kg. Under the influence of the continuous stabilized war, too much importance was placed on great firing ranges and the considerably greater weights were not taken into consideration. Later, in the war of movement and in the defense against tanks, when the actual purpose of the field cannon, i.e., the close cooperation with the infantry, was again brought to the foreground, the former "superseded" field cannon number 96, which showed a greater maneuverability, was again resorted to. After the war a continuation of the wrong development could be observed in almost all countries. The present 7.5 or 7.7 cm. field cannon, the firing range of which has been increased to 16 km., has been changed from its original purpose due to a one-sided development It is unusable for almost all kinds of combat which may come in question within the fighting terrain depth.

The field cannon no longer represents the standard cannon of the divisional artillery. Its effect in forming centers of gravity is too small. Every artillerist knows that it is exceedingly difficult to find a covered position for such a flat trajectory gun. Furthermore the day is definitely past for the shooting of cannons of this size from open or half-covered positions. The opportunity of utilizing the great firing range is so small, in view of the number of near targets, that the additional weight and unmaneuverability of the cannon does not pay

The field cannon is further not suited as an auxiliary arm for the infantry. The range and the weight of the cannon are too great, and the maneuverability in infantry battle is not sufficient.

For the same reasons the field cannon also can not be used today as an anti-tank weapon.

In its present construction, the field cannon is at most a special cannon for distant targets. In this connection it should be remembered that its effect at great distances is too small for harassing fire. The cannon can at the utmost be used in small numbers as a light, distance cannon with the divisional artillery at points where heavy flat trajectory guns (10 cm.) cannot follow. Nevertheless the field cannon is everywhere being adhered to as the main weapon of the divisional artillery and improvements are constantly being made on the same without considering that it has become useless for its original purpose as the main fighting weapon of the division.

Keeping the same example, the field cannon, if we investigate the fighting terrain depth and the maneuverability of the cannon instead of looking into the development of the range, we arrive at the following demands:

1. Considering the fighting terrain depth, the firing range and the weight must be reduced. The infantry requires within the bounds of its organization a 7.5 cm. caliber gun, firing at the utmost 5 km. and weighing no more than 250 kg. in firing position.
2. This cannon must never be a flat trajectory cannon, but must be a high trajectory fire weapon.

A comparison of the constructions of various countries shows that such requirements can be met.

Type	*Weight*	*Range*
7.5 cm. Norwegian Mountain Howitzer	600 kg.	8,800 meters
7.5 cm. Infantry Howitzer "Siderius"	367 "	3,680 "
7.5 cm. Japanese Mountain Howitzer	521 "	6,500 "
7.5 cm. Infantry Cannon "Bofors"	365 "	6,000 "
7.5 cm. French Infantry Howitzer	850 "	8,300 "
7.5 cm. Schneider Mountain Cannon	680 "	9,500 "

If one follows the technical development of *artillery*, one sees that the caliber has remained the same for many years, while in the case of new specialty arms no decision has been made as to a fixed caliber. Financial reasons probably play a part in this. There is no difficulty in establishing the various calibers according to the tactical requirements taking into consideration the effect and fighting terrain depth. It is only surprising that it should have taken fifteen years before the proper caliber for infantry cannons and infantry howitzers was ascertained. In a number of countries decisions are finally being taken establishing certain calibers, for example, for infantry cannons 4.7 cm. and for infantry howitzers (trench mortars) 6 to 8 cm. caliber. In my investigations I shall use the calibers 7.5 cm., 10.5 cm., 15 cm. and 21 cm. which have been established for decades.

It is just as important for the development of the artillery to ascertain the fighting terrain depth or space for the individual cannons or groups of cannons as it is to ascertain the caliber. Furthermore the minimum and the maximum firing range required for this fighting area should be determined. Caliber and fighting range are factors which can be established and which form the basis for the construction of cannons and guns. From this the weight and maneuverability limits will result. These influence the use and applicability to a greater extent than any other firing characteristic. After these two factors have been carefully investigated, they should be standardized for a long time to come. While the calibers have remained rather stationary, the fighting terrain depth has changed during the last decades. According to the experiences of the world war the following three tactical considerations create a limit to the fighting terrain depth:

1. Ability to maintain contact between artillery and the fighting troop.

2. Observation possibilities.
3. Targets.

An attempt was made to overcome the difficulty of contact by creating artillery contact officers and by employing various kinds of signalling means. In most cases they only constituted a substitute which demanded many sacrifices and in the decisive moment worked too late or did not work at all. Furthermore, the observation possibility for the various kinds of weapons are exhausted at a certain distance. The infantry auxiliary artillery will always have to depend on its own observations. The large mass of divisional artillery will not be able to rely on aviators or ranging picket observers. By the time they can report, the favorable moment for action is past. In his article, "Observation." Major Kaiser studied the problem of artillery observation and claimed that the question of modern artillery reconnaissance and firing observation is as yet unsolved. The problem is unsolved for the simple reason that it is desired to see everything while in reality nothing can be seen because of the difficult and complicated requirements. Furthermore, as is correctly explained in Major Kaiser's article, *objectives* are lacking due to modern tactics. It was believed that by exaggerating the firing range, all distant targets might be reached, but the decisive and nearest targets were left out of consideration. Here the various problems overlap. It is necessary to establish the fighting terrain depths for the various kinds of cannons or guns and to limit the same to the average firing and observation possibilities.

In the following an attempt is made to show the use and the fighting terrain depth of the cannons and to bring up the question what weights may serve as a limit if the fighting terrain depth and the caliber are firmly established. The weights of the cannons as mentioned are based on estimates. They serve merely to draw attention to the principle. If the artillery is considered in terms of fighting terrain depth, and maneuverability, the following divisions are arrived at:

1. Infantry Artillery
2. Field Artillery
3. Position Artillery
4. Flying Artillery (bombers)

The following chart shows this classification of artillery with comparative position and fighting terrain depths.

CLASSIFICATION OF ARTILLERY

Type	Depth of Position	Depth of Fighting Terrain	Weight of Gun
	10 8 6 4 2	2 4 6 8 10 12 14 16 18	
	Kilometers	Kilometers	
Infantry Artillery		Lt. Inf. How. 7.5 cm.	110 lbs.
		Heavy Inf. How. 7.5 cm.	550 "
		Inf. Cannon. 4.7 cm.	550 "
Field Artillery		Lt. Field How. 10.5 cm.	2,200 "
		Lt. Field Cannon. 7.5 cm.	2,200 "
		Heavy Field How. 15. cm.	3,960 "
		Heavy Field Cannon, 10.5 cm.	4,840 "
		Heavy Field How. 21 cm.	11,000 "
		Heavy Field Cannon	13,200 "
Position Artillery		Weight of gun Decisive up to 20 Kilometers	
Flying Artillery (Bomber)		From 15 Kilometers	

1. *Infantry Artillery*

The average fighting terrain depth is 4 km., the average position terrain depth is 1 km. Much is being said today about infantry artillery but people are not clear in what the infantry artillery requirements really are. Some believe that infantry artillery is only anti-tank guns, others believe it is the auxiliary weapons of the divisional artillery, while still others believe it is trench mortars. In the first place infantry artillery must consist of high trajectory guns (light infantry howitzer and heavy infantry howitzer). Furthermore the infantry cannon is a special arm for anti-tank defense and to combat distant individual targets. The infantry artillery is part of the battalion or regiment and independently handles all infantry combats which were formerly handled by the field artillery, particularly the field cannon.

a. Light infantry howitzer:

Caliber 7.5 cm., weight 50 kg., firing range 3 km.

This is a battalion substitute for the former light trench mortar. It is the main weapon of the battalion. *Of the foreign constructions*, the trench mortar Stokes-Brandt is the one which has best answered the requirements so far.

b. Heavy infantry howitzer:

Caliber 7.5 cm., weight 250 kg., firing range 5 km.

This is the main weapon of the regiment. It is mounted on splinter-proof automatic carriages (caterpillar). It can be dismounted in the shortest possible space of time for stationary combats and placed on wheels or tripod. Some foreign firms (B. Bofors, Siderius, Vickers, Skoda) also meet these requirements but with somewhat heavier weights.

c. Infantry cannon:

Caliber 4.7 cm., weight 250 kg.

They are mainly anti-tank guns, therefore primarily meant to attack armor plates. In view of the high initial velocity required for this purpose, a greater firing range than would be necessary for tactical reasons is required. The cannon may therefore also be used by the infantry for distant targets, outside of the average fighting terrain depth.

Allotment

Every infantry company should have an auxiliary platoon (4th platoon) consisting of one light infantry howitzer, one heavy infantry howitzer and one 2 cm. anti-aircraft machine gun.

Every battalion should have one machine gun company of four platoons, the 1st to 3rd platoons each consisting of three heavy machine guns and the fourth platoon consisting of three antiaircraft machine guns (2 cm.). Furthermore each battalion should have one infantry battery of four platoons, platoons 1 to 3, inclusive, each consisting of three light infantry howitzers, the fourth platoon consisting of three infantry cannons.

Every regiment should have two infantry batteries each consisting of four platoons. The 1st to 3rd platoons of each battery consisting of two heavy infantry howitzers each, and the fourth platoon of three 2 cm. anti-aircraft machine guns.

The following armament would therefore result:

Infantry Battalion	*Infantry Regiment*
9 heavy machine guns	27 heavy machine guns
6 anti-aircraft machine guns	24 anti-aircraft machine guns (2 cm.)
12 light infantry howitzers	36 light infantry howitzers
6 infantry cannons (TAK)	12 heavy infantry howitzers
	18 infantry cannons

The fighting power of the light infantry howitzer therefore lies with the battalion; the fighting power of the heavy infantry howitzer lies with the regiment. The infantry regiment and the infantry battalion would in view of this allotment be in a position to solve all fighting problems within the depth of their fighting terrain.

2. *Field Artillery*

Originally the term field artillery implied mobility. Field Artillery meant the mobile artillery of the division while the foot artillery was intended merely as a besieging artillery for position combats. Later on the dividing line disappeared and the division was made as to caliber size. The designations field artillery and foot artillery are therefore today no longer correct. It would be more correct if we today had only one mobile artillery of the field army, and one less mobile artillery for the struggle against fortifications. As position warfare was the rule during the world war and on account of the wrong exaggeration of technical developments after the war, this classification of artillery has not as yet become noticeable. I consider a classification as to mobile artillery of the field army, i.e. "field artillery" and less mobile artillery, i.e. "position artillery" correct. This would mean that with the field artillery the mobility (i.e. weight of cannons) within the limits of moving warfare is of paramount importance. while with the so-called position artillery the firing effect and firing range come first and the mobility last.

The field artillery, as divisional artillery and corps artillery, is intended solely to furnish the center of operations and to decide the combat within the limits of the division and the corps.

The average fighting terrain depth is 7 km. for field artillery.

The average position terrain depth is 3 km. for light and medium guns.

The average position terrain depth is 4 km. for heavy guns.

In consideration of the above, the following guns would belong to the field artillery.

a. Divisional artillery:
   1. Light field howitzer, caliber 10.5 cm., weight 1,000 kg., firing range 10 km. (main gun for the divisional artillery).
   2. Light field cannon, caliber 7.5 cm., weight 1,000 kg., firing range 12 km. (can be used only as light distant combat arm).
   3. Heavy field howitzer, caliber 15 cm., weight 1,800 kg., firing range 10 km. (carrier of the destruction fire and the artillery combat).
   4. Heavy field cannon, caliber 10.5 cm., weight 2,200 kg., firing range 14 km. (distant firing cannon for the division).

b. Corps artillery:
   1. Heaviest field howitzer, caliber 21 cm., weight 5,000 kg., firing range 10 km. (to destroy heavy combat fortifications and artillery combat).
   2. Heavy field cannon, caliber 15 cm., weight 6,000 kg., firing range 16 km. (distant combat gun for the corps).

Considering organization, the infantry units as well as the artillery must be so divided and equipped with weapons that they will be able to comply with all requirements within their combat terrain, without dispersing their fighting power.

The battery defends itself against enemy air attacks. The combat of tanks and armored cars within the position terrain of the artillery is directed by the division. It is impossible to have superior command posts direct the combatting of armored cars and anti-aircraft defense in each individual case, as then the favorable moment for taking action has passed. In view of the foregoing it would be advisable to combine the divisional artillery in *one* artillery regiment, the commander of which is at the same time the artillery leader of the division. The following organization will therefore result for the divisional artillery:

I. Battalion

1st to 3rd Battery, 10.5 cm. light field howitzers

4th Battery, 7.5 cm. light field cannons

II. Battalion

1st to 3rd Battery, 10.5 cm. light field howitzers

4th Battery, 7.5 cm. light field cannons

III. Battalion

1st to 3rd Battery, 15 cm. heavy field howitzers

4th Battery, 10.5 cm. heavy field cannons

(The batteries of the 1st to 3rd Battalions have 3 guns each.)

IV. Battalion (anti-aircraft)

1st to 3rd Battery, 7.5 cm. light anti-aircraft cannon

4th Battery, six 2 cm. anti-aircraft machine guns.

Furthermore each battalion would have one platoon 4.7 cm. infantry cannons of three guns each and each battery would have one anti-aircraft machine gun (2 cm.).

The following would be at the disposal of the division (not counting the 2 cm. anti-aircraft machine guns):

Infantry Artillery (Battalion and Regimental artillery):

	Weight		*Caliber*	
108 light infantry howitzers	50	kg.	7.5	cm.
36 heavy infantry howitzers	250	"	7.5	"
54 infantry cannons	250	"	4.7	"

Field Artillery (Divisional Artillery):

18 light field howitzers	1,000	"	10.5	"
6 light field cannons	1,000	"	7.5	"
9 heavy field howitzers	1,800	"	15	"
3 heavy field cannons	2,200	"	10.5	"
12 infantry cannons	250	"	4.7	"
12 light anti-aircraft cannons			7.5	"

The remaining responsibilities of the mobile artillery (reinforcement for the artillery combat, destruction of heavy field fortifications, distant targets) belong to the corps artillery whose main weapons are the heaviest field howitzers, caliber 21 cm., and the heaviest field cannon, caliber 15 cm.

3. *Position Artillery and Flying Artillery*

Next to the field artillery, which directs its main attention to mobility and a limited fighting terrain depth, comes the position artillery, intended for stabilized warfare, combat against fortresses, and temporarily frozen fronts, whose tactical responsibilities and main characteristics are the following:

1. Fighting effect, which is expressed by the size of the caliber.
2. Increased firing range in order to carry the combat into the depth zone and force fire supremacy in the artillery combat as to effect and distance.

In the case of position artillery a much greater margin is left to technique. It should, however, be considered whether tactics here also do not create a limit to the combat terrain depth and thus to firing range. This question today arises through the extensive development of aircraft weapons. Is it still worth while to construct guns with a firing range of 60 to 140 km.? Is not the objective reached more quickly and in a more simple manner by the bomber, particularly if the difficulty of artillery observation is taken into consideration? I therefore believe that for tactical as well as financial reasons a limit may also be set for the position artillery as regards firing range. From a combat terrain of 20 km. depth and a position terrain of 10 km., a maximum firing range of 30 km. would result, and this would answer all tactical requirements. Contrary to the present fantastic demands as to firing range and caliber, a tactically much more desirable mobility for medium and heavy flat trajectory guns would remain.

Furthermore artillery combat can much more successfully and more quickly be taken over today by the flying artillery, i.e. the bomber squadrons, which are not delayed by going into position and by the difficulties of observation. The flying artillery should be combined in the artillery corps so that it may, together with the corps artillery, carry the combat into the depths of the enemy territory.

This résumé on combat terrain and weapons is intended only to call attention to the necessity for mobility, which in artillery matters today is often forgotten. One often demands tactical and operative mobility but only has motorization and speed in mind. The tactical mobility which we require today is not so much a question of speed but it is more a question of making the weapons themselves mobile and adequate."

From the "*Deutsche Wehr.*"

FIELD ARTILLERY R.O.T.C. ANNUAL PISTOL COMPETITION

IN 1921 the Chief of Field Artillery, in cooperation with the National Rifle Association, organized an annual pistol competition for Field Artillery R.O.T.C. units. The .45 caliber automatic pistol was the weapon originally used in this match, and its employment continued through the year 1932. At that time it was discarded due to the difficulty of obtaining sufficient .45 caliber ammunition for practice for this match. In the year 1930, a caliber .22 competition was opened for Field Artillery R.O.T.C. units, as several of them were unable to fire in the .45 caliber match. The competition became so much more popular than that of the .45 caliber, that the latter was discontinued after 1932.

The winners of the annual competition from the date of its beginning were as follows:

.45 CALIBER

1921—University of Missouri
1922—University of Missouri
1923—Alabama Polytechnic Institute
1924—Alabama Polytechnic Institute
1925—Princeton University
1926—Alabama Polytechnic Institute
1927—Purdue University
1928—University of Missouri
1929—University of Missouri
1930—University of Oklahoma
1931—University of Oklahoma
1932—University of Oklahoma

.22 CALIBER

1930—Purdue University
1931—Princeton University
1932—University of Missouri
1933—University of Oklahoma
1934—University of Oklahoma

Some of the conditions governing the .22 caliber pistol competition for 1935 follow:

Open to: Each Field Artillery unit is eligible to enter one team. Each team will consist of five (5) men. All must be students actually enrolled in the Field Artillery unit of the R.O.T.C. and attending instruction regularly therein. Graduates of the R.O.T.C. are not eligible.

Arm: Any .22 caliber automatic pistol.

Sights: Any, provided that they are strictly open and not more than 10 inches apart.

Ammunition: Any rim-fire.

Course: 10 shots per man, slow-fire, fired on one target; 10 shots timed-fire, fired in two strings of 5 shots each on one target; 10 shots rapid-fire in two strings of 5 shots each on one target. (Note: Slow-fire, one minute per shot; timed-fire, twenty second for each string of five shots.)

Targets: Standard American 50-foot pistol target for slow-fire. Standard American 50-foot rapid-fire pistol target for timed and rapid-fire stages.

The winner of this match for 1935 is Purdue University with a score of 1,382. The four teams next in order of scores are:

University of Oklahoma—1,346
Cornell University—1,342
University of Missouri—1,335
Iowa State College of Agricultural and Mechanical Arts—1,324

The scores of each member of the three highest teams follow:

PURDUE UNIVERSITY—SILVER MEDALS

Name	*Slow*	*Rapid*	*Timed*	*Total*
Yarber, W. H.	89	96	95	280
Partlow, C. O.	91	91	98	280
Bradshaw, J. O.	89	93	95	277
Grannis, C. O.	82	96	96	274
Newhall, J. N.	81	94	96	271
			Total	1,382

UNIVERSITY OF OKLAHOMA—BRONZE MEDALS

Name	*Slow*	*Rapid*	*Timed*	*Total*
Cox, Mark S.	92	92	97	281
Blake, Homer C.	85	96	92	273
Newkumet, Phil J.	90	91	90	271
Watt, John J., Jr.	91	88	92	271
Newkumet, Frank J.	78	82	90	250
			Total	1,346

CORNELL UNIVERSITY—BRONZE MEDALS

Name	*Slow*	*Rapid*	*Timed*	*Total*
Crissey, W. F.	89	93	93	275
Ward, B.	87	96	88	271
Schroeck, F. E.	90	90	90	270
Waring, S.	83	94	93	270
Schlenker, N. E.	79	89	88	256
			Total	1,342

The highest individual score, 281, was made by the three students listed below:

Jordan, Albert, Iowa State College of A. & M. Arts
Meyers, James D., University of Missouri
Cox, Mark S., University of Oklahoma

As the result of winning this competition, Purdue University will have possession of the silver challenge cup for one year and each member of its pistol team has been presented with a silver medal designed especially for this Field Artillery R.O.T.C. Competition and furnished by the National Rifle Association. Each member of the teams winning second and third places have received bronze medals of the same design.

THE MILLS OF NEERWINDEN

BY FLETCHER PRATT

THE long wars that grew out of the effort of Louis XIV to make himself king of Europe and the world have a certain formal insincerity of character, like the rules of politeness which prescribed that two angry men should bow and offer snuff before coming to blows. After the death of Marshal Turenne something almost unreal enters the whole military panorama; the methods of march and countermarch, of siege and relief, of victory and defeat even, are regulated by a set of curiously inflexible rules. Campaigns lack any guiding principle but a mouse-like nibbling at hostile positions—the bankrupt strategy of Joffre and 1915. Huge armies roll like thunderclouds across the plains of Flanders, but behind them the civil population is hardly aware that a war is in progress Just at the moment when they appear about to meet in a world-shaking storm, there is an avoidance and both forces go tripping through a network of fortresses that covers whole provinces. When a battle does take place it is the result of a stumbling, accidental meeting or as a by-product of the siege or relief of some town. After the battle there is no pursuit and hardly any result. The old game goes on with the same elaborate formality that causes a fencer's thrust in quart to succeed his parry in tierce.

The prevalence of this formalized nibbling has brought upon these campaigns the neglect of students of war. Campaigns based on brilliant strategy are interesting; they are the story of great results accomplished in the face of great difficulties, of events that have changed the face of the world. Campaigns without strategy are only a wearisome recital of marches and combats, as futile as last year's newspaper. We hear from the history books that Turenne gave the French army an education in the new principles of war that Gustavus Adolphus had discovered; we hear that he was followed by a generation of illustrious commanders who ruined the Spanish-Austrian hegemony and almost captured all Europe—Crequi, Vauban, Catinat, Luxembourg. But it is difficult to find anyone who can tell how this result was accomplished or even anyone who can name a campaign or battle conducted by any one of these leaders. Their lack of the large view, of strategic principles, has made them only names in a book of reference.

Yet on the battlefield men manoeuvred as adroitly and died as desperately in 1700 as they do under machine-gun fire; and if our attention is diverted for the moment from the question of strategy, which is, after all, an unteachable matter of individual genius, the age of Louis XIV has much to tell us. It was the age in which cavalry recovered and infantry abandoned the use of shock tactics, when the pike disappeared and artillery (except for the specialized purpose of sieges) almost disappeared with it. For the field-gun was the concomitant of the pike; it had been invented by Gustavus Adolphus to blow up the solid squares of pikemen who were such a menace to his arms; and when the improved muskets altogether replaced the pike as an infantry arm, the light cannon had lost practically its only reason for existence. Its effective range was hardly greater than that of a musket; it was less accurate and slower, it made heavy demands in transport and men to handle it, and against open formations its killing power was dictinctly less than if the artillerists had been handling small arms.

Turenne, indeed, had used field-guns effectively, but there was about all Turenne's ideas an air of improvisation, of utility for the moment alone, that deprived them of permanent validity. Nobody after Entzheim tried out the experiment of forming cavalry in the center and infantry on the wings, in spite of the fact that it succeeded for him; an artillery charge won the battle of the Dunes, but even Turenne never repeated the experiment. Then he died, midway in a campaign that bade fair to be his masterpiece, and the process of decay in the artillery arm that he had arrested set in again. That it did not cancel the progress he had made can, I think, be attributed to two factors—an event and an institution.

The system by which artillery remained the property of civilian contractors who leased their guns to the government by the campaign was undoubtedly a bad one, but in safeguarding their investment the contractors performed this important service—they exercised pressure on the government to keep with the armies the trains of artillery that generals would otherwise have subordinated or discarded, forcing upon reluctant tacticians the study of its use and possibilities. This was the institution. The event was one of those spectacular demonstrations of the power of an uncertain arm, like the battle of Cambrai. General the Duke of Luxembourg was isolated in Utrecht with a corps of the French army numbering 20,000 men. A Dutch army of 70,000 swooped down on him; there was no possibility of relief or reinforcement and the only place where he could find support and safety was Maestricht, the whole length of Holland away. His corps was forfeit; nothing he did could possibly worsen his position, and in the emergency he attempted a retreat formation new to warfare as offering a possibility of escape.

The whole cavalry force of his army was pushed out as flank-guards. The baggage marched first in the column with the heavy artillery train following, then the foot, and last of all, forming the rear-guard, the twenty 4- and 8-pounder guns which were all the light artillery Luxembourg possessed. The Dutch flung their cavalry onto this unusual rear-guard again and again; the guns stood fast all alone, firing double-shotted volleys till the last echelon of infantry could face round to their support. They beat off every attack in a series of actions as determined as they were brilliant. Not only was the moving column undamaged, but it inflicted more losses than it took, and Luxembourg's guns moved so fast and hit so hard that they outpaced the Dutch foot, which was never able to make contact. He reached Maestricht to find the world ringing with his exploit, as well it might, for it was the greatest retreat since the invention of gunpowder, the only one, indeed, that had not ended in ruin and destruction. Luxembourg's eyes were opened to the importance of field artillery; simultaneously the court's eyes were opened to Luxembourg. He received his marshal's baton and the command of an independent army and entered the stage of history in a leading role.

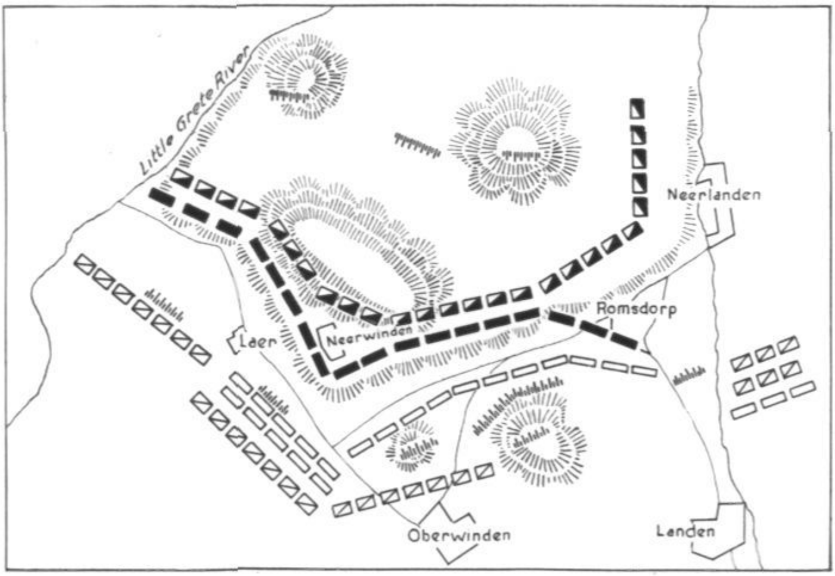
Hunchbacked, ugly, subject to rickets and fits, son of a father who had been executed after a duel indistinguishable from a murder, indolent and debauched to the point of viciousness, he was probably the most unpromising cloth from which a great captain was ever cut, yet "on the day of battle he seemed seized with happy inspirations against which no ardor of William's and no steadiness of Dutch or English soldiers could stand."

The William of the quotation was William of Orange, King of England and Stadtholder of Holland, the lifelong enemy of Louis XIV, himself a great general and the subtlest and most persistent politician of the time. He raised league after league against the French; he fought campaign after campaign against them and victory rode with his banners, save only when he was opposed by the invincible Luxembourg. The two met first at Fleurus in 1690 and Luxembourg won: they met again at Leuze in 1691 and once more Luxembourg had the better of it; at Steenkirk in 1692 William caught his old adversary at a disadvantage, numbers, position, everything on his side, but when the French went forward in the final rally they drove their enemies from the field.

In 1693 the bulk of the Sun King's forces were drawn away to Germany, but the old opponents faced each other in Flanders, now with reduced armies. The Allies, Dutch, Bavarians and English, under William's command were 50,000 strong; Luxembourg had 70,000, but the difficult task of making progress through a tangle of fortified towns and interlacing streams. William was in the province of Liege in July, south by east of Tirlemont. He intrenched a strong position and waited for his opponent to move. Liege was a powerful fortress, Tirlemont another; Luxembourg would be caught at a disadvantage if he attempted to besiege either with a force nearly his own strength ready to break his lines. He must retreat or make a side movement that would expose him to flank attack.

The French marshal chose neither alternative. On the night of the 28th July William's scouts brought word that they had encountered heavy enemy cavalry patrols straight south of the intrenched position. William, thinking these must be the flankers for a movement on Liege, pushed forward some of his own horse for a stroke. They were not enough; as twilight closed in there was a ringing clash of cavalry right at the front of the fortified position, and the Allied troopers came streaming back in defeat with the news that Luxembourg and his whole army were at hand, preparing to attack with the day.

William prepared to receive the attack with a right good will, confident that this time he would reverse the verdict of Leuze and Steenkirk, for he quite reasonably believed his position impregnable.



On the right it was covered by a broad and marshy river, the Little Grete; on his left it was protected by a narrower but not less soggy brook, impassable for cavalry. Between the two rose a plateau, the plateau of Neerwinden, dotted with eminences on each of which a row of windmills stood out. Across the front was a sharp declivity, ending in a sunken road at the base of the plateau; along the edge of the latter stood a thick quickset hedge, the military value of which had been improved by a liberal use of trenches and redoubts. The houses of a village in the center—Neerwinden—were loopholed for defence and connected with barricades. Behind the hedge, in the town, in the trenches and all along the rim of the plateau the Allied infantry were installed. The cavalry was higher up and farther back to ride down with the advantage of the slope into any force that might breach the line of foot, all except a few squadrons held out at the left rear to keep the position from being turned across the brook through the village of Neerlanden where it had a bridge. A small force of infantry held a salient at the left end of the line, in the village of Romsdorp, which was likewise fortified. The Duke of Ormond had general charge of the left wing; the Elector of Bavaria held the right.

The Allies had 110 guns, of which 50 were heavy pieces and

10 mortars. The light artillery (4's and 8's) was scattered all along the front, poking through the hedges right up with the infantry lines. The heavies and mortars were in three groups, one on a little round hill behind the right wing, one in the valley behind the hill that overhung Neerwinden, the third on a hill farther back, overlooking the brook and the Neerlanden bridge.

Luxembourg had spent the evening hours reconnoitering the position; as the men came up they filed into the lines they would occupy for the morning's attack and slept on their arms. His left, opposite and beyond the village of Laer, he covered with cavalry alone; he meant to hold this flank refused. From Laer round the valley to opposite Romsdorp lay the bulk of the infantry under the ablest of his commanders—the exiled Duke of Berwick in the center, with the Sieur de Rubantel at the head of the famous Regiment Maison du Roi, the king's household guard of France, and the best troops in the world. Behind this semicircle of infantry lay more cavalry; out to the right, with a flying wing, both horse and foot, beyond the village of Landen where the cavalry fight of last evening had taken place, was Marshal Feuquiere.

It is characteristic of the brightening of the mist of mystification with which the early artillerists surrounded their technique that we know more both of the organization and arrangement of Luxembourg's guns than we do of those in any previous battle. He had eighty, a third less than the Allies, divided into eight "brigades" of ten guns each, the whole under the command of Grand Master of Artillery de Vigny, the same ingenious soul who had suggested the retreat formation which had saved the army between Utrecht and Maestricht, twenty years before. The interesting feature is that seven of the eight brigades, 70 guns, were light field pieces, and we have Luxembourg's own order of battle to tell us where he put them.

One brigade was with the flying wing on the French right, to fire into Romsdorp; three more occupied the low eminence between Romsdorp and Oberwinden (which town was behind the French center) firing into the Allied left center. A little hill between Oberwinden and Neerwinden held another brigade, one fired across the valley into Neerwinden and one covered the cavalry of the left, beyond Laer. The single brigade of heavies crowned the hill between Romsdorp and Oberwinden.

At four in the morning the guns on both sides opened fire through the mist of the valleys. The French began to form in ranks, with the enemy's cannon-balls thudding and bounding among them, causing infrequent casualties. At five the sun was up and the mists shivered away; William's light artillery made good practice on the masses gathering opposite Neerwinden, against whom he was able to deliver a plunging fire, but his heavies had not range enough to reach Luxembourg's lines and stopped after a few rounds. The French artillerists had to shoot uphill at targets hidden by trench and hedge; they did little damage except in the towns, where they breached the barricades and sent the houses tumbling down.

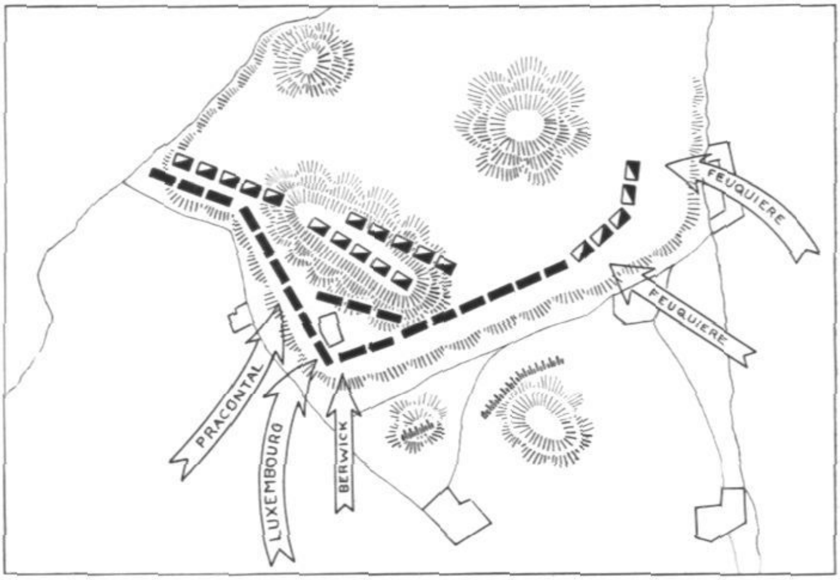
At six Luxembourg was ready; a band of music blew, the standards were borne forward, and the Duke of Berwick, with Maison du Roi and the regiments of Piedmont and Orleans, was hurled right across the valley, straight on Neerwinden and the Allied center. William, on a hilltop in the rear, was thunderstruck to see them come; it was just the movement he had foreseen and provided against. His thin lips pinched with anger, he galloped forward to see what was wrong with his artillery, found there was nothing wrong with it, that it was tearing long files right through the heart of Maison du Roi. but that the stubborn Frenchmen were coming right on across the sunken road and up the slope in spite of everything. Just as he arrived they stormed over the barricades and into the village; there was a brief, savage street-fight and the place was taken. According to one of his staff—"'Quelle nation!' il s'ecria, et alors il commencait a desespoir."

But if the King really did despair his actions gave no sign of it; the heavy artillery was directed on Neerwinden from the rear; the cavalry of the center was ordered up and the town regained after a long, hard struggle in which every house was a fortress. "However, the English were not long there till they were attacked by the brigade of Guiche, with the Duke of Bourbon at their head, who retook the town and beat the enemy into the Valley, where their cannon were planted." Once more the gallant Frenchmen in Neerwinden were hammered by the heavies; as the guns ceased the King came over the hill and down into the town with the reserve cavalry from his left and half-a-dozen battalions from the same spot to eject them the second time. Neerwinden was in ruins now and the ruins were afire; the hedge had been torn to pieces in front, the trenches were broken down and half filled with dead men, but the place was held as more and more of the English and Dutch poured into it, steady, well-drilled men with wonderful stomach for this kind of hard, slugging battle.

Luxembourg had spent upward of five thousand men in his blows at the Allied center; just as Bourbon and his brigade of Guiche came flooding back across the valley, he threw forward the Sieur de Pracontal with the reserve cavalry of the center, between Neerwinden and Laer. They went in with a rush and a swing, rode right through the hedge, over the trenches and broke the Allied line, but behind Laer got caught in a complex of ravines and hedges with the fire of William's right wing heavy guns beating down on them. All the fire went out of their charge, the English cavalry hit them front and flank, and they went back on the track of the foot, shattered and beaten.

Luxembourg rode to the lines opposite Neerwinden to meet Bourbon and Pracontal as their broken men came streaming back. The battle looked lost, the attacks had failed, but the situation was not without its compensations. Romsdorp and Neerwinden had been hammered out of shape by de Vigny's well-placed guns and were useless as defensive centers. Some of the Allied field artillery had been smashed up in the villages; more had gone lost when Pracontal charged, and the heavies were too far back to do any damage. The French had a superiority of gunfire all along the line now, and William's defensive reserves were concentrated in heavy masses to hold Neerwinden, where they were under fire from 60 of the 80 French pieces. The Allies had suffered nearly as much in the morning charges as the French; now they were suffering more, and as Luxembourg gazed across the valley he could make out a movement of marching men as William drew still more from his left to support the salient around the center. The sight filled the French marshal with one of his happiest inspirations:

"Tell Monsieur de Feuquiere to fall on with foot and horse,"



he cried, "if we make one more charge, by God's grace we will beat them yet."

He rode among the shattered regiments, rallying them for a last charge. As they saw the ugly little hunchbacked man, with his sword raised above his head, Maison du Roi, gathering round him, burst into cheers; Berwick rallied Piedmont and Orleans on their flanks, the dragoons were dismounted, and with the whole center ployed into one solid phalanx of infantry, Luxembourg led his men forward in one of those inspired charges "against which no ardor of William's nor steadiness of Dutch or English soldiers could stand." They burst into Neerwinden and carried village and trench in a Homeric hand-to-hand struggle. On the slope behind, the King brought up every man he could gather, and halted the French advance with a furious cavalry charge, right against the muskets, but as the battle hung, momentarily stabilized, neither side able to gain an inch, the break and the decision came like a stroke of lightning.

Feuquiere had swung forward against Romsdorp with his cavalry in the lead. The place was disgarnished, but there was enough of Ormond's men left in it to bring down half his first line with a volley of musketry as the horsemen slowed in the marshes round the brook. They reeled back, but the infantry passed through and carried the blazing village with the bayonet, then rushed right on up the plateau, up the hill on the other side where William's reserve heavy batteries were placed. At the same time the horse, obliquing farther right, swept through Neerlanden, came across the bridge and up the hill into the teeth of the guns. The heavies opened fire on them, but the blood of the French was up, they could not be stopped now, they rode right into the batteries from one side as the infantry assaulted them from the other. The weakened Allied left broke, Ormond was captured, the guns were carried, swung around on their trails and opened with a murdurous enfilade on their former owners where the latter stood struggling with Luxembourg's drive in the center.

Whole regiments went down under that fire; with hardly a pause the victory-maddened Frenchmen rolled right down the line, the Allied army collapsed and fled or was tumbled into the Grete. When William collected his fugitives, far in the rear, he had less than 30,000 men left, many of them weaponless, and had lost 90 cannon, almost his whole artillery equipment. It was the greatest victory of the war; indeed, in a practical sense it ended the war, for though the struggle dragged on through another year of sieges, the end was only what Neerwinden had decided it would be—a peace which left France the hegemony of Europe.

"The curs't humpback!" cried William with tears of vexation in his eyes, "Can I never beat him?"

Luxembourg smiled, a trifle grimly, when the remark was reported to him. "How does he know I have a hump?" he inquired, "He has never seen my back."

No, nor ever would. For however much those English and Dutch troops who stood beneath the concentric fire of de Vigny's guns might be animated by the spirit of Cromwell's Puritan crusaders, the Frenchmen of the Maison du Roi were filled with a romantic devotion that gave them as lofty a spirit and had received a drill that gave them as disciplined a valor. When courage and discipline are equal in the ranks it is the intelligence of the high command that tells the story, and William of Orange, though he might be striving for a nobler ideal and a greater freedom in the broad sense, was, on the battlefield, shackled by tradition. He accepted the tradition that artillery should be scattered along the front of the battle as an auxilliary to small-arms fire. He accepted the tradition that cavalry cannot cross intrenchments or streams in the face of a good defense; that infantry cannot charge uphill into a hot fire and still arrive strong enough to fight, that a man in a trench is worth two out of it; most of all, he accepted the new tradition that artillery was valuable in proportion to its weight of metal—and it cost him the battle, the war, and nearly the efforts of a lifetime.

Luxembourg, on the other hand, was free from any tradititon but the one Turenne had left him—that all traditions are useless and the method should be suited to the end desired. Nothing is more remarkable in a period when all the weight of authority was against it, than his artillery concentration on the village of Neerwinden. William's guns were apparently concentrated where they could do the most work, actually they were dispersed; Luxembourg's, apparently scattered, were actually concentrated, three-fourths of them, on a single spot; they blew the village to pieces and shot the heart out of the Allied reserves that crowded in to hold that key point in a manner that was not to be seen again till the coming of Napoleon Bonaparte. And Luxembourg's own last charge, for all its apparent thoughtless dash, seems to have taken a direction that gave it the cover of those guns till the moment of contact. Nothing is more remarkable—unless it be the amazing determination with which the French marshal rallied all his forces and personally led them right into the spot where three attacks had already been beaten back. Neither William of Orange nor any other leader would see the back of a man like that.

But when the next war came the hunchback was in his grave and so was Orange; the stone the latter had rejected in building the edifice of his resistance to France had become the head of the corner and the mighty name of Marlborough boomed like a thunder across the battlefields of Europe.

THE 7TH FIELD ARTILLERY TOURS NEW ENGLAND

THE Seventh Field Artillery, stationed at Fort Ethan Allen, Vermont, recently completed an interesting test march of its new motor equipment. A march of approximately 550 miles was made in three marching days. The purpose of the march was to acquaint the personnel of the regiment with the strategic march capabilities of its new equipment and the technique of marching truck-drawn artillery. As such the march was successful and a great deal of practical experience was obtained.

The regiment marched on 14 May from Fort Ethan Allen, Vermont, to Fort Devens, Mass.—210 miles in 10 hours; on 16 May to Fort Williams, Maine—120 miles in 6½ hours; and on 17 May to Fort Ethan Allen, Vermont—230 miles in 11 hours. All types of driving were encountered on the first day. Traffic was relatively light except while passing through large cities. The second day the march was almost continuously through thickly populated areas. Passage through all cities was effected with the aid of motorcycle policemen and continuously green traffic lights, by previous arrangement with local police authorities. The third day's march offered the most varied terrain, the route being over the White and Green Mountains of New Hampshire and Vermont.

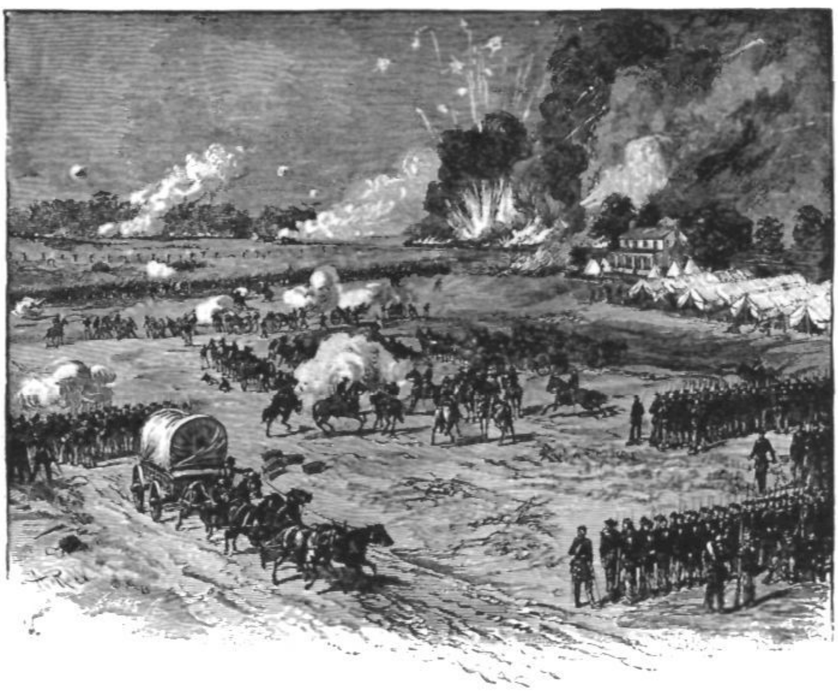
The march was conducted by battalion with the battery as the march unit. Each battery commander was furnished with a map on which the route was marked and all section chiefs and drivers were informed of the route of each day's march. No route markers were used. On two occasions parts of batteries became detached because of making a wrong turn but rejoined of their own accord without any appreciable delay after realizing their error. A speed of 25 M.P.H. was set for the leading vehicle of each unit the first day but this was found to be too slow and was increased to 30 M.P.H. for the second and third day's march. A distance of from 50 to 100 yards was maintained between vehicles.

Each battalion was accompanied by a Battalion Maintenance Section from the Service Battery, consisting of one Reconnaissance Car carrying the Battalion Motor officer and Battalion Motor Sergeant, one gas truck, one winch truck and a mechanic's light repair vehicle. Only the battery motor sergeant fell out with disabled vehicles. If unable to remove the disability the vehicle was to be picked up by the Battalion Maintenance Section. Only four vehicles fell out during the entire march, none for a greater period than 15 minutes and all disabilities were removed by battery personnel without recourse to the Battalion Maintenance Section. Gasing was accomplished at the noon halt from 300 gallon tanks mounted in trucks where available, or from 55 gallon drums equipped with outlet hoses.

Pyramidal tents, cots, and full field equipment were carried by all organizations. The column extended for almost five miles on the road and took 25 minutes to pass a given point, discounting intervals between battalions. Halts were made one hour after departures, at noon, one hour after noon and upon closing up at outskirts of large cities, preparatory to being conducted through by local police. There were no punctures. The average miles per gallon of gasoline were 17.6 for Chevrolet reconnaissance cars and pick up trucks and 9.8 for Dodge 1½ ton trucks.

The march showed quite clearly the difficulties of marching a truck-drawn regiment as a single unit. It appears quite evident that the battalion should be the largest march column under most circumstances. It also appears evident that for a strategic march under favorable conditions of road, traffic, and weather, 30 or even 35 M.P.H. is none too great a speed for the leading vehicle in each march unit. From a mechanical standpoint the new motor equipment of the 7th Field Artillery was found satisfactory as no defects developed on the entire march.

It might be of interest to elaborate on the maintenance set up of the 7th Field Artillery at this point. A Regimental Maintenance Section has been formed in the Service Battery with proportionate assistance from the other batteries of the regiment. This section is headed by a Regimental Motor Officer and assistant but so staffed and equipped as to split up into two battalion maintenance sections when the regiment takes the field, one section to accompany each battalion. Each section consists of a reconnaissance car, two maintenance trucks (one equipped with a winch for wrecker service) and a light repair truck. Each section carries a duplicate assortment of spare parts, parts common, and mechanic's tools. The section is commanded by the battalion motor officer. The functions of the regimental maintenance section then, in the field, are simply those of inspection, supervision, record, and supply of spare parts. All repairs of whatever nature which the battery maintenance groups are unable to handle are turned over to the battalion sections. In garrison the two sections are combined under one roof to reduce overhead and the whole is operated as a regimental maintenance section. This system has proven quite practicable and efficient both in garrison and in the field. Each section is composed of three or four mechanics and a noncommissioned officer acting as Battalion Motor Sergeant, and a Lieutenant of the Service Battery as Battalion Motor Officer. In nine months of operation, the 7th Field Artillery has handled all its own maintenance without recourse to any outside shop.



THE BEST RADIO WAVELENGTH FOR THE FIELD ARTILLERY

BY 1ST LIEUTENANT G. E. WROCKLOFF, JR., FIELD ARTILLERY

THE purpose of this paper is to discuss the subject of radio wavelengths with a view to applying the most suitable to the problem of radio communication in the Field Artillery. After a careful investigation of the characteristics of various wavelengths, I believe that those of less than ten meters offer the best solution to the problem confronting us. In a concise manner, I shall try to present the evidence in the case now in hearing, and you, the reader, shall be the judge.

Tremendous technical advances have been made in radio equipment, scientific observations have been made over extended periods of time, but, with due credit to the progress that has been made technically and scientifically, it is doubtful whether or not any marked progress will be made in the control of radio waves after they leave the immediate supervision of man. An effort will be made to explain the nature of radio waves, their propagation, and transmission in order to acquaint the reader with the subject. But, so far as is possible in treating a highly technical subject, the more technical terms will be omitted or explained in lay language.

The principal demand for radio in the Field Artillery is for communication where more secret methods are not practical; where wire lines can not be reasonably maintained. The first case that comes to mind is that of forward observation of supporting fires. Past experience has shown that wire lines in forward battle areas are difficult to install and practically impossible to maintain. Radio offers a solution. Whether this observation be from the air or terrestrial, comparatively short ranges are required for this work. The ground range should never exceed the range of the supporting gun, and probably should be limited to the most used range of that gun. Greater range means a waste of power, and, more important, exposition to enemy interception. The second possible use for radio in the Field Artillery is for column control in truck-drawn units. If the march unit of Field Artillery is to be the battalion, the maximum range needed should be the marching length of that battalion. Greater range clutters up the air unnecessarily and lengthens the distance through which other means of control must be used in the presence of the enemy.

In attacking this problem, we are confronted with the fact that the Field Artillery requirements differ quite radically from those of commercial communication organizations. We are searching for limited ranges in contrast to the general commercial requirement of greater distance. The limitations in power supply imposed on the field of battle are considerably more stringent than those imposed by the pocketbook of the commercial company. Consequently, we can not follow blindly the existing commercial practices in seeking a solution to the problem in the Field Artillery. Since the problem must be faced and solved, it was thought that a treatment of the unchanging characteristics of the radio waves themselves would explain one of the fundamentals that would aid in the solution of that problem.

Radio waves are produced by what is known as a radio transmitter. Such a transmitter, in its simplest form, consists of an inductance coil, resistance of the circuit, a condenser (aerial and ground with the atmosphere for a dialectric), and some applied force in the form of an alternating voltage. Let us assume that the aerial is given a positive charge. This will induce a negative charge in the ground, the opposite plate of the condenser. This represents energy stored in the condenser and is evidenced by a physical stress set up in the elastic medium separating the aerial and the ground. As soon as the two plates (aerial and ground) are shorted through the inductance coil, an electric current will start to flow. The current flowing through the coil will build up around it an electromagnetic field which is a storage of energy in the coil. When the ground has about reached the potential of the aerial, this current will tend to die down, and the field around the coil will collapse. The collapse of this field will return an electromagnetic force to the circuit, which will keep the current moving in the same direction. Thus a positive charge is built up in the ground until the inductive force is dissipated, when the process will reverse. The resistance of the circuit gives a damping action to these oscillations so that they would die down, were not an outside electromotive force applied to keep the circuit in oscillation. It must be remembered that these oscillations take place in such a small fraction of time as to be practically instantaneous. The action can be readily visualized by considering the action of a pendulum. At one end of the swing, energy is stored statically in the unbalanced position of the weight. At the center of the swing, energy is stored dynamically in the velocity of the weight and its mass. Friction of the air and of the pendulum itself corresponds to the resistance of the above mentioned circuit. As the strain in the elastic medium is reversed by the oscillations of the circuit, a wave motion is set up in that medium. The frequency of oscillation determines the distance between corresponding points of successive waves. This distance constitutes the wavelength. High frequency oscillation gives a shorter wavelength than that of a lower frequency.

The presence of these waves was first discovered by Hertz while he was testing the electromagnetic theory of light as propounded by Maxwell. Marconi conceived the idea of utilizing these waves as a means of communication. His first experiments presumed that they would follow all of the then-known laws of light. His equipment of concave mirrors gave the effect of an electric searchlight, in remarkable similarity to experiments carried on some thirty years later. Although Marconi accepted the light theory for the propagation of radio waves, he was not confined by this limitation. He increased the distance of transmission until the curvature of the earth precluded the seeing of a searchlight. The spanning of the Atlantic threw the light theory into disfavor. Various theories were advanced to explain the phenomenon of distant transmission, but they were not widely accepted.

The light theory was brought to the front again by simultaneous and independent conclusions reached by Kennelly and Heaviside. They explained distant transmission by reflection of the waves from an ionized layer existing at a great height in the atmosphere. While it is convenient to consider the reflection as taking place sharply, it is probably a bending process with the sharpest bending taking place at the highest point.

If it were a simple reflection, all wavelengths would be reflected at the same angle. The average of a large number of observations made by A. H. Taylor, of the Naval Research Laboratory at Anacostia, D. C., during the months of January, February, and March, 1929 and 1930, indicates that this angle varies in an inverse proportion to the wavelength. The following table, which is reproduced from his observations, gives the distances from the transmitter at which the reflected wave returned to the earth's surface. Two way communication was established between two stations, and the frequency was raised by small increments until the signal dropped out.

Wavelength	reflected at:
15 meters	800 miles
13.2 meters	1100 miles
11.5 meters	1200 miles
10.7 meters	1400 miles
9.4 meters	1800 miles
8.3 meters	Greater than 1800 miles.
7.5 meters	Greater than 1800 miles.

These observations preclude the theory of a simple reflection, since variations in wavelength produce in the reflected ray variations that could not exist in the simple reflection common in everyday life.

On the basis of what is known about refraction, it is improbable that this sky wave is returned to the earth by simple refraction. Observations of light have proved that the shorter waves are more refrangible than the longer ones. This is in contradiction to the results observed in the above table, for it is noted that as the wavelength decreases, the distance at which the sky wave returns to the earth increases. Simple diffraction, as commonly observed, fails fully to explain this phenomenon on similar grounds

It is probable that the actual cause is a combination of reflection, refraction, and diffraction. This theory, while difficult to explain in detail, would account for polarization noted in the downcoming wave. The operation of reflection and refraction results in partial polarization of light waves. This partial polarization has been noted frequently in radio waves returned from the ionized layer. No generally accepted theory has been advanced to explain wholly this observed phenomenon of polarization.

Kennelly and Heaviside suggested the presence of one layer or ionized strata. Observations since that theory was suggested indicate the presence of two such layers, and possibly more. These layers are at tremendous heights, 100 to 200 miles and higher, depending on the altitude of the sun, weather, latitude of transmitter and receiver, season of the year, sun spots, and a number of other variables. The problem of explaining the exact cause of all of the observed phenomena of distant transmission is rendered extremely difficult by the lack of knowledge of the composition of the upper atmosphere or the many and rapid changes that take place in it. During the day, the sun acts to increase the ionization of these layers, giving the apparent effect of lowering them. A. H. Taylor observed this height to be at a minimum from an hour to an hour and a half after noon. The improved night transmission is explained by the raising of the apparent height of the layer after sunset.

Therefore we can state, without contradiction, that when a radio signal is heard in a receiver, the wave must have traveled over either or both of two paths. If it comes direct from the transmitter, it is said to be the ground wave. If it has been turned back from the ionized layer, it is called the sky wave. In certain locations with respect to the transmitter, and at certain times both the sky wave and the ground wave may be heard. If they are in phase, the result is a very strong signal. If they are out of phase, the signal is correspondingly weaker, even to the point of complete neutralization. The ground wave dies out quite rapidly as the frequency increases. For the highest frequency in the broadcast band the distance is about 150 miles before all evidence of the ground wave disappears. As the frequency is increased, the distance of the ground wave transmission approaches the transmission distance of visible light. However, the sky wave will be turned back to the earth, except for the very high frequencies. That distance between the point beyond which the ground wave can not be received and the point where the sky wave first becomes audible is termed the skipped distance. In the low frequency end of the radio spectrum there is little or no skipped distance, since the longer waves are turned back to the earth quite abruptly. In the high frequency end of the spectrum, the skipped distance becomes quite large because the ground wave dies out more quickly, and the shorter waves are turned back to the earth more gradually than is the case with the longer waves.

One of the outstanding phenomena of radio transmission and reception is known as fading. It is a matter of common experience to observe a strong signal fade into a weak or inaudible one for no apparent cause. If the receiver were on the edge of the skipped distance in the position where only the sky wave was heard, the raising of the ionized layer would increase the skipped distance so that the signal could not be heard from the original position. As has been suggested above, interference between the ground wave and the sky wave might produce a similar result. Numerous explanations have been offered to account for fading; it may be temporary or for a short period, or it may extend over a considerable period of time. The fact remains that it does occur and that it does play a very important part in radio communications.

By means of a number of different types of antenna sufficiently spaced to prevent interaction and yet close enough to insure that records obtained simultaneously on similar antennas were alike, observations were made at Kensington, Md., on short period fading. Observations were taken over a period of about six months principally on two stations WJZ and WBAL at a distance of 300 km. and 50 km. respectively. The wavelengths of the two stations were respectively 450 m. and 310 m. Although other stations were observed during this time, the superior consistency with which these two could be received gave a larger number of records on which conclusions could be based.

From these observations the following conclusions were drawn:

1. Considerable fading is caused by the apparent fact that the indirect ray undergoes variations in intensity between transmitter and receiver.

2. Much evidence is found to support the theory that there is interference between the ground wave and the indirect wave, when the transmission distance is sufficiently short to permit the reception of the ground wave. At times this interference completely neutralized both.

3. The indirect ray does not always follow the great circle route between transmitter and receiver, which accounts for a difference in phase of less than 180 degrees between otherwise similar records made simultaneously.

4. No proof of fading caused by fluctuating height of the ionized layer was found, but evidence was found of the refraction of the indirect wave from a rising layer.

5. Rotation of the plane of polarization of the waves refracted from the upper atmosphere was considered to be the cause of much fading, particularly noticeable at sunset, although not wholly confined to that time.

6. Refractions arriving by multiple paths were evidenced by a periodic type of fading superimposed on the main intensity variations. They were 180 degrees out of phase on simultaneous records taken on two coil antennae, one in the maximum and one in the minimum position.

While these conclusions are drawn from a series of observations which were not considered by their author, Parkinson, to be complete, they point to an explanation of the phenomena of short period fading. It is worthy of note to mark the complex nature of the problem.

Up to the close of the European war, it was generally believed that wavelengths of less than one or two hundred meters were practically useless for communication. Experience up to that time indicated that the rapid dying out of signals of shorter wavelengths would destroy their usefulness for communication purposes. The powerful stations built just at the close of the war were built to operate with wavelengths as great as 30,000 meters. These longer wavelengths have no noticeable skipped distance and give a theoretically steadier signal. Wenstrom estimates that seven stations could adequately cover the United States with broadcast service on a wavelength of approximately 1,500 meters. The power cost of such a station with an output of 10,000 kw., operating 18 hours a day, at one cent per kwh. would be $5,000,000 a year. This figure is indicataive of the tremendous power requirements of transmission for these long wavelengths. Another feature of these longer wavelengths is the relatively high atmospheric noise level. A. H. Taylor estimates that the noise from atmospherics is twice as great at 1,500 meters as it is at 500 meters. L. W. Austin, of the Bureau of Standards, estimates that this ratio is greater than 2 to 1 and less than 4 to 1. Another difficulty arises in the costly antenna equipment required for the transmission of these longer wavelengths. A

Trans-Atlantic radio station operating with 18,000 and 13,000 meter waves completed an antenna system in Nauen, Germany, in 1924, consisting of two masts 258 meters high, seven masts 210 meters high, and four masts 150 meters high. The overall length of the system was 2,484 meters. As the wavelength decreases, power requirements, atmospherics, and antenna requirements likewise decrease, but at the expense of a more continuous theoretical coverage of greater distances.

To recapitulate, the following characteristics are noted in the longer wavelengths:

1. Better theoretical coverage of greater areas. The greater range of the ground wave alone would indicate this, but this theoretical gain is somewhat counteracted by;

2. Greater atmospherics among the longer wavelengths. Comparatively low frequencies are generated by such natural factors as lightning, dust storms, and other electrical disturbances of natural and man-made origin.

3. Power requirements for good communication seem to increase very rapidly as the wavelength is increased.

4. Antenna requirements for readable communication are greater for these longer wavelengths than is justified in the Field Artillery.

5. Some form of fading exists in all radio waves that are reflected from the Kennelly-Heaviside layer. This feature might mean a discontinuance of communication.

6. While it has not been specifically mentioned as a detriment, the fact must be considered that these reflected waves constitute a very potent source of radio interference when a large number of stations are on the air at the same time. Two sets that were out of the ground range of each other by hundreds of miles might interfere with each others traffic by means of the reflected wave. This characteristic, which involves skipped distance, is one which can not be ignored in the solution of the radio problem. Reference to the table given earlier in the paper would indicate that this consideration alone dictates the adoption of wavelengths of less than 10 meters.

These waves of less than 10 meters in length have been termed quasi optical waves because of their marked similarity to light waves in many characteristics. However, it is impossible to draw a definite line of demarkation between these quasi optical waves and those whose characteristics differ because of slightly greater length. These characteristics overlap in the radio spectrum much the same as characteristics do in the light spectrum. A change of one characteristics makes a corresponding change in all characteristics. However, wavelengths of less than ten meters begin to demonstrate special characteristics that differentiate them from the longer wavelengths.

One of the particularly noticeable characteristics of the quasi optical portion of the radio spectrum is that these waves, in general, are propagated in a straight line; that is to say, there are few or no waves reflected from the ionized layer. This necessitates a near optical path between stations, but eliminates all of the ordinary causes of fading, since the waves travel along one and only one path between transmitter and receiver.

In a series of tests made by the Bell Telephone Laboratories, Inc., with a relatively high powered transmitter, working on wavelengths of from 3.7 to 4.7 meters, it was noted that cross-country transit was accompanied by marked variations in the field intensity. Locations were readily found where reception was very weak—usually areas, as gullies, below the average land level. Hilltop reception was uniformly good, and a range of 50 miles was obtained on one trip by the expedient of carrying the receiver to the top of an airplane beacon tower, when the ground signal was very weak. Trees and metallic structures along the road had considerable effect, caused by reradiation and giving the effect of a "fringe" on the signal. The signal strength was likewise varied by such small changes as the opening of the car door. Observations from an airplane indicated, from a computed curve, that a satisfactory signal could be heard at a distance of nearly 150 miles at an altitude of 8,000 feet.

Short waves may be concentrated into beams. The average gain in an optical reflector is from 10,000 to 100,000 against 30 to 40 for the average directive antenna with a wavelength of 20 meters. Even in the shorter lengths of less than a meter, trouble is encountered in applying optical systems because effective reflector systems should be some orders of magnitude larger than the wavelength. Whereas the maximum results obtainable in optics may not be achieved with radio waves, the fact that similar results are approached offers interesting possibilities in the solution of our problem.

Noise level of atmospherics is very low compared to that of the longer wavelengths. Oscillations of these higher frequencies do not occur naturally, and man-made oscillations are ordinarily much farther down the frequency scale. This elimination of static, natural or man-made, improves the quality and dependability of communication in this portion of the radio spectrum.

Theory and practice have shown that humidity, rain, or fog have no appreciable effect on propagation of waves down to approximately 5cm. in length. Below 5cm. down to 3cm. the effect of all of these factors has been noted, especially the content of carbon dioxide in the air. Waves below 3cm. have no appreciable radiation, being absorbed and scattered in the immediate vicinity of the transmitter. Radiation of electromagnetic waves that would permit communication commences again only at the shorter heat waves and the infra-red and light range.

Quasi optical waves may be easily modulated over a wide band spread. This particular property lends itself readily to voice transmission; in fact, it is only by modulation that the voice may be transmitted by radio waves. The present development in transmission equipment does not permit the generation of a stable continuous wave in this portion of the radio spectrum, and these quasi optical waves are valuable to communication only when they are modulated. As a compensating factor for lack of stability, it should be noted that there are approximately 60 channels, 20 kilocycles wide from 60 to 80 meter wavelengths, and approximately 60 channels 200 kilocycles wide from 6 to 8 meter wavelengths. As stability is improved with technical developments, the available channels will increase tremendously.

Physical difficulties are encountered in the generation of these shorter wavelengths unless small tubes and low output are used. One of the most serious is the protection of the glass tubes at the points in which the electrodes are sealed. The large capacitative currents through these connections cause excessive heat in tubes operating below three meters. Even with the small tubes, low output, or slightly longer wavelengths the heat developed gives a sensibly lower degree of stability than is commonly obtained in the longer wavelengths. Unless, and until, technical improvements overcome this difficulty, any marked degree of stability is an impossibility in these quasi optical wavelengths.

Power requirements drop off very rapidly as the wavelength is decreased. In fact, it was the legal limit of power permissible which forced amateurs to explore the short wavelength end of the radio spectrum. Utilizing wavelengths below 10 meters, sets have been built in which transmitter, receiver, and power supply are contained, the whole making no more than a one man load. These sets are capable of transmitting and receiving over a near optical range of around five miles.

To sum up the characteristics of the quasi optical waves, the following are noted:

1. Whereas a near optical path is required for good signals, the virtual elimination of fading insures a better and more reliable form of communication.

2. Low atmospheric noise level promises an additional improvement in communication with these waves.

3. Power requirements are more nearly in line with what can be expected on the field of battle, and are really practical.

4. Skipped distance would indicate that the reflected wave would cause no interference under 1,800 miles and possibly none.

5. Engineering difficulties in technical construction make stability, comparable to that of long wave construction, impossible at present.

CONCLUSIONS

1. The near optical path required for wavelengths of less than 10 meters more than compensates for uncontrollable fading at longer wavelengths. Experience has shown that comparatively little training is required for operators to learn the characteristics of terrain that offer reasonably good transmission and reception.

2. The concentration of these waves into beams, by either directive antennae or reflectors, offers a possibility of further decrease in power requirements and corresponding interference to the flanks. Should technical improvements fail to overcome the stability problem, this lack of interference to the flanks would correspond to an almost unlimited increase in the number of channels available in a given area.

3. The atmospheric noise level is so much lower at these shorter wavelengths that more reliable communication is insured.

4. Wavelengths below 5cm. are of little value for communication.

5. Modulation properties of quasi optical waves answers a very necessary demand in the Field Artillery. Voice transmission materially shortens the period of training for operators. This time might be available behind the lines and a large number of trained men might be available in the rear areas, but no untrained man can possibly transmit an intelligible message with a key. Since radio operators will suffer casualties, especially in the front lines, the question of training is one on which the whole system of radio communication depends.

6. The comparatively high degree of stability obtained with longer wavelengths is an engineering impossibility at present with these quasi optical waves. While stability is a very desirable feature, the high degree obtained in the longer wavelengths is not as essential in these shorter waves. It is not unreasonable to expect that future developments will somewhat improve this situation.

7. Characteristics of the quasi optical waves indicate a solution to the communication problem of forward observation. The solution offered is not a perfect answer, but indications are that it is probably the best compromise available. Technical difficulties obstruct the achievement of perfection here as in many other Field Artillery problems. However, the lack of present perfection should not be allowed to stand in the way of development along the line that indicates the best solution.

8. Research to date seems to indicate that radio does not offer much in the solution of the problem of column control. If quasi optical waves are used, varying terrain materially affects the readability of the signal received. If longer waves are used, they are much easier to intercept. While military information might not be obtained from the individual messages, an artillery concentration could be easily surmized from the interception of a large amount of column control traffic. In the first case, dependable communication is not certain. In the second, although overcoming the difficulty of dependability, the longer waves would tend to destroy secrecy. Any system of column control which

will not work reasonably well under most circumstances, will probably result in a complete breakdown of communication when it is needed most.

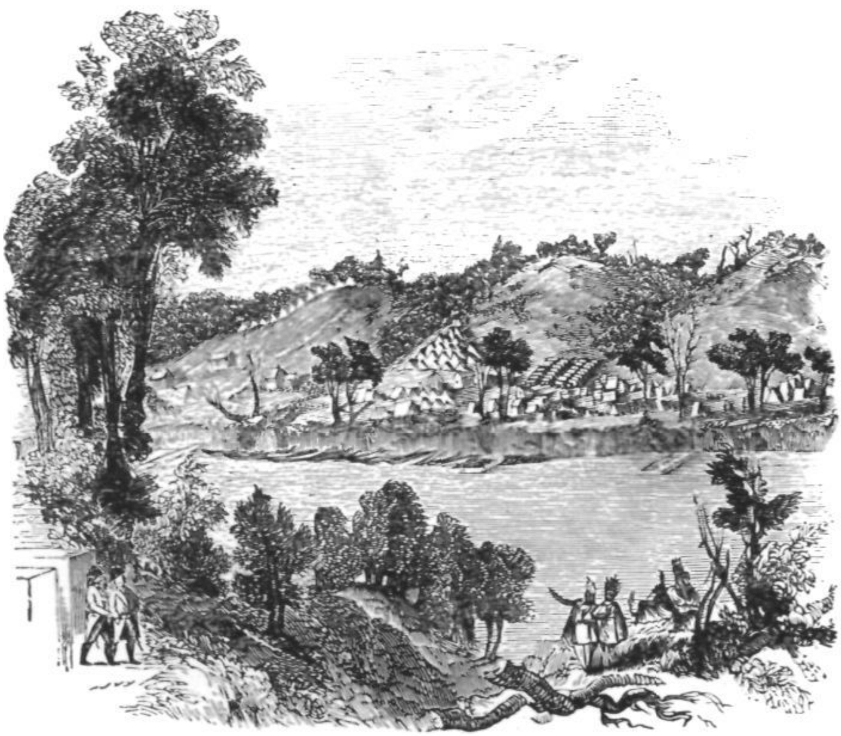
In closing, the following points should be mentioned:

1. The evidence presented was extracted from the Proceedings of the Institute of Radio Engineers, probably the best treatment in the world of radio engineering problems.

2. This evidence was gathered by extended observations of the characteristics of radio waves due to causes beyond the control, even the knowledge, of man.

3. In an effort to secure brevity, what were considered to be cumulative examples have been eliminated.

4. The conclusions are those of the author who believes that they are fundamentally sound.



FIELD ARTILLERY NOTES

Graduates U. S. M. A., 1935, Assigned to the Field Artillery

The appointment as second lieutenants in the Regular Army of the United States, with rank from June 12, 1935, and the assignment to arms of the following-named cadets, graduates of the United States Military Academy, class of 1935, are announced. Class rank is shown by the number in front of each officer's name:

FIELD ARTILLERY

6. David Campbell Wallace
24. George Ruhlen
25. Cornelis DeWitt Willcox Lang
29. John Joseph Duffy
31. Carl Watkins Miller
32. Salvatore Andrew Armogida
33. William Paulding Grieves
34. Stanley Tage Birger Johnson
35. James Van Gorder Wilson
36. Frank Alexander Osmanski
38. Frederick Benjamin Hall, Jr.
39. Langfitt Bowditch Wilby
43. Elmer John Koehler
44. Charles Albert Symroski
47. Harry Jacob Lemley, Jr.
48. Duncan Sinclair
49. John Kimball Brown, Jr.
50. Geoffrey Dixon Ellerson
51. Robert Morris Stillman
55. George Blackburne, Jr.
57. George Stafford Eckhardt
62. Edward Stephen Bechtold
65. Ivan Clare Rumsey
66. Raymond William Sumi
67. Daniel John Murphy
70. Edward Gray
71. Hugh McClellan Exton
72. Durward Ellsworth Breakefield
74. Sanford Welsh Horstman
76. David Gilbert Presnell
77. Harry Herndon Critz
80. Edward Kraus
83. Earl Leo Barr
84. John Alexis Gloriod
85. Nathaniel Macon Martin
88. James Martin Worthington
90. Robert Clarence McDonald, Jr.
91. Joseph Waters Keating
93. Kenneth Paul Bergquist
94. John Newton Wilson
96. Lawrence Robert St. John
97. Gerald Frederick Brown
99. Robert Van Roo
100. Arthur Allison Fickel
101. Charles Maclean Peeke
103. Raymond Boyd Firehock
104. Downs Eugene Ingram
106. Edgar Allan Clarke
109. Harrison Barnwell Harden, Jr.
112. James Luke Frink, Jr.
113. Elmer John Gibson
115. James Howard Walsh
116. Walter Joseph Bryde

Refresher Course at the Field Artillery School

Sometime during the school year 1935-36, a Refresher Course of five weeks' duration for field officers will be given at the Field Artillery School. Officers detailed to take this course will be on temporary duty and will not be considered as part of the allotment of Field Artillery officers as students at special service schools. It is contemplated sending eight officers to this course during the next school year.

Recent Trip of the Chief of Field Artillery

General Birnie, accompanied by Major John H. Wallace, of his office, left Washington on June 15th and arrived at Fort Sam Houston June 17th. While at that post he observed the 2nd Field Artillery Brigade at drill and visited the buildings occupied thereby. He motored to Camp Bullis, where he saw the Field Artillery R.O.T.C. Unit of the Agricultural and Mechanical College of Texas in camp.

Leaving San Antonio on the evening of June 19th, General Birnie and Major Wallace arrived at Fort Sill in the evening of June 20th. Besides observing the general activities of the Field Artillery School, the Chief of Field Artillery was in the midst of general field exercises, attended the annual post horse show and was the speaker at the commencement exercises of the Regular Class on June 29th.

Upon leaving Fort Sill on June 30th. General Birnie took the train for Fort Des Moines, where he arrived early on July 1. After looking over the Third Battalion, 80th Field Artillery, and its housing facilities, the Chief of Field Artillery left Des Moines late on July 1st, arriving in Washington on July 3rd.

GRADUATES—ARMY WAR COLLEGE, NAVAL WAR COLLEGE—AND THEIR FUTURE ASSIGNMENTS

ARMY WAR COLLEGE

Name	*Future Assignment*
Lt. Col. L. R. Dougherty	Org. Res., Los Angeles, Cal.
Lt. Col. L. C. Sparks	War Department General Staff, Washington, D. C.
Lt. Col. C. A. Selleck	Hdqrs. 1st Corps Area, Boston, Mass.
Major A. V. Arnold	Staff and Faculty, F. A. School, Ft. Sill, Okla.
Major F. W. Bowley	7th F. A., Ft. Ethan Allen, Vermont.
Major D. E. Cain	ROTC, Princeton University, Princeton, N. J.
Major T. T. Handy	Naval War College, 1935-36 course.
Major F. Heard	Field Artillery of the 2d Division, Ft. Sam Houston, Texas.
Major J. M. Swing	6th F. A., Fort Hoyle, Maryland.
Major H. C. Vanderveer	Instructor, Cavalry School, Ft. Riley, Kans.
Capt. A. R. Wilson	Instructor, C&GSS, Ft. Leavenworth, Kans.

NAVAL WAR COLLEGE

Major C. Andrus	Field Artillery Board, Ft. Bragg, N. C.

Graduates—The Field Artillery School, 1934-35 Class

ADVANCED COURSE IN HORSEMANSHIP (REGULAR ARMY)

1st Lieut. Claude A. Billingsley
1st Lieut. John E. Theimer
1st Lieut. Paul S. Thompson

ADVANCED COURSE IN MOTORS (REGULAR ARMY)

1st Lieut. Julian H. Baumann
1st Lieut. Frederic J. Brown
1st Lieut. Church M. Matthews
1st Lieut. Oliver W. van den Berg

ADVANCED COURSE IN COMMUNICATION (REGULAR ARMY)

1st Lieut. Rex E. Chandler
1st Lieut. James E. Holley
1st Lieut. James R. Wheaton
1st Lieut. George E. Wrockloff, Jr.

REGULAR COURSE (REGULAR ARMY)

2nd Lieut. James F. Ammerman
2nd Lieut. Frederick D. Atkinson
2nd Lieut. Edward S. Berry
2nd Lieut. Champlin F. Buck, Jr.
2nd Lieut. Truman W. Carrithers
2nd Lieut. John W. Cave
1st Lieut. Robert E. Chandler
1st Lieut. Arthur L. Cobb
1st Lieut. Ralph C. Cooper
1st Lieut. Robert G. Crandall
2nd Lieut. John P. Daley
2nd Lieut. Mahlon S. Davis
2nd Lieut. William W. Dick, Jr.
2nd Lieut. Thomas I. Edgar
1st Lieut. Francis E. Fellows
1st Lieut. John F. Fiske
2nd Lieut. Alva R. Fitch
1st Lieut. Dale R. French
2nd Lieut. Alphonse A. Greene
2nd Lieut. William E. Grubbs
2nd Lieut. Clarence H. Gunderson
2nd Lieut. Robert Hackett
2nd Lieut. Barksdale Hamlett
2nd Lieut. James J. Heriot
1st Lieut. Allen L. Keyes
2nd Lieut. Donald C. Little
1st Lieut. William C. Lucas
2nd Lieut. John J. MacFarland
2nd Lieut. Charles F. McNair
1st Lieut. John C. Oakes
2nd Lieut. Andrew P. O'Meara
2nd Lieut. Harry B. Packard
2nd Lieut. Theodore W. Parker
2nd Lieut. Robert A. Ports
2nd Lieut. Charles W. Raymond
1st Lieut. Wellington A. Samouce
2nd Lieut. Irvin R. Schimmelpfenning
2nd Lieut. Winfield W. Sisson
2nd Lieut. George S. Speidel, Jr.
2nd Lieut. Alexander G. Stone
2nd Lieut. James F. Stroker
1st Lieut. Daniel N. Sundt
1st Lieut. William A. Walker
2nd Lieut. Albert Watson, II
1st Lieut. Richard D. Wentworth
2nd Lieut. George M. Wertz, Jr.
1st Lieut. Willis W. Whelchel
1st Lieut. Leslie H. Wyman

OTHER OFFICERS

1st Lieut. James E. Bowen, Jr., Inf.
1st Lieut. Randall M. Victory, USMC
Captain Eugene H. Price, USMC
1st Lieut. Raymond F. Crist, Jr., USMC

The United States Field Artillery Association

ORGANIZED JUNE 7, 1910

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