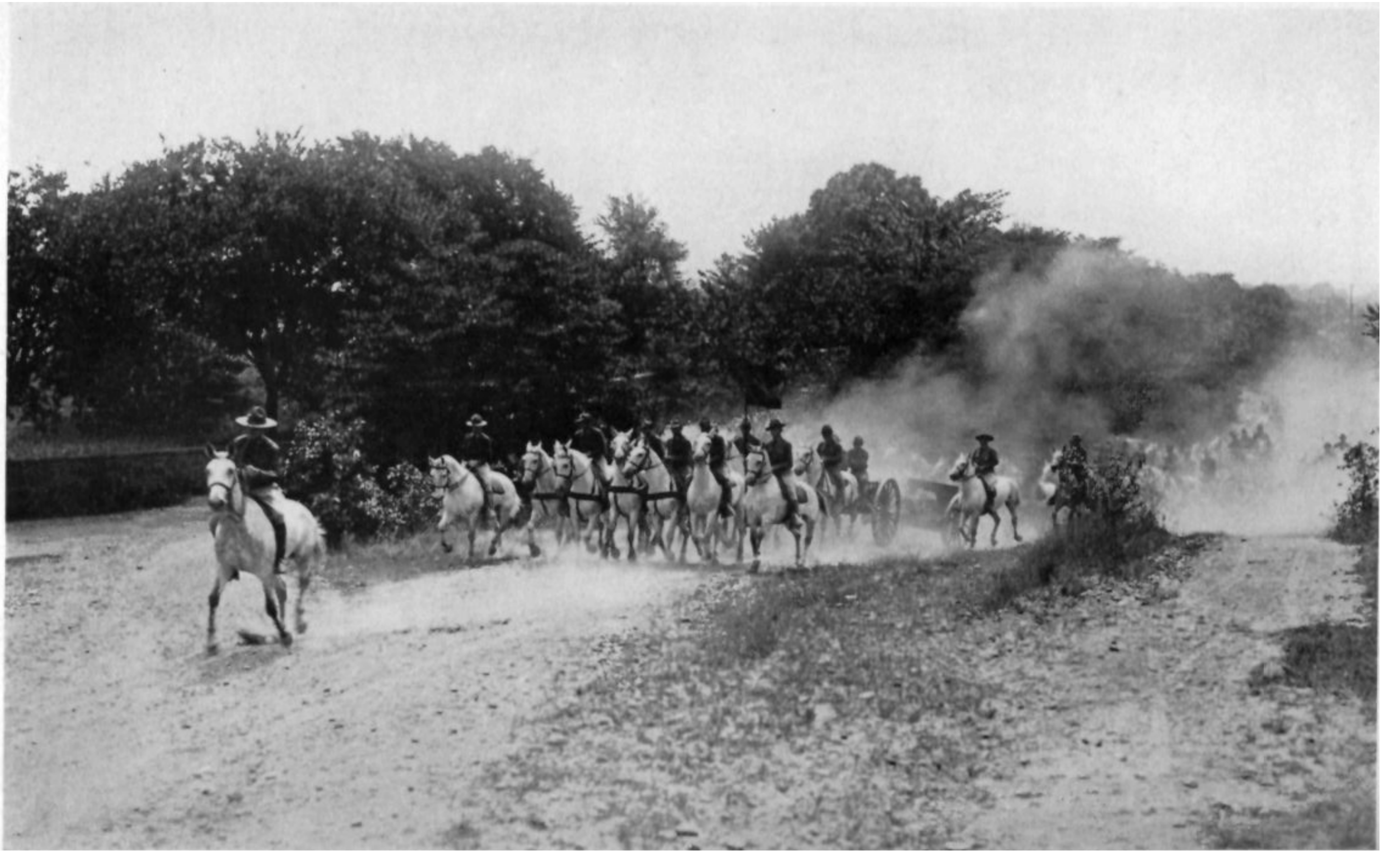
No. 5, September-October, 1931



BATTERY C, 16TH F. A., HITTING THE DUSTY TRAIL IN VIRGINIA

THE FIELD ARTILLERY JOURNAL

VOL. XXI | SEPTEMBER-OCTOBER | No. 5

STRIP MOSAICS

BY LIEUTENANTS E. L. SIBERT AND C. C. BLANCHARD
Department of Gunnery, The Field Artillery School

FOREWORD

BY LT. COLONEL L. J. McNAIR
Assistant Commandant, The Field Artillery School

THE technique of preparing artillery fire by means of a map or its equivalent is well established as a result of the World War. Without this technique, the effective employment of great masses of artillery in that war, especially in surprise attacks, would have been impossible. Map firing by no means obviates the necessity of observation, although it permits fire for effect when observation is impossible or when fire for adjustment is not permissible. But even with observation, the map is indispensable for the coordinated tactical and technical employment of masses of artillery in major operations.

The maps used in the World War were developed during a long period of stabilization, and were confined to a narrow strip along the stabilized front. If the Allied armies had advanced from the Rhine in June, 1919, as was planned in case the Germans refused to sign the Treaty, suitable maps would not have been available.

The war of tomorrow will require maps in no lesser degree than the World War, and there need be no hesitation in assuming that they will not be available, initially at least. No matter how rapid the movement, it is to be expected that there will be periods of stabilization in some degree, in order to permit development and concerted and decisive action by the full strength of the opposing forces.

The air photograph affords a remarkably satisfactory substitute for the map, adequate for all essential purposes and surely available. The air map is a practical reality, and the rapid advances being made in air photography promise even more satisfactory results in the future.

The artillery entered the World War with no very definite conception of many aspects of its employment; much was learned during the war, but there is no denying that untold thousands of rounds of ammunition were wasted and that many lives were lost unnecessarily. The air photograph clears the way to applying valuable lessons of the World War under practically all conditions.

While ability to prepare and conduct fire against a visible target is an undeniable requisite in an artilleryman, he who is unable to prepare his fire from the map, or its prospective successor, the air photograph, is unprepared for his duties in war.

The lack of suitable maps often prevents proper training in the service at large. The strip mosaic can be obtained readily through the Air Corps. It is to be hoped that the accompanying article by two progressive and talented young officers may serve to stimulate interest and activity along lines which certainly will find wide application in any future war.

* * * *

WHEN accurate, contoured fire control maps are available, the handling of artillery fire presents no new nor difficult problems. However, such maps will not be available at the beginning of any future campaign.

Recognizing this fact, the artillery has trained for open warfare by exercises in which the situation is issued verbally and fire prepared and conducted from observation posts. These exercises usually avoid the problem of a major operation, such as a preparation for a division attack, but specialize on the operation of a smaller unit, such as an advance guard, involving a battery or a battalion of Field Artillery. Enemy sky-line batteries and infantry groups in the vicinity of prominent terrain features fare badly, but what of the vast majority of the enemy's defensive works, well hidden or defiladed, that must be neutralized before an attack can go across? From past experience, it has been estimated that 95% of the fire of artillery in battle will not be observed from ground OPs. We do not mean to imply that "shooting from the hip" has no role, but only that in the ordinary case it does not seem to offer a satisfactory preparation against a serious-minded enemy who takes advantage of his ground and is ready to hit back.

For a solution of the problem presented to the Field Artilleryman by a warfare-of-movement situation, we must look to air photography. As a substitute for a fire control map, *the strip mosaic* has great possibilities.

An elementary discussion of air photographs was given in the November-December issue of THE FIELD ARTILLERY JOURNAL. A series of overlapping air photographs is called a "reconnaissance strip." These photos can be assembled by precision methods into a mosaic and can then be rephotographed and produced in quantity. To show that the Air Corps appreciates the importance of air photographs and may be relied upon to furnish them in future operations, we will quote briefly from *Observation Aviation, The Air Corps Tactical School:*

> "The necessity for a great amount of aerial photography during the phase of operations prior to contact will call for the installation of a camera on nearly every observation airplane carrying out a close reconnaissance mission. As the hostile ground forces approach each other, the photographic missions already referred to will begin, special emphasis being paid to the area in which contact will take place.
>
> "Before contact between the hostile ground forces, ground anti-aircraft defenses will not be encountered in sufficient strength to prevent taking short strips of photographs at almost any altitude."

GENERAL SITUATION

In order to investigate the application of the strip mosaic, let us take the following general situation, omitting everything not pertinent to the problem at hand:

> Our forces are operating in Western Oklahoma. No maps are available except a small scale general map and commercial road maps. Our engineers may be expected to furnish uncontoured maps, made from composite photographs within a few days if weather conditions are favorable. The 1st Infantry Brigade, 1st F. A. attached, will bivouac tonight five miles east of Fort Sill and is under orders to start early tomorrow morning to march west on the road FORT SILL—the pass north of SIGNAL MOUNTAIN and to seize the pass. Friendly columns

are on parallel roads two or three miles to the north and south. Enemy forces marching east will probably be encountered tomorrow a short distance west of Fort Sill.

In such a situation, it is probable that reconnaissance strips of the route could have been prepared well in advance, not only as an aid to the march of this column, but also for general mapping and intelligence purposes. Adverse weather conditions or a change in plans may have prevented the preparation of the strips in advance. In this case the brigade requests them from the nearest attached air unit. The action of the Air Corps force is as follows, for example:

The mission is given to a pilot and observer. The pilot climbs to a high altitude, and taking advantage of any clouds and flying a route best designed to avoid enemy pursuit and anti-aircraft, arrives at a point five miles west of Signal Mountain. He then flies the line Signal Mountain-Fort Sill. The observer meanwhile adjusts his camera and starts taking a series of overlapping photographs. *Five minutes later,* the plane arrives over Fort Sill and the observer stops the camera. Upon return of the plane to the airdrome, the negatives are developed and prints made. Those covering the zone of advance are assembled into a mosaic.

The question of gridding the strip now arrives. An accurate grid can be drawn if two points of which the coordinates are known can be spotted. Such is unlikely to be the case. An accurate grid can be determined after the troops reach the area and establish some control by survey. However, since the strip will be needed for tactical purposes before our forces reach the area and for fire control purposes soon thereafter, it seems more desirable, that an arbitrary approximate grid be put on before the strips are turned out in quantity. Thus all persons concerned will be using the same grid and, regardless of the fact that the lines are not spaced exactly 1,000 yards apart nor oriented exactly north and south, they will read coordinates and Y-azimuths alike so that a point located by one may be designated to another.

The strip accompanying this article, for example, was taken at an altitude of about 15,000 feet with a camera having a focal length of one foot. The scale of the strip is, then, 1/15,000 approximately.

From a road map, it was seen that Signal Mountain was west of Fort Sill. Using this information, an arbitrary grid was drawn.

The gridded strip can now be rephotographed to any scale desired, subject to the size of the copying camera and the length of the mosaic. If too small a scale is used, much detail will be lost; if too large a scale, our photographs will be bulky. Reduction or enlargement to an exact scale cannot be done without considerable loss of time, however, a close approximation can be done quickly. A scale of about 1/20,000 will usually be satisfactory. The necessary number of copies are now made. In order not to overtax the photographic laboratory, this number must be kept to a minimum, but must allow distribution to include batteries and companies. For an Infanry Brigade with a regiment of Field Artillery attached, 100 copies should suffice. The number must be a great deal less than the number of maps which would be issued under similar circumstances.

Let us consider the time required for securing the strip mosaics in a situation as given previously. The time allowances which appear below are liberal and can be reduced by such means as delivering the strips by airplane. The ultimate goal should be to complete the schedule in the time required for a division to deploy from column.

2:30 P. M.—Route of Brigade and probable area of contact decided upon.
3:00 P. M.—Airdrome receives mission of making the strip.
3:30 P. M.—Airplane takes off.
4:00 P. M.—Starts taking pictures.
4:05 P. M.—Finishes taking pictures.
4:30 P. M.—Laboratory receives film.
5:30 P. M.—Negatives developed and dried.
5:45 P. M.—Prints made.
7:00 P. M.—Prints dried.
8:00 P. M.—Strip assembled and gridded.
9:00 P. M.—Strip rephotographed.
10:00 P. M.—Negative of strip developed and dried.
12:00 M.—Prints made (100 copies).
12:30 A. M.—Prints ready for issue.
2:30 A. M.—Prints reach Brigade Headquarters.
6:30 A. M.—Prints issued to all units.

SPECIAL SITUATION

In an artillery battalion, the following persons should have copies of the strip: the battalion commander, the combat train commander, the liaison officers, and the gun-battery commanders. Also, the air observers working with this battalion and the supported infantry should have similar copies. To illustrate our problem we will take the situation of the of the 1st Bn, 1st F. A.

> At 6:30 A. M., the C. O. 1st F. A., assembles his battalion commanders and issues his orders, including the following:
>
> "The 1st Infantry Brigade will attack at 12:00 Noon, enveloping the enemy's right and seizing the pass north of Signal Mountain. Boundaries, formations and line of departure as shown by overlay. (See Plate I)
>
> "1st Bn. 1st F. A., to support the 1st Infantry from positions in the zone of advance of the 1st Infantry. Details of preparation later."

Having been assigned an area, the battalion commander selects positions for his batteries. The strip is of great value in indicating positions that will be inconspicuous on enemy air photos, positions in shadows or on broken and discolored ground being desirable.

The preliminary survey operations should be started as soon as the battalion is assigned an area. The battalion RO will habitually be in charge of this work and will be assisted by the battery RO's. The operations that must be performed are as follows:

a. The scale of the strip must be determined.

b. By survey, the base pieces and OPs must be located on the strip and the relative altitudes of these points determined.

c. A base point (and additional check points, where greatly differing ranges are to be fired) must be selected for each battery, and basic data computed.

DETERMINATION OF THE SCALE OF THE STRIP

The battalion RO, in our example, tapes the distance between two nearby road junctions and finds it to be 578 yards. With a 1/20,000 scale, on the photo the same road distance measures 535 yards. Therefore, any measurements on the photo made with a 1/20,000 scale must be multiplied by $^{578}/_{535}$ or 1.080 to obtain the corresponding ground distances. To plot a known ground distance onto the photo, it must first be multiplied by $^{535}/_{578}$ or .925. Instead of using a 1/20,000 scale, we could construct a scale, to read yards, for this particular strip.

If we desire to open fire before the scale of the strip has been determined, we assume the distance between grid lines to represent 1,000 yards and compute our initial data on that basis. While our initial data may be in error 300 or 400 yards, our data for transfers will not be affected as may be seen later.

SURVEY

Very often the position of a place mark or a base piece can be spotted by inspection on the photo, especially if it is near a building, road crossing, isolated tree, or similar features that can be surely identified. One feature in the picture is as accurately located on our strip as another, which is not the case with a map. If a position cannot be determined by inspection, the photo is fastened onto a plane table and the position is located by resection, using points such as mentioned above; or the board is set up at some point which can be spotted, oriented by sighting on another such point and the position is then located by traverse. To determine altitudes the battalion RO establishes a point of origin, calls its altitude 1,000 feet, reads the site in turn to each OP and base piece and, using ranges taken from the strip, computes the altitude of each of these points. As the aiming circle is the best available instrument for reading vertical angles, its index error should have been determined before hand. One or more intermediate stations may be required for positions which cannot be seen from the point of origin. This origin point may also be used as a declinating station. As each battery will register at once, the RO need not lay out an orienting line.

The work sheet of a battalion reconnaissance officer is shown in figure 1. The total time required for this survey was one hour, one officer, assisted by two enlisted men, actually doing the work, including determining the scale of the photo, declinating an aiming circle to agree with the grid on the strip, locating all battery positions and OPs as shown, determining the altitude of each of these points and of one base point. A comparison of the results of his work and the true ground locations as later verified is given below:

ERRORS IN LOCATION ON STRIP

Base piece, Btry. A—Traverse of 747 yds	2	yards	error
Base piece, Btry. B—Inspection	0	"	"
Base piece, Btry. C—Tracing paper resection	5	"	"
OP Battalion—Italian resection	3	"	"
OP Btry. A—Inspection	0	"	"
OP Btry. B—Inspection	0	"	"
OP Btry. C—Traverse of 47 yards	4	"	"
Average error, all methods	2	yards	

BATTALION RECONNAISSANCE OFFICER'S WORK SHEET

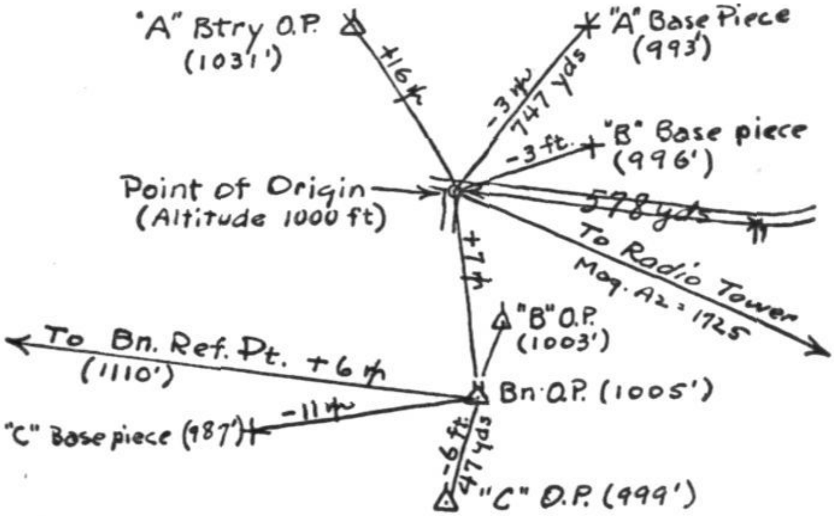


Photo Distance = 535
Range in yards = 578

Grid Az. Radio Tower = 1975
Mag. " " " = 1725

Dec. Const. of A.C. 8461 = 250

Points	Photo Dist.	Yards	Site	Diff. in Alt.
Origin-"A" O.P.	700	647	+16	+31'
" -"A" Gun	690	747	-3	-7'
" -"B" O.P.	x x	x x	x	+3'
" -"B" Gun	280	300	-4	-4'
" -Bn. O.P.	200	216	+7	+5'
Bn. O.P. -"C" O.P.	42	47	x	-6'
" -"C" Gun	350	380	-11	-13'
" -Ref. Pt.	4700	5090	+6	+105'

FIGURE 1

The smallness of the error as compared to usual plane table work results from the fact that suitable points for resection or for beginning a traverse can be found near the position which we desire to locate. However, control points differing greatly in altitude from the general level must not be used due to distortion caused by relief; also, points near the edge of the strip should be avoided.

DATA FOR BASE POINTS

Each battery should be given a base point near the center of its sector, so that K transfers to probable targets will not exceed the 4/3 or 3/4 range change nor the 300 mil deflection change laid down by Training Regulations. With a well calibrated battalion, the adjustment of one battery on a check point should give enough information to fire the others, as might be necessary when no points in the vicinity of the target are visible from the ground OPs, and an adjustment has been made with one battery by airplane or balloon observation. High burst ranging will not produce very accurate results with a strip mosaic since the altitude of the unseen check point is not known.

To show a method of preparing data from the strip, we will take the case of "A" battery. The BC selects for an aiming point the right edge of a concrete wall 1,000 yards to the front. The deflection is measured with a protractor as 6,300 mils. The B. C. learns from the battalion RO the altitude of the gun and base point and computes the site; $\frac{532-596}{5.5}$ = +6.4. He measures the range to the base point as 5,160 on the strip, multiplies this by 1.080 (ratio of photo scale to 1/20,000 scale), and thus determines the initial range to be 5,580. The errors of this data as compared to the true map data as later verified appears below:

Deflection.................... 2 mils
Site............................... 1 mil
Range ....20 yards

THE TIME ELEMENT

Let us stop a minute and bring our time schedule up to date. In as much as we are figuring the minimum time required, we will assume that the battalion commander received his orders shortly after he had received the strip mosaic. Again, we will make liberal allowances.

6:30 A. M.—Orders issued to Battalion Commander.
7:00 A. M.—Battalion Commander issues his orders.
7:30 A. M.—Scale of strip given to battery ROs.
8:00 A. M.—Altitudes and locations of all base pieces and OPs determined.
8:30 A. M.—All batteries registered.

We have carried the narrative forward through all the preliminary operations. From this point on we will discuss the strip mosaic in connection with fire missions.

FIRE MISSIONS AND DIRECTION

At this point, we have a battalion in position and registered. Fire missions must now be determined and designated to the batteries. The strip mosaic will prove of great value for this purpose. Once a target has been spotted on the strip, the fire mission can be assigned readily to batteries by the use of overlays or coordinates.

Many targets may be identified on the strip itself. Bridges, cross roads, small woods on terrain that offers little cover, buildings and similar features are suitable targets for harassing fire. In many instances, enemy works, constructed before the photographs were made, will appear.

The battalion commander from his observation post will observe targets on which he wants fire placed. It is probable that the target or its locality can be immediately spotted on the strip. If this cannot be done, the battalion commander follows the following procedure, for example: He observes a target 100 mils to the right of the reference point. He then draws on his strip, a ray corresponding to this direction and hence passing through the target. By comparing the appearance of the strip along this ray to the terrain, he can spot the target on the strip. The target is assigned by coordinates.

The battery commander, discovering a target from his OP, can spot it on his strip as described above. If he desires to adjust on this target, the strip offers a means of computing accurate data as hereafter described. In any case, the nature of the target and its coordinates are sent to the battalion commander.

To the liaison officer, who has neither the time nor means for survey work, the strip is of great importance. On it his own position can be spotted by inspection with satisfactory accuracy. He can then spot targets and report their location by radio or telephone. Such a location will surely be close enough to put fire on the target after one sensing; for example, "50 left, 100 short." When the difficulties of communications are considered, adjustment of fire by a liaison officer when the initial bursts are far from the targets, offers small chance of success.

The airplane, or balloon, observer prefers a strip mosaic to the best fire control map for the obvious reason that the strip is a reproduction of what he actually sees from the air. Where neither strip nor map are available, target locations must be given by "lay-on-me" or similar methods which work better in time of peace than they will in war.

A valuable source of information of enemy targets, used in conjunction with the strip is the "pin-point," that is, a single, relative large scale photo taken to show a particular locality. Examples are shown in Plates II and III, the latter having been gridded to correspond to the strip shown in Plate I. The pinpoints may be developed by "quick-work" and dropped directly to the artillery ten minutes after being exposed. On these, we can locate many signs of enemy activity, such as trenches and battery positions, and even see the results of our own concentrations fired previously to the time the pictures were taken. The target, having been identified on the pin-point, is transferred to the strip by inspection or by a tracing paper transfer. This process is far more simple when the strip is used than when a map is used, as, in the later case, there is a possibility of the pin-point not containing sufficient control points.

In connection with pin-points, we wish to call attention to the development of night photography. Further experience along this line, will be had during the spring field exercises at the Field Artillery School.

From the foregoing we may safely conclude that the strip mosaic, for intelligence and fire direction purposes, is an excellent substitute for a fire control map, in some cases even superior to a map. At the command posts, missions can be quickly assigned by telephone or overlays without confusion. Such is not the case in a moving situation where neither a map nor a suitable substitute is available.

For instance, in a mapless situation a battalion commander has been informed by a liaison officer that there is a group of machine guns in the vicinity of a certain prominent bush which is described. If the bush is prominent enough, the battalion commander may locate it. The appearance of the bush may be vastly different as seen at the OP from what is seen by the liaison officer so further description may be required. The same procedure now takes place as the battalion commander describes the target to a battery commander. Soon messages from the regiment, from batteries, liaison officers, radio stations and similar sources will have the battalion CP completely swamped.

For the howitzer regiment of the division, or for reinforcing regiments that will execute counter-battery and long range missions, the need of a map or its substitute is so apparent that it needs no discussion.

FIRE

We have discussed the sources of missions—examination of the strip, ground observers, air observers, liaison officers and pin-points—and fire direction by reference to a strip. We will now investigate the use of the strip for preparation of data.

Below appears estimated values of different types of fire, that adjusted and observed from a ground OP being assigned a value of 100.

Observed from ground OP	—100
Adjusted by air observers	— 75
Transfers	— 50
Map data corrected	— 25

Obviously, fire should be observed from a ground OP whenever possible. Failing this, the air observer should be used. These methods can be used only on the exceptional target. Map data corrected, poor at best, has little application to the moving situation. The greatest value to gunnery of our strip mosaic is that it gives us a means of bringing unobserved fire on a target by K transfer methods. (See page 96, TR 430-85).

To make a K transfer, the procedure is almost the same whether a map or a strip mosaic is used. The shift is as measured with a protractor. The ranges to the check point and to the target can be measured with a 1/20,000 scale in either case. It is not necessary to convert the distances measured on the strip to true range since K and K′ are simply ratios. The greatest difference between the map and strip is the means of computing site.

In the case of the strip, the site of a target must be estimated after studying the terrain from an OP and on the strip. The altitudes of a number of visible points in the target area should be determined and marked on the photograph at the first opportunity. By comparing the location of the target to these points and a study of stream lines and ground forms as shown on the strip, a fair estimate can be made of the altitude of the target. When the altitude of a check point is unknown—for instance when the check adjustment is made by air observation—the altitude can be assumed to be that of the battery. The site of a target is then determined by estimating the *difference of altitude* of the target and the check point. Thus a false K and false sites are introduced, which, however are almost compensating.

The error introduced into a K transfer by a poor estimate of the altitude is not as great as might be supposed. For instance, we underestimate the difference in altitude of check-point and target by 48 feet, which is 16 yards. Assuming the range to be 8,000 yards, this affects our initial elevation by 16/8 or 2 mils. From the range table for the French 75mm gun, Shell MI, Fuzelong, Normal charge, we learn that this error affects our range by 8 yards. With the 105 howitzer, our range will generally be affected by an amount well within the probable error of our materiel.

Below is an example of an actual K transfer worked out on the strip mosaic reproduced herewith, using the set-up of one of the batteries in the narrative example.

Battery A (French 75-mm Guns), adjusts on its base points as a check point with Shell MI, Fuze Long.

CHECK ADJUSTMENT

Adjusted deflection	Base deflection
Adjusted elevation	252 mils
Site (measured from OP)	+6.4 mils (T/G=108 feet)

Check adjusted range=245.6 mils=5627 yards

Altitude of battery (from survey)=987 feet

Altitude of check point (from site)=1095 feet

Altitude of target is estimated as about 55 feet lower than the check point or 1040 feet

BASIC DATA FROM STRIP FOR BN-1

Target map range=4675
Shift=R42

INITIAL DATA

$K' = \frac{\text{Target map range}}{\text{Check map range}} = \frac{4675}{5162} = .905$

Site= $\frac{1040 - 987}{3+5}$ =+3.5 mils

Range=Check adjusted range×K′=5627+.905±5092 yards
Elevation=201.9

Site = $\frac{+3.5}{205.4}$

Commands: BDR 44, Sh MI FL, * * *, Quadrant 205

In order to examine the accuracy of K transfers made on the strip let us assume that in the narrative example the battalion fires the concentration on the targets listed, all assumed to be invisible from the battalion and battery OPs. Data is computed by K transfers in each case, and fires delivered without adjustment. Actually we would expect reports from the air observers, liaison officers, or ground OPs on the effect of some of these concentrations and could improve them. In the table below are given the values of K′ and the deflection shifts, determined first from an accurate grid on which the true locations of the guns and targets are plotted, and secondly from the strip mosaic.

Target	Data from	Battery A			Battery B			Battery C		
		Df.	R	K′	Df.	R	K′	Df.	R	K′
Battery Base Point	Map		5575		0	6450		0	3712	
	Photo		5162		0	6005		0	3438	
BN-1	Map	R 42	5045	.905	R 128	4880	1.321	R 65	4205	.882
	Photo	R 42	4675	.905		4530	1.319	R 67	3902	.882
BN-2	Map	L 21	5965	1.070	R 50	5770	1.118	L 40	5065	.733
	Photo	L 19	5530	1.071	R 48	5357	1.118	L 38	4700	.733
BN-3	Map	L 67	5320	.954	R 5	5095	1.266	L 78	4390	.846
	Photo	L 68	4930	.955	R 8	4735	1.269	L 76	4072	.846
BN-4	Map	L 58	7070	1.268	L 4	6845	.943	L 106	6135	.606
	Photo	L 57	6555	1.270	L 3	6390	.944	L 104	5698	.604
BN-5	Map	L 201	6245	1.120	L 140	5965	1.081	L 258	5215	.712
	Photo	L 201	5785	1.121	L 141	5535	1.080	L 259	4845	.711

The errors introduced into these transfers by the use of the strip are as listed below. The errors are given in yards in each case.

Target	Battery A			Battery B			Battery C		
	Df.	Si	R	Df.	Si	R	Df.	Si	R
BN-1	0	0	0	0	13	5	2	12	0
BN-2	12	4	6	10	10	0	2	5	0
BN-3	5	8	5	15	11	10	2	0	0
BN-4	7	11	13	7	4	5	2	0	10
BN-5	0	14	6	6	0	5	1	40	5

Based on these results, we have the following probable errors of basic data:

Deflection ....4.0 yards
Site ....5.6 "
Range ....3.9 "

Actually the errors introduced into the range will be less than shown above. Assuming the average range due to weather conditions and materiel to be 50 yards, then the probable error from all causes for this above strip transfers becomes $\sqrt{(50)^2+(5.6)^2+(3.9)^2}$, or 50.4 yards. Thus, the probable error introduced into our transfers by the use of the strip amounts to less than one yard. This is so small as to throw suspicion on our statements; nevertheless we offer the figures as computed.

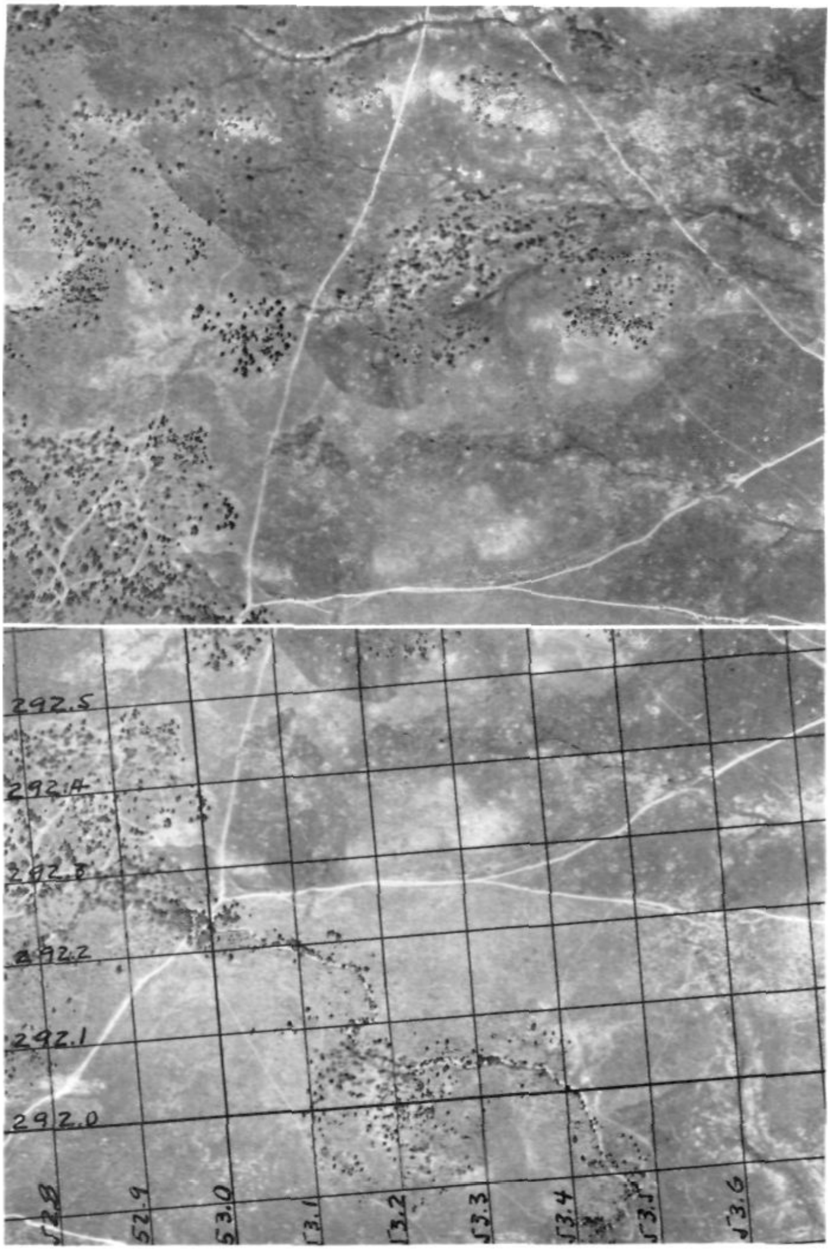
Our experience, limited to five or six strips and 30 or 40 targets, leads us to believe that the error introduced into a K transfer by the inaccuracy of a strip, will be less than 20 yards. Also the results of actual K transfers using data from strips, made by students at the Field Artillery School, have produced results as accurate as those made by map K-transfers.

BATTALION CONCENTRATIONS

The strip mosaic gives us a means of executing one type of fire which is important, namely, concentration of the fire of an entire battalion quickly on a target. This will be facilitated by having the batteries well grouped. For example: The liaison officer reports, "Infantry concentration, one battalion, at 53.2-91.6, can adjust." To adjust each battery in turn will defeat our purpose of bringing a mass of fire quickly on the target. The battalion commander designates the target to the batteries as he received it, adding "altitude 1060 feet" so that the error of site will be the same for all batteries, and directs that Battery "B" adjust. He prescribes the number of rounds to be fired by each battery, a maximum rate of fire, and the distribution desired. All batteries prepare K transfers and Battery "B" fires one or more salvos. The liaison officer reports, for instance, "40 right, 100 over;" all batteries apply this correction and at the word of the battalion commander, start fire for effect at the maximum rate.

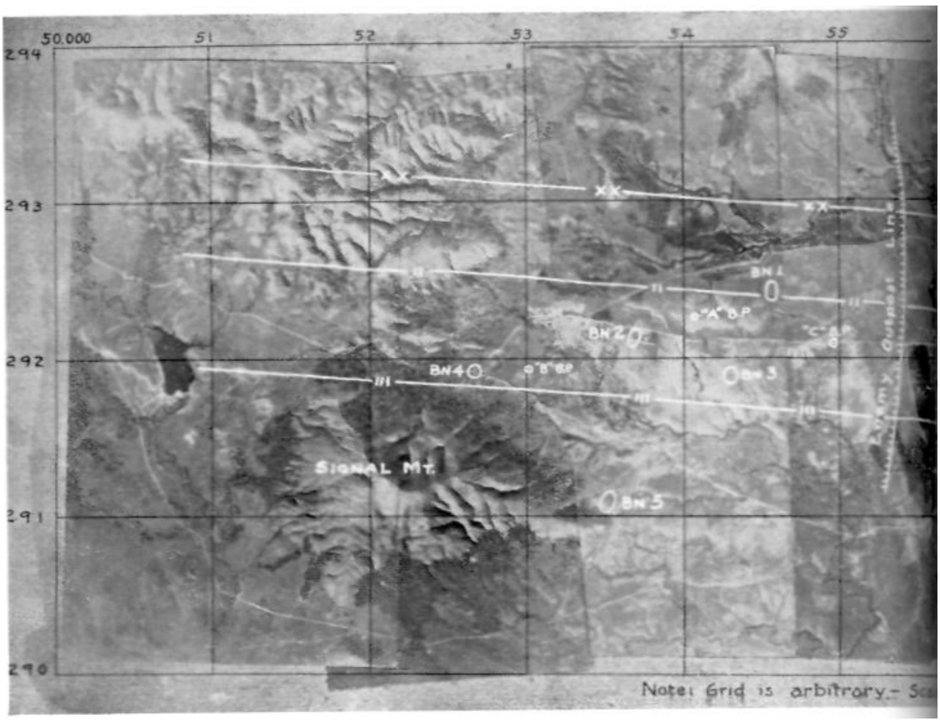
CONCLUSIONS

1. Strip mosaics, assembled and gridded as described, should be furnished for all operations. When change of plans, weather, or other conditions do not permit this work before contact, every effort should be made to speed up their production and distribution.
2. For tactical functions in the artillery battalion—selection of position, determining and assigning missions, liaison—the strip is entirely satisfactory.
3. For fire control purposes—computing data, transfers—the strip is satisfactory except in very rugged country.
4. For the use of the strip, little additional training is needed by those familiar with the orthodox methods of rapid and deliberate preparation of fire.



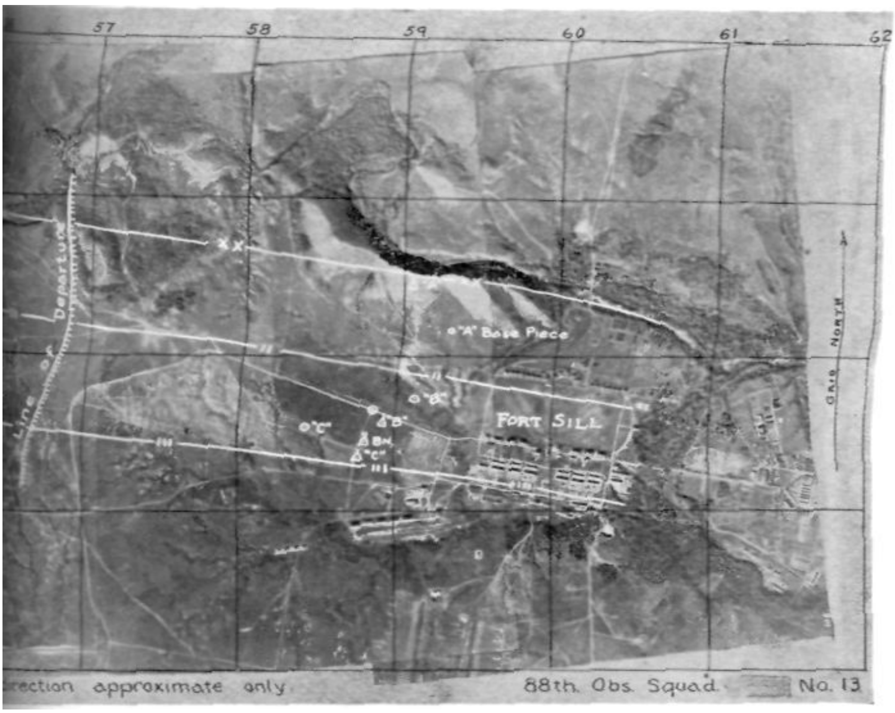
TOP: AIR PHOTO TO BE USED AS PART OF MOSAIC BOTTOM:
SAME AS ABOVE, BUT WITH GRID SUPERIMPOSED

PLATE 1—SHOWING STRIP MOSAIC OF FORT SILL—SIGNAL



NOTE: THE 1:20,000 STRIP MOSAIC DESCRIBED IN THE TEXT IS 21½ INCES LONG

MOUNTAIN AREA WITH OVERLAY SHOWING BOUNDARIES, ETC.



SLIGHTLY MORE THAN TWICE THE SIZE OF THIS ILLUSTRATION

DIVISION ARTILLERY

BY GENERAL CULMANN, French Army

This is the second of two articles on this subject. The first article appeared in the July-August number of THE FIELD ARTILLERY JOURNAL.

THE LIGHT GUN-HOWITZER

POSSIBILITY of a light gun-howitzer. The absolute necessity of having a high angle fire light field weapon is proven by the fact that during the war the French artillery had to provide its 75mm guns with reduced charge ammunition to reduce the muzzle velocity from 550 to 340 meters per second; that is to say it was cut down to about two-thirds of the normal velocity, yet this was only the first timid step. Angles of fall were obtained with these reduced charges as follows: 8°4′ for a range of 2,000 meters; 17°25′ for a range of 3,000 meters, 30°57′ for a range of 4,000 meters. These angles of fall are about twice as great as those which were obtainable with normal propelling charges. The question comes up, is it possible to obtain still greater angles of fall, which would be technically satisfactory, by further reducing the propelling charge.

It is the general opinion that long chambers such as are necessary for strong propelling charges are unsatisfactory when the propelling charges are greatly reduced. Certain theorists claim that when the chamber is too long for the propelling charge the gas pressure at the moment the projectile starts to move is developing in an undulatory manner. The impulsion given to the projectile would thus vary from one instant to another and accuracy in dispersion would be very mediocre, and the gun might even swell up. If it were found that these phenomena occurred it would be necessary and altogether possible to construct guns which would have chambers of two different lengths. However, this theory may be true when there is a reduction of initial velocity as much as 8 to 1 for example, but if there were only a variation of 3 to 1 the theory might not hold. In fact we know of a gun 45 calibers long which fires with a muzzle velocity of anywhere from 900 to 250 meters per second without damaging the tube and at the same time giving satisfactory dispersion, and this was all done with the same kind of powder. It is evident if various kinds of powder were used which would be appropriate for the desired muzzle velocity, other factors would enter.

All of which brings us to the statement that there are two procedures which can be adopted, or they could be employed simultaneously, to obtain high angles of fire from guns: first, to utilize different powders for great, medium or low muzzle velocity; second, to construct the tube so that its chamber can be varied in length.

The second of these methods has been employed by the French since 1925. The Schneider factory built for the Greek army an 85mm gun with a double chamber, that is to say a chamber which has at its front end two conical rings of different sizes against one or the other of which the projectile is rammed. If the projectile is to be fired with a low propelling charge it is provided with a band which stops it at the rearmost conical ring. Thus the size of the chamber is reduced. When the projectile is to be fired with a large propelling charge it is rammed well forward so that it is seated against the second or forward ring. In this case length of the chamber is at the maximum. Tubes of this design have stood up well under very trying field tests. This weapon is provided with muzzle breaks which take some of the force of recoil from the regular recoil system and therefore allow the latter to be lighter. The following are certain characteristics of this Greek 85mm gun:

For firing at maximum ranges (heavy projectiles):

Weight of shell	10 kg.
Weight of bursting charge	760 grams
Initial velocity	675 and 635 meters per second
Maximum range	15 kilometers

For firing at medium ranges with curved trajectories (shell with big bursting charge):

Weight of projectile	8.8 kilograms
Weight of bursting charge	1,300 grams
Muzzle velocity varying from	550 to 225 m.p.s.
Maximum range	9 kilometers

Angles of fall with the minimum muzzle velocity:

11°50′ for a range of	2,000 meters
20°10′ for a range of	3,000 meters
31°0′ for a range of	4,000 meters
51°35′ (angle departure 45°)	4,960 meters

Shrapnel:

Weight of projectile	10 kilograms
Initial velocity	635 meters
Maximum range	11 kilometers

Other characteristics:

Elevation	–6° to +65°
Traverse	54°
Trail	split—like French 155 G.P.F.
Length of tube	2.96 meters (34.8 calibers)
Weight of gun on the road	2,330 kilograms (horse-drawn) 2,310 kilograms (motor-drawn)
Weight of gun in battery	1,970 kilograms

Since the maximum elevation is +65° this Schneider gun can be made to fire vertically. The great elevation is necessary on account of the mountainous terrain in the Balkans, otherwise an elevation of +40° would be sufficient.

The Bofors factory (Sweden) is reported to have a gun of the following specifications:

Caliber	90 mm.
Weight of projectile	10 kg.
Muzzle velocity	625-630 meters
Maximum range	14 kilometers
Length of tube	40 calibers

The existence of these 85mm Schneider and 90mm Bofors guns proves that it is possible to build a light gun-howitzer; one which would be light enough to go anywhere, which would have a range and power of projectile at least 50 per cent greater than World War light weapons and trajectories sufficiently curved to enable them to reach at medium ranges an enemy located behind slopes.

The 85mm gun referred to has an inner sleeve so that it can be relined easily—an important consideration for all modern weapons built for high muzzle velocity and rapid fire. The gun is made up of two concentric tubes. The inner tube or sleeve has very small play between it and the outer tube and is so arranged that the inner tube can not rotate, twist or slip inside of the outer tube when the gun is fired. When the gun is fired the inner sleeve which is not thick enough to withstand the pressure of the bursting gases swells somewhat, but it very quickly comes in contact with the outer tube which is strong enough to resist pressure. The inner tube is elastic enough to resume its original dimensions after the gun is fired. In other words the two tubes have different functions. The outer tube does not have to withstand the friction of the projectile nor the high temperatures and for these reasons does not wear out. On the other hand the inner tube must bear all these factors of wear and it also serves as an intermediary in transmitting the pressure of the propelling gases to the outer tube which is strong enough to resist them. The inner sleeve only costs about 1-3 the price of the whole tube. It does not wear as fast as the old type of solid tube. The inner tube can be easily replaced. In one of these Schneider guns it was removed very quickly without special tools even after it was slightly swollen on account of firing 1,100 rounds consecutively with interior pressure of 3,300 to 3,500 kgs., which is more than 50 per cent of the normal pressure.

When the inner tube is worn out it can be replaced on the battlefield, since the operation only lasts about ten minutes.

Advantages and disadvantages of light gun-howitzer—High angle fire is particularly suitable for supporting Infantry for the following reasons: first, it enables the weapons to be deployed in depth behind crests, villages or woods. Thus reconnaissance for positions from which to support the Infantry is expedited and facilitated; second, the distance which the supported Infantry must keep behind the bursting shells in order that they may not be injured by them is considerably smaller with howitzers than with guns. Thus the support which can be given to the Infantry is more efficacious and can be carried on for a longer time. Third, the low muzzle velocity of howitzers does much less damage to them than the high muzzle velocity does to guns.

As a matter of fact such long ranges as 9 to 15 kilometers when used by field pieces are principally for the preliminaries to combat—to delay the enemy, to harass him during deployment, to interdict certain routes of approach to him, to support our advanced guards and out-posts and to take under fire hostile batteries while they are still at a considerable distance. However, as soon as the battle has really begun the ranges which field pieces will be using for supporting their Infantry will be less than 9 kilometers and at these medium and shorter ranges, low muzzle velocities can and should be employed to obtain high angle fire. We can certainly state that howitzers wear out less than guns. This is a great advantage when he remember that in fourteen months—from July, 1917, to September, 1918—the replacements of the 75mm guns for the French Army were greater than the total number of guns in use at any time during the period. It is easy to see that the inability to re-line these guns brought about a tremendous expense.

However, there are certain disadvantages of gun-howitzers which are often exaggerated. They are as follows: first, the use of the variable propelling charge excludes the use of fixed ammunition. Here it should be remembered that cartridge cases are dead weight and the price is far from neglible. With 85 and 90mm calibers when it is desired to get ranges of 15 kilometers it is necessary for a round of fixed ammunition to be 80 centimeters or a meter long, and it will weigh 13 to 15 kilograms. This is too long and too heavy to be easily handled and fire would be slowed down. The necessity of inserting successive charges for the different zones likewise slows down the fire but this objection is not as serious as it is usually considered.

It is well known that the 75mm gun can shoot twenty rounds per minute. Nevertheless to avoid excessive wear it was necessary to cut down this rate of fire during the World War and now the French regulations only permit the following rates of fire with a muzzle velocity of 550 meters:

10-12 rounds per minute for not to exceed 2 minutes.

6-8 rounds per minute for not to exceed 5 minutes.

4 rounds per minute from 5 to 15 minutes.

2 rounds per minute for several hours.

But with the reduced charge which carries a muzzle velocity of 340 meters per second, which is still high, our regulations authorize rates of fire double the above.

Therefore from the point of view of conservation of material it appears that a gun-howitzer can fire more rapidly than a gun using the low muzzle velocities which are usual in supporting Infantry under ordinary tactical and terrain conditions. *The gun-howitzer puts out more rounds per hour than the gun*.

Furthermore experience of the War shows us that eight rounds per gun per minute is sufficient in the great majority of cases. Very great rates of fire are used only in crises against fleeting targets or in repelling an attack on the batteries themselves. It should be remembered, however, that a gun-howitzer, even when it uses unfixed ammunition can easily fire 15 rounds per piece per minute.

The rate of fire of 20 rounds per gun per minute was only used by our 75's under exceptional circumstances when the German Infantry foolishly attacked in very dense formation as it did in certain phases of the battles of Ypres and Verdun. Yet would not 15 shells weighing 8.8 kilograms and containing 1,300 grams of explosives each be every bit as annihilating as 20 shells weighing 5.3 kilograms and containing 800 grams of explosives each? In one minute the 85mm gun-howitzer would have fired into the enemy 112.5 kilograms of metal and 19.5 kilograms of explosives whereas the 75mm gun would have only 90 kilograms of metal and 16 kilograms of explosives.

The only real disadvantage of the gun-howitzer is the many charges it employs. This disadvantage is not important when compared with its many advantages. It is a step in progress which can not be avoided by artillerymen.

It must be remembered that in all lines of endeavor improvements in technique demand more from the human element. The military service is no exception to this rule.

ANTI-TANK FIRE

The targets under this heading which we must think about are evidently not the old war-time weakly armored slow tanks which operated in small flocks. We must think about modern tanks with specifications somewhat as follows: first, heavy tanks armed with cannon, weighing 60 or 80 tons each with steel armor 60 to 80mm thick over their most vital parts. Second, lighter tanks less heavily armored with a speed of about 30 kilometers per hour across country.

In view of the fact that these targets will be both mobile and armored, fire against them will have to be direct fire at short ranges. The ranges will have to be less than 2,000 or even 1,500 meters. Without going into the matter of conduct of fire for the moment, let us consider what must be done as regards the armor element. We should be able to get some data on the caliber of weapon necessary for anti-tank use and the muzzle velocity which would be needed in order that the projectile should rupture the armor.

The first question which comes up is—"Is it necessary only to stop or immobilize hostile by injuring its most fragile parts such as tracks, wheels, radiator, etc., or is it necessary actually to kill the tank with one shot which would perforate and ruin its armor?"

There can be no doubt as to the answer to this question. In the first place these tanks are mobile and their advance is very dangerous to us. Furthermore the enemy would not employ his tanks except in important offensive operations and therefore it is necessary to break up any attack just as quickly as possible. *So an anti-tank gun must be capable of piercing 80mm of fine steel at a range of 1,500 meters*. The shell should not only strike it at a normal angle of incidence, but it should incline 15 or 20 degrees.

The French 75mm gun, model 1897, firing an armor piercing projectile weighing 6.4 kilograms can not pierce steel parts thicker than 45mm. The remaining velocity at 1,500 meters, about 460 m.p.s., is too weak. The 75mm gun of the more modern type with very high muzzle velocity, for example 800 m.p.s., would be strong enough to pierce the armor if the projectile struck at a normal angle, but would not be strong enough if it hit at oblique angle. Moreover such a high muzzle velocity would wear out the tube after six or eight hundred rounds. The French 75mm gun (model 1897) if well looked after and not required to fire too rapidly or in too prolonged manner, would not be worn until after it had fired some six to twelve thousand rounds. Its maximum daily consumption of ammunition is about 1,200 rounds.

These two points show that in order to solve the anti-tank gun problem it is necessary to have a gun of a caliber greater than 75mm and one which at the same time has a muzzle velocity greater than that of the French 75, model 1897 (550 m.p.s.).

As regards caliber, the 85mm Schneider or the 90mm Bofors gun-howitzer would be sufficient for projectiles weighing 10 kilograms instead of 6.4 kilograms of the 75's.

As regards the maximum muzzle velocities for these weapons (675mm for the 85mm and 625 meters for the 90mm gun-howitzer) it may be stated that these muzzle velocities, although sufficient for normal firing, would be somewhat too low for armor piercing purposes. They should be about 700 meters per second. The following points should also be borne in mind: first, the velocity of the projectile when it hits the target should not have fallen off too much. It appears that with a target at a range of 1,500 meters, a remaining velocity of 500 or 550 meters per second is indispensable. Second, the quality of the steel in the armor piercing projectile must be very high. It has been found that the thickness of steel plate which can be pierced by the projectile varies according to the quality of the steel of the projectile. Other things being equal, a projectile of excellent quality steel will pierce armor twice as thick as one of a low quality steel.

The bursting charge can be very small—just a hundred or so grams is sufficient. The projectile will burst without any fuze at all on account of the violent shock it receives when it hits the armored plate and the great heat engendered thereby.

During the War the 75mm guns were often placed in forward positions along fronts where tank attacks were possible. These guns were put in direct fire positions and were most carefully camouflaged. They were for no other purpose than for use against tanks, and therefore they remain silent on all other occasions. This arrangement was a very uneconomical employment of artillery, and furthermore it was not a sufficient protection in case of an attack by great masses of tanks. Nowadays it would be out of the question to leave a lot of guns unoccupied waiting for the right kind of target to appear. Therefore the following is considered a proper conception of anti-tank guns: a gun which first of all is effective against tanks and in the second place can be used advantageously against any other ground target. For these reasons it should be supplied with high explosive shell and shrapnel just like other division artillery weapons. Its carriage should be constructed so as to be especially efficacious in direct fire. Since they have to fight in close liaison with the Infantry, anti-tank batteries should be an organic part of the division artillery and they should be organized into an additional battalion of the normal composition.

ANTI-AIRCRAFT FIRE

The ballistic characteristics of all antiaircraft guns cause us to make the following observations on this subject:

Since airplanes are flying higher and higher and faster and faster any gun similar to the 75mm French gun, model 1897, is unsatisfactory for the following reasons: its vertical range or ceiling is only 5,000 meters; its muzzle velocity only 550 meters and the danger radius of its projectile is inadequate. Above all, antiaircraft weapons must have high muzzle velocity in order to cut down time of flight and also to reach great altitudes.

The Schneider Company makes an antiaircraft 75mm gun which has a muzzle velocity of 750 meters per second and a ceiling of 9,500 meters. Its horizontal range is 14,500 meters. But a gun of 75mm caliber is not big enough because the danger radius of its projectile is too small. Even during the war both the French and the Germans used 105mm guns and now we find that in the navies of the different great nations antiaircraft weapons or 90 and 100mm caliber are used and muzzle velocity varies from 750 to 850 meters per second.

At the beginning of the World War, 75mm guns mounted on special fixed carriages were used. They were strung along the whole front at distances of 5 to 10 kilometers apart and were employed as individual or isolated guns. It soon became apparent that it was necessary to use antiaircraft guns in masses rather than individually and furthermore it was necessary to have a group of three batteries of motorized antiaircraft guns with its batteries located on a triangle 4 or 5 kilometers to the side in order to obtain any considerable protection on a 10 kilometer front. Thus the number of antiaircraft guns was increased six fold at least.

But in view of the fact that airplanes can not fly every day and are employed in large numbers only in certain situations, it is evident that it is very uneconomical to assign a large number of guns exclusively to antiaircraft missions. Technically terrestrial fire is nothing more than a special case of antiaircraft fire. Thus we come to the conclusion that antiaircraft artillery must be prepared to take on terrestrial artillery missions, perhaps as secondary missions.

After all the ideal ballistic characteristics of a field gun, an anti-tank and an anti-aircraft gun are the same, namely: caliber of 85 or 90mm, muzzle velocity of 700 meters per second, horizontal range of 14 to 15 kilometers and vertical range of 9 to 10 kilometers. Moreover it is essential that some of the guns should be of a caliber even larger than those for purposes of antiaircraft defense—guns of 105 to 120mm.

Antiaircraft defense extends beyond the realm of the division. The front of a French division with its three infantry regiments is only three kilometers in the attack and five in strong defensive action and its normal depth of action is about ten kilometers. On the other hand antiaircraft defense must extend beyond the combat lines. There must be antiaircraft defense in sufficient depth to protect the large headquarters, the assembly areas for reserves, detraining and detrucking areas and also to cover the flanks.

For these reasons we find that groups of antiaircraft artillery are organic parts of units larger than the division. It would appear proper to attach groups of antiaircraft artillery to army corps in the ratio of one group for each division in the corps.

Listening Devices and Methods of Locating Antiaircraft. It is evident that such powerful antiaircraft weapons as we have referred to above must be assisted by devices which can hear the hostile aircraft at considerable distances and by devices which enable the guns to locate hostile aircraft quickly and precisely. Furthermore instantaneous transmission of such data is essential. As regards listening devices it is now possible to rely upon them for distances of about 10 kilometers and their maximum radius is about 18 to 20 kilometers under the most favorable circumstances. As regards direction they have an accuracy of one-half a grade (a grade is 1-100 of a quadrant or 1.9 degree). It is only necessary to turn the listening device by this small angle to cause the sensation of the sound of the plane to pass from one ear to the other. These results have been obtained by Messrs. Saulter-Harlé who have released their device to France and other countries.

We can admit that an airplane flies on a straight line at a constant altitude until its pilot receives some warning of hostile activities, let us say for a length of the time, T, which transpires from the moment the air plane is discovered to the moment when it is reached either by a projectile or by the rays of light from the antiaircraft search light. The hypothesis is particularly reasonable since the length of time, T, is very short. For this reason it is of capital importance to locate quickly the position of a hostile plane which probably has a speed of over 50 meters per second or 180 kilometers per hour and to transmit instantaneously and reliably the data regarding height and direction to the guns or to the search light.

In order to locate the position of hostile aircraft two methods are in use at the present time; the optical method which uses telescopes and is applicable only in the day time, and the acoustic method which uses a listening device which, up to the present time, has only been used at night. The first method is the best because the accuracy of locating an object which can be seen is greater than the accuracy of locating an object which can only be heard, and furthermore the optical method is preferable because the speed at which the light rays travel is naturally much greater than the rate of travel of sound. The rate of travel of sound is only about six times as fast as that of an airplane.

Messrs. Saulter-Harlé have worked out a method of using the visual system on clear nights. In this system the listening device is only used to get the approximate direction of the hostile airplane after which the telescope is employed as soon as possible.

Instantaneous and sure transmission of data for the calculated future position of hostile airplanes excludes the use of telephones, since they are conducive to errors, and are slow and tiring to their operators. Messrs. Saulter-Harlé have replaced obsolete telephone communication by an electrical apparatus, telepointage, which functions instantaneously and silently.

SEARCH LIGHTS

Search lights for antiaircraft use are different from search lights for terrestrial purposes. For antiaircraft use the beam is necessarily circular in cross section because the plane can move quickly both in height and direction, but for terrestrial targets it is better to have a rectangular beam because these targets are usually big and move slowly and don't make rapid changes of altitude. Furthermore beams of rectangular cross section get the best results as regards the intensity of lumination.

Our Naval search lights have mirrors which are silver plated whereas the Army uses gold plated mirrors. The reason for this is that salt sea air damages gold plated mirrors more than it does silver plated ones. However, the golden beams are less blinding and more transparent than silver beams and it is therefore easier to locate targets with the gold ones. An airplane can be seen anywhere in the golden beam whereas it is generally only visible at the edges of a silver beam. Furthermore the range of the silver beam is not quite as great as that of the gold beam. The distance at which an airplane is ordinarily discernible is about 10,000 meters horizontally and 12,000 meters vertically with a 120 centimeter search light which has modern brilliantly burning carbons. These ranges fit in very well with the ranges of the listening devices and of antiaircraft cannon.

HEAVY ARTILLERY FOR ARMY CORPS

It is absolutely indispensable that the action of gun-howitzers (85 or 90mm caliber) and medium howitzers (150mm caliber) be protected, reenforced and lengthened by powerful *guns* whose principal missions are counterbattery and interdiction. These missions are beyond the realm of the division. During the War counterbattery missions of distances greater than 8 or 10 kilometers were corps or even army functions during attacks where the frontage was small. An episode which occurred during the battle of Somme shows in a striking manner the necessity for this arrangement. A French corps complained that its artillery was being violently bombarded by German batteries which could not be located. The general who commanded the army to which this corps belonged issued orders to his other corps to locate the German batteries which were doing the damage. After several days the latter were located, and it was found that they were not facing the batteries which had received the rough treatment, nor were they even across the lines from the French flanking corps. It was found that the German guns which were doing the damage were across from a French corps which was two corps over to the right.

The range of corps artillery must be 20 kilometers at least. For counterbattery it is necessary that the caliber be at least 150 or 155mm, in other words, equal to the division howitzers. For interdiction and harrassing fire 155mm guns are very uneconomical. The projectiles are very expensive, costing about 400 francs each. As regards these kinds of fire, it might be said about them is that it might be well for the corps to use them to reenforce its division under certain circumstances, for example, assisting advance guards, rear guards and in operations on very extended fronts. In France the 105mm gun is so employed, but its range is not much greater than that of the regular 75.

The Schneider factories have built for a foreign government a 105mm gun with a range of 19 kilometers and a projectile weighing 16.4 kilograms. This range is not enough, nor is the weapon sufficiently accurate, and the projectile does not contain enough explosive. The fact remains that 105mm caliber is not enough for ranges of 20 kilometers and one can not get around the fact that it takes a 115 or 120mm gun to propel a 122 kilogram projectile that distance.

The French organization which provides that corps artillery should have as many battalions of 115 or 150mm guns as there are divisions in the corps seems very proper.

TRACTION

Horse-drawn. Horse traction is the only kind of traction that makes it possible for artillery to go anywhere provided the gun and carriage do not weigh more than 2,500 kg. It is therefore suitable for gun-howitzers which must go over all sorts of terrain under all conditions. The 8-horse team is able to pull three or four tons at the rate of march of the Infantry. It is sufficient to drag the medium division howitzers which have just enough mobility to be satisfactory on the field of battle.

If the weight of the gun and carriage is more than four tons it is necessary to split the load if horses are still to provide the traction. However, with such great weights motor traction is generally better.

Motorized. As a result of experiences during the World War motorized artillery in France is divided into three categories:

1. Portée-artillery (75 and 105mm guns and 155mm howitzers).
2. Tractor-drawn (155 GPF guns).
3. Self-propelled weapons.

Portée artillery. During the World War it became necessary to carry artillery in tractors beginning with 1917, because at that time the available horse flesh began to give out and the procurement of forage became very difficult. On the other hand motorization was facilitated due to the assistance of the United States. In 1918 portée artillery gave precious service because it enabled large masses of artillery to be concentrated at important points. It provides an excellent solution to strategic mobility since 75mm guns can be moved 100 or 120 kilometers in 24 hours by means of it.

However, portée artillery is tied down to the road. Going into position is a laborious and slow process and must necessarily be done in the vicinity of roads. Of course, the occupation of position by portée artillery can be accelerated to some degree by having small tractors carried along with the guns or by borrowing teams from nearby horse-drawn outfits. Getting out of position presents the same difficulty. The tactical mobility of portée artillery is always a weakness. The employment of portée artillery causes a special tactical situation. A 75mm portée battery is not interchangeable with regular horse-drawn 75mm batteries on the field of battle. Portée artillery is the result of special conditions and on the whole it must be said that this kind of locomotion is not an expedient to be recommended.

Tractor-drawn artillery. In order to be utilized promptly under all combat conditions, this kind of artillery must be able to go anywhere with its tractors, its guns and its ammunition vehicles. It is not sufficient for it only to be able to move on good roads. Moreover occupation of position must be easy and quick. In order to have great tactical as well as strategical mobility all vehicles should have caterpillar tracks which satisfy the following conditions: they must not tear up the roads nor wear themselves out, they must be able to pull about 20 tons without excessive deterioration due to fast marching (35 kilometers per hour) and they must be able to withstand firing at high elevations.

The Citroen-Kegresse track suffices for the first two conditions stated above, but as far as is known it does not answer the third requirement.

Self-propelled mounts. Self-propelled mounts have certainly some precious characteristics all of their own: great mobility, ability to move easily on terrain with slopes as great as 30°, ability to occupy and move out of positions almost instantaneously, ability to change direction of fire very quickly even when the changes are great, and the ability to transport the gun crew and the first increment of ammunition along with the piece. Moreover shields up to a thickness of 25mm can be provided and this, of course, means that the guns can be more bravely handled and the personnel protected against bullets and shell fragments. It is a great advantage to have a shield which gives protection from above and from the front and to a part of the sides. Thick armor would be too heavy and interfere with mobility. All around armor is objectionable on account of the lack of ventilation which it causes. The above listed qualities enable self-propelled mounts to be very suitable for short, violent, close-up fighting at critical moments when direct fire is used, especially in tank fighting. With a gun having 90 or 100mm calibers the whole self-propelled mount would weigh about 20 tons. This weight would not be too much to permit movement by railroad. However, self-propelled mounts must have specially qualified chauffeurs. These mounts are very costly to keep in good condition and can only be employed to a limited extent. Anti-tank self-propelled batteries should be used as an artillery reserve for divisions.

CONCLUSIONS

From a tactical point of view division artillery, in order to warrant its existence, must support its infantry no matter what kind of terrain it is on, nor what kind of enemy it is up against. The enemy may be in the open, in trenches, behind armor, on the ground or in the air. Division artillery must have curved fire at medium ranges (3 or 4 kilometers). At distances less than this curved fire can only be obtained by special small weapons such as infantry accompanying guns or mortars.

We can not have special kinds of artillery for each kind of fire that is desired in a division. In other words it is not practicable to have one kind of gun for instantaneous shell fire and another kind for high angle fire. An antiaircraft gun must be able to fire on terrestrial targets and an anti-tank gun must be able to fire at objects which are not armored.

It is necessary to reduce the number of types of artillery to the minimum in order to avoid ammunition complications.

There must be a certain amount of homogeneity as to maximum ranges—14 or 15 kilometers for division artillery and about 20 kilometers for corps.

All this brings one to the conclusion that the following organization is best suited for a division composed of three regiments, and for a corps composed of two divisions.

Division artillery should have:

1 regiment consisting of 3 battalions of 90mm horse-drawn gun-howitzers.

1 regiment consisting of 2 battalions of 150mm howitzers either horse-drawn or tractor-drawn.

1 group of 3 batteries of anti-tank guns, self-propelled.
1 company consisting of 2 sections, each with 3 search lights for terrestrial use, tractor-drawn.

Corps artillery should have:

1 regiment consisting of 2 battalions of 115mm guns.
2 battalions of 150mm guns, motor-drawn.
1 regiment consisting of 2 battalions of 90mm antiaircraft guns on tractor-drawn trailers along with listening devices and search lights.

GENERAL FREDERIC CULMANN

DITINGUISHED FRENCH ARTILLERYMAN. AUTHOR OF THE ARTICLES ON DIVISION ARTILLERY APPEARING IN THIS AND THE LAST ISSUE OF THE FIELD ARTILLERY JOURNAL

THE FIELD ARTILLERY R. O. T. C. AT PURDUE

PURDUE IS OUR LARGEST AND ONLY MOTORIZED R. O. T. C. UNIT. ITS ENROLLMENT LAST YEAR WAS 2049

OKLAHOMA UNIVERSITY R. O. T. C. PISTOL TEAM
LEFT TO RIGHT: LT. IVAN D. YEATON, COACH; JACK LOUTHAN, CAPTAIN; WM. VOGT, CAPTAIN-ELECT; DENNIS PETTY; TOM MAYRATH; ROBERT MAYRATH; LUCIEN WRIGHT; PAUL BUCY

PISTOL MARKSMANSHIP

BY LIEUT. IVAN D. YEATON, F. A., Coach of National F. A., R. O. T. C. Championship Team

FOR the second successive year the University of Oklahoma R. O. T. C. Pistol Team has won the Field Artillery intercollegiate championship. Out of the sixteen matches which include National, Southwestern, and State, they placed first in six of them, second in five, and third in two.

Of the strictly team matches they placed first in the National intercollegiate, first in one and second in the other of the Oklahoma State meets, and second in the Southwestern (open), losing the championship in this to the crack San Antonio police team by one point.

Members of the O. U. team hold the following 1931 honors:

Oklahoma Individual Pistol Championship
Oklahoma Target Pistol Championship
Oklahoma Police Pistol Team Championship
Oklahoma Target Pistol Team 2nd place
Oklahoma Police Pistol Match 2nd place
Oklahoma Target Pistol Match 2nd place
Oklahoma Bobbing Target Match 3rd place
Southwestern Individual Pistol Championship
Southwestern Rapid and Timed (Trinity) Fire Championship
Southwestern Pistol Team Match 2nd place
Southwestern 15 yard Match 7th and 8th place
Southwestern 25 yard Match 2nd and 5th place
Southwestern 50 yard Match 3rd and 8th place
Southwestern Slow Fire Any Pistol Match 8th, 10th and 11th
National F. A., R. O. T. C. 45 cal. Championship.

An outstanding difficulty in the work this year has been the fact that various changes in rules and requirements forced the boys to shift constantly from one weapon to another, using alternately 22 automatics, 38 revolvers, and 45 pistols, while the ranges have been anywhere from fifty feet to fifty yards involving a continual change of sights.

Major E. P. Parker, Jr., whose untiring efforts made the intercollegiate championship possible last year, again rallied to the support of the team and built them a new fifty-yard range to meet the new conditions of the national match. Besides this, he purchased two 38 revolvers, two 22's on 45 frames, sent the team on two trips, one to Dallas, Texas, the other to Okmulgee, Oklahoma, and presented the team with letters, sweaters and keys.

It may be of interest to those contemplating the coaching of similar teams to know that the following list of instructions is issued to each member of the pistol squad to be tacked on the wall in a conspicuous place in his room and read every day until memorized.

INSTRUCTIONS FOR PISTOL SQUAD, UNIVERSITY OF OKLAHOMA

1. FEET	12 to 18 inches apart and parallel.
2. FACE	45 degrees from target.
3. LEGS	Straight without stiffness.
4. HIPS	Level.
5. BACK	Straight without stiffness
6. SHOULDERS	Level and relaxed.
7. NECK	Turned slightly without strain.
8. HEAD	Vertical.
9. EYES	Both wide open.
10. LEFT ARM	Hanging relaxed at side.
11. RIGHT ARM	Horizontal and straight without stiffness.
12. PISTOL	In prolongation of bones of forearm.
13. RIGHT HAND	Top level with forearm.
14. FINGERS	Thumb and first finger holding pistol, thumb level with or higher than first finger, 2nd, 3rd and 4th fingers slightly relaxed.
15. BREATH	Normal, but held by throat and not diaphragm while squeezing.
16. BODY	Straight without stiffness, relaxed all over.
17. CLOTHING	Loose and comfortable.
18. BALANCE	Perfect, center of gravity must be in center of support.

THINGS YOU MUST DO

1. Practice exactly the way you intend to shoot.
2. Face a mirror once each day and check on your position.
3. Exercise at least one hour each day.
4. Shoot at least three times a week.
5. Think of only four things while you are squeezing the trigger.
    (a) Rear sight
    (b) Front sight
    (c) Target
    (d) Squeeze
6. Be unconscious of all else except (5) above when the hammer falls.

7. Align your sights as quickly as possible and squeeze as soon as and as long as your sights are on the proper target.
8. Hold your arm out as long as possible in practice and as short as possible when shooting.
9. Squeeze slowly with eyes and thoughts centered on target.
10. Check up on each detail every day.

THINGS TO REMEMBER AND READ EACH DAY

1. A shot sent on its way can not be recalled.
2. Your reputation hangs on every shot fired.
3. No one can be a competition shot who neglects any small detail.
4. An expert pistol shot is only a FAIR shot compared to a COMPETITION SHOT.
5. Leave nothing to chance and trust no one.
6. A competition shot who drinks and smokes is only an expert.
7. Stop drinking alcohol, tea and coffee, and stop smoking gradually taking 30 days to complete, and allowing yourself at least 90 days' freedom before a big match.
8. Always wear your most comfortable clothes to shoot in.
9. Never shoot without inspecting:
   Pistol—High lights on sights
   Slide works freely and smoothly
   Trigger smooth and uninterrupted
   Sights clean, smooth and black
   Bore clean
   Magazine undented and clip spring working
   Ammunition—Inspect and load clip yourself
   Bullets clean and free from dents, ridges or flat places
   Cartridge case free from dirt, rust or dents
   Case not swollen or bullet too free
10. All a coach can do is to tell you what to do and how to do it.
11. As 50 per cent of your work is done at home without observation, the hope for you to become a competition shot is the desire so great that you keep it in mind at all times, and practice at every opportunity.
12. During the 30 days preceding a match keep your habits and your bowels regular, and do not change any detail just before the match.

13. Safety precautions:
    (a) Never place a loaded magazine in a pistol until you have taken your place at the firing point
    (b) Remove magazine and unload before leaving the firing point
    (c) Always hold loaded pistol at raise pistol except when firing
    (d) Always remove magazine before reducing a jam.
    (e) Face the target as long as you have a loaded pistol in your hand.
    (f) All pistols around the firing point not in use should have the slide locked back and the magazine out.
14. Always practice on something harder than you use for record, that is, a heavier gun, harder trigger, smaller bullseye, etc.
15. All weights hung on the arm should progress from shoulder to the end of the barrel, start with a light weight and slowly increase.
16. Three pounds held properly for six minutes is twice as beneficial as six pounds held three minutes.
17. You are in stricter training than any other athlete.
18. Ten days' break in training takes twenty days' hard work to overcome.
19. Use the fewest number of muscles possible when shooting and work these few the hardest in training.
20. A shot fired in desperation to get rid of it is always a bad one.
21. If anything happens after you start to squeeze, such as eyes water, hand trembles, clothes uncomfortable, or outside interference, stop squeezing at once and lock your piece.
22. Eyes must be focused on the bullseye not the sights.
23. Never aim at any place except the bottom of the black as shown in a normal sight.
24. If a normal sight gives you a good group but not in the center of the black change your sights but not your sighting.
25. Protect the sights on your gun as you value your reputation as a shot.
26. A good exercise is to sight pistol, close your eyes and squeeze until the hammer falls, then open your eyes and see where your sights are.

27. If you are having trouble squeezing the trigger, occasionally cock and lock pistol, then squeeze as long and as hard as possible.
28. Every time you squeeze a trigger consider that the gun is loaded.
29. If you know when your gun is going off it probably will not be a bullseye.
30. Pressure on the trigger should only be kept up as long as the sights are on the bullseye. Do not try to catch it on the way by, a good score can not be made that way.
31. In rapid fire go from position of raised pistol to aiming position by shortest route, a smooth rapid extension of the arm, straight from the shoulder, at the same time inserting the finger in the trigger guard and holding the breath.
32. Use all speed possible aligning the sights and take all time possible squeezing the trigger.
33. Do not let elbow bend during recoil and get back on the target as quickly as possible.
34. Release trigger during recoil so that the sear may reengage and immediately start to squeeze again.
35. In firing at bobbers pick a definite spot to fire at.
36. If you are in any sort of trouble talk it over with your coach.
37. If you feel your self getting stale tell your coach and he will let you off for a few days.
38. Keep a chart of your shot group under different lighting effects.
39. Do not attempt to cut your trigger down, your coach will send it back to the factory if he thinks it necessary.
40. Too light a trigger has cost many a match.
41. Do not stare at your target or anyone else, look at something green between shots if possible.
42. Be a hard worker.

MARCHING WITH THE HORSE ARTILLERY

BY LIEUT. G. B. McREYNOLDS, 82nd F. A.

DURING the past year the First Battalion, Eighty-Second Field Artillery (Horse), under command of Major John P. Lucas, has been making experimental marches, several of which have received a certain amount of publicity. It is thought that an account of its march procedure might be of interest to other field artillerymen who, while not faced with the problems of mobility of the organic artillery of a cavalry division, are nevertheless concerned with the possibilities of the horse as a prime mover.

Despite a general impression to the contrary, the Horse Artillery Battalion has not set out to make records or break them. Our greatest training problem is naturally that of mobility, and through a series of training marches we have endeavored to develop a march technique that would enable us to keep up with the cavalry during an actual emergency, without the loss of animals, or any decrease in efficiency due to injuries and excessive fatigue. Service conditions have been approximated with loads of either live or dummy ammunition, and no compromise has been made with the training objective for publicity purposes.

It is unfair, of course, to compare a test march made under ideal conditions of weather, forage, and horse flesh to the achievement of Horse Artillery in active service. When the 20th Brigade, Royal Horse Artillery, covered ninety-seven miles in forty-eight hours on the Plain of Esdraelonin September, 1918, it was on half rations of forage and in warm weather. But the terrain was pretty much the same as that we covered in southern New Mexico, and the British lost quantities of their animals. We are told that the days of the Horse Artillery are numbered, and that the next few years will see the motorization of all field artillery. Plans are now being discussed for the replacement of the 75mm field guns (Model 1897 French) in the Cavalry Division with some other type of cannon. We may be the last die-hards of a decaying tradition, but it is a source of great satisfaction to all in the Battalion that we can keep the guns rolling close behind the cavalry.

The Battalion of course is organized on the basis of three pairs of horses to each carriage with cannoneers individually mounted. The horses are rather lighter than the typical artillery draft type, averaging about 1,150 pounds, and can move very rapidly when necessary. It has been found, however, that in the deep sand of this part of the country, eight horses are often necessary in draft, so the extra drivers were taken from the gun squads and the extra animals from the cannoneers mounts. The drivers alternate in riding the off and near horses, so as to equalize the burden on the pair.

In October, 1930, the idea of changing off drivers was carried further. A march of 113 miles was made in three days. The second day, a difficult pass in the Organ Mountains was negotiated, and named Rucker Pass, in honor of a former Battalion Commander. The last 50 miles of the 113 were made in one march, largely at night, from Las Cruces, N. M., to Fort Bliss. The route lay over metaled roads, and was covered in 14 hours total elapsed time. At every other hourly halt, the off and near horses were interchanged in each pair, the driver always riding the off horse on the soft shoulder of the highway. In some cases, pairs were alternated in the lead.

On January 20, 1931, the march was stretched somewhat. The unit marched to the Fort Bliss Target Range, 29 miles north of the post, and back the same day, covering the 58 miles in 12 hours' marching time. This time the route lay over an unimproved sand road. The weather was cold and dry, and the rate of march—almost five miles an hour—cannot be maintained for any length of time over hard roads, or in warm weather.

On March 3 and 4, 1931, a longer test march was made. The Battalion left Fort Bliss at 5:00 P. M., marched through El Paso, over the Scenic Drive on Mt. Franklin, up the valley highway to Berino, N. M., across Fillmore Pass to the target range, and back to the post over dirt roads. The total of 73 miles was covered before 4:00 P. M. the next day. The actual marching time, however, was 16 hours and 45 minutes including the regular hourly halts—giving a marching rate of 4.36 m.p.h.

The first halt for feed and water was made at Old Berino, N. M., after covering 32 miles over hard roads. The animals were watered by bucket out of an irrigation ditch and fed a mixture of oats and alfalfa leaves. Two feeds of this had been previously prepared and were carried in the grain bags. The night was clear and cold, and the animals drank but little at this time. The entire halt program, which included only coffee and sandwiches for the men, consumed only an hour.

The second halt was made at 5:00 A. M., at Target Range Well. The horses were unharnessed, watered, and a half hour after they got in were given a half ration of hay. Not until 6:30 A. M., after the men had breakfasted, was the grain fed; and at 7:30 the remainder of the hay was fed out. The battalion was here until nine o'clock.

The last phase of the march was broken by the noon halt, where the animals were watered from wagons (one bucket each) and fed the remainder of the mixed oats and alfalfa. The significant feature of the march, however, was the condition of the animals upon return to the post. We had been warned that if any such march were attempted, the stock would be done up for the Cavalry Division maneuvers in May, but the contrary was the case. A week after the march, the animals were in as good flesh as before they started. No horses were injured. One had colic, apparently from something eaten before leaving the post, and later died—the post mortem examination showing a ruptured diaphragm. One had the hair rubbed off a shoulder due to faulty adjustment of harness during the night. Three horses were a little lame, but walked sound the day following the march.

The precautions taken to safeguard the horses are routine procedure in the battalion, and no extraordinary measures were adopted during the longer marches. It is believed that the matter of feeding animals when tired is of the greatest importance. The fact that there has been no case of laminitis in the battalion for months indicates that perhaps "road founder" is due more to improper feeding on the march than to pounding on hard roads.

Grain is never fed soon after a halt when it is possible to rest the horses first. During the march described above, twice it was impossible to rest them before feeding, and in both cases a feed had been prepared consisting of equal parts of oats and alfalfa leaves (by bulk), averaging about three pounds of oats to the feed. While this would be impracticable in the field, it is significant to recall that the English in France chopped hay to feed with grain, and their results seemed to justify the trouble taken.

The hay prevents the animal from bolting his grain, with the resultant elimination of undigested food, and, in some cases, disability from sickness.

The horses of the battalion are not a specially selected lot; many of them are old, and the quality of remounts received during the past few years has been anything but superior. Actually there are at present in the battalion 68 horses over 20 years old and 36 over 18. They have been conditioned by the usual routine of garrison life and field training, and the manner in which they made a rather severe march is due in great measure to the training in draft of the drivers and non-commissioned officers, and to the march discipline prevailing in the battalion.

The fact that there is no interfering is attributed partly to the practice of changing the off horses in each pair, so that the driver is never riding the animal on the pavement. When traveling over dirt roads, the change is made every third hour. Each near horse has a white brow band, and each off horse a red, in order to facilitate the change over during night marches.

The fact that the driver rides both horses in his pair precludes the carrying of his roll on the saddle. To take care of this, simple iron frames have been constructed in the battery blacksmith shops to go on the rear of each limber. This has increased the average weight of the loaded limber 142 lbs.

To approximate service conditions, live ammunition was at first carried in the caissons, but over the rough terrain we cover, the ammunition did not stand up. The rounds became unfixed, and in some cases even the boosters of H. E. shell started to come loose. This, in addition to the excessive weight of the French caisson, is such a serious handicap to artillery operating in the southwest, that the Cavalry Division Board has improvised a light spring cart for carrying fixed ammunition in rope containers of six rounds each. The cart carries a total of ninety rounds, and weighs loaded a ton less than the French caisson. Experience has shown that the "Torpedo Wagon" can be handled by four horses over the most difficult terrain passable for wheeled vehicles.

During the first practice marches, live ammunition was carried in the caissons, but this was finally stopped by the Post Ordnance Officer due to the damage described above. As a consequence, sand loaded ammunition was prepared by the Ordnance, and has been carried in the caissons on all practice marches, averaging in total weight 912½ pounds per section.

The matter of gaits and rates of march has been worked out in considerable detail. The gait schedule, when computed for the regulation walk and trot, gives 4 1-3 miles per hour including the hourly halt. Experience has shown that the trot cannot be maintained for more than five minutes at a time without increasing the fatigue beyond all proportion to the increase in speed, so it has not been practicable to increase the average rate of march except in emergencies or under ideal conditions.

For the beginning of a march, or after a long halt, the following schedule is adhered to:

Walk	15 minutes
Trot	5 minutes
Walk	10 minutes
Halt	15 minutes

Thereafter, each hour is divided as follows:

Walk	5 minutes
Trot	5 minutes
Walk	10 minutes
Trot	5 minutes
Walk	10 minutes
Trot	5 minutes
Walk	10 minutes
Halt	10 minutes

The battery commanders, of course, will vary this from time to time when the conditions of the terrain at any particular point make the trot inadvisable. No additional time is allowed at halts for unhitching and changing over the off and near horses in each pair.

The battalion has been fortunate in its Veterinarian, who rides the column continually, and watches the weaker horses like an anxious mother. Indeed, the eternal vigilance of all concerned has been the price paid for such mobility as has been attained in the Horse Artillery.

ORGANIZATION, ARMAMENT AND EMPLOYMENT OF FIELD ARTILLERY

BY GENERAL C. P. SUMMERALL

THE 1st Division, A. E. F., entered the Menil-la-Tour Sector January 19, 1918. The sector covered a front of about six kilometers. The artillery consisted of the normal 1st Field Artillery Brigade, and in addition four 95mm French guns, and eight 90mm French guns, old model, all of which were served by the 1st Field Artillery Brigade. The quantity of French corps artillery is not known, but probably consisted of several batteries of old rifles. It gave little assistance and practically all counter battery work was done by the divisional artillery.

The artillery was organized in depth with the 90 and 95mm guns and one gun from each of nine 75mm batteries in forward positions. Approximately six 155mm guns were also kept in forward positions for distant counter battery work. The remainder of the guns occupied rear positions and only fired protective barrages. One battalion of 75mm guns was withdrawn so far to the rear that it could barely reach a few parts of our front line. This battalion never fired. All of the guns covered the second position which was the real defensive line.

A principle in the employment of artillery is that the maximum width which a single battery of 75mm guns can effectually cover for a barrage is 200 meters. It was therefore impossible to deliver barrage fire over even half of the front at one time. The most sensitive parts were therefore selected and were covered by the normal barrage. The remainder was covered by eventual barrages. The front was later extended to approximately 12 kilometers for subsequent divisions. It is manifest that the artillery defense was merely nominal. At no time could the sector have resisted an attack along the entire front, or along any considerable portion of the front. The enemy knew where the normal barrages fell, and he actually crossed our lines by raiding parties at other places before his presence could be discovered and the eventual barrages fired. Every method was adopted to develop skill in shifting and firing the guns by the sentinels continually on duty. Telephone lines and in some cases visual signal communications extended from every battery to the company centers of the front line with artillery officers and enlisted men as operators and liaison details. Nothing, however, could compensate for the great deficiency in artillery. An eventual barrage is of little value except to reinforce other normal barrages. It is a poor reliance, and it is even dangerous because it inspires a false feeling of security to the Infantry.

For the raids of March 11, the French supplied guns to make the following total under the Division:

75mm guns	96
155mm howitzers	24
105mm guns	8
120mm guns	22
155mm guns	6
95mm guns	4
90mm guns	8

There were also used in the raids, 12-75mm guns and 8-95mm guns from a neighboring division. All the remaining artillery of the two neighboring divisions were used to make false cages and to deliver interdiction fire. The corps artillery executed a part of the counter battery, the remainder being performed by the howitzers of the Division. The area raided was about one kilometer wide. The artillery had therefore the following density of barrage and protective fire:

1—75mm gun for each 10 meters of front.

1—155mm, 90mm or 95mm gun for each 60 meters of front.

For counter Battery:

2 guns or 2 155mm howitzers for each known hostile battery.

The raids were made practically without loss to the Infantry.

The Division entered the Cantigny Sector on April 24. The front covered about 3½ kilometers. Later the front was increased to nearly 8 kilometers. The artillery was echeloned in depth, with only forward guns from 75mm batteries and from 3 155mm batteries. One battalion of 75mm guns could only reach the front line with long range shells, and it was not allowed to answer barrage calls. All guns could cover the second line which was the real position of defense. Whenever an attack by the enemy was expected, one or two French regiments of 75s were added to the Division, and placed in rear of the third line. They could only fire in front of the second and third lines. During the occupation of the sector there were added to the Division 42 French howitzers of various models up to 280mms, but they were mostly in rear of the third line and a few only could reach the first line.

The normal artillery of the sector was as follows:

84 75mm guns.
16 155mm howitzers.

The amount of corps and army artillery is not known, but it was wholly inadequate for counter battery work, and the divisional howitzers devoted practically all of their fire to the enemy's batteries. During the early part of the occupation, the 75mm batteries were able to fire an effective barrage, but when the sector was extended it was necessary to confine the normal barrages to sensitive points and to cover the remainder of the front by eventual barrages.

For the attack on Cantigny, May 28th, over a front of 2 kilometers, the French added artillery to make the total in the Division as follows:

132 75mm guns.
36 155mm howitzers.
16 220 and 280mm howitzers.

The counter battery was executed by the Corps, which had enough artillery to place at least 2 guns on each known enemy battery.

The density in the Division was therefore:

1 75mm gun for each 15 meters of front.
1 155mm, 220m or 280mm howitzer for each 38 meters of front.

In addition, the Division employed 24 58mm, 6 150mm and 4 240mm trench mortars.

The preparation and the covering fire were successful, and the advance was made with few losses. When, however, the corps artillery was withdrawn immediately after the arrival of our

Infantry upon the objective, it became necessary to have the divisional artillery assume the duties of counter battery, as well as of protecting the new line. It was altogether inadequate and our Infantry suffered heavily in consequence.

The Division attacked at Soissons on July 18th over a front of 3 kilometers. The divisional artillery consisted of:

84 75mm guns.
24 155 howitzers.

The counter battery was performed by the Corps, but gave little protection from the enemy's numerous and well served batteries.

The density of the barrage and protective artillery was:

75mm, one gun for each 35 meters of front.
155mm howitzer, one gun for each 125 meters of front.

The artillery support was hopelessly inadequate, though the guns were used with boldness and efficiency. The Division lost over 7,000 men in 5 days while gaining 11 kilometers. The barrage was so thin that the Infantry could not recognize it. In general, it was necessary to combine all the artillery to fire in front of one regiment or of one brigade for successive advances. As usual, the losses of the Infantry paid for the deficiency of the artillery.

From the latter part of July to the latter part of August the Division occupied the Sezarais Sector with a front of 8 kilometers. The sector was organized in depth similar to those formerly held.

The artillery consisted of:

48 75mm guns.
24 155mm howitzers.
12 95mm guns, old model.

It was wholly inadequate for defense over such a front. The usual method of covering sensitive points by normal barrages, and the remainder of the front by eventual barrages, was adopted.

On September 12 the Division attacked at the St. Mihiel salient over a front of about 3 kilometers with the left flank exposed.

The following constituted the divisional artillery:

120 75mm guns.
40 155mm howitzers.
8 8-inch howitzers.

The counter battery was performed by the corps artillery.

The barrage and protective artillery had the following density:

75mm—one gun for each 24 meters of front.
155mm howitzer and 8-inch howitzer—one gun for each 62 meters of front.

The preparation and the covering fire were fairly good, and the losses did not exceed 1,000 men. The enemy, however, had begun his withdrawal before the assault, and the resistance was below normal.

The Division entered the line west of the Meuse September 30, and attacked on October 4 on a front of over 4 kilometers, which ultimately was extended to 6 kilometers.

The divisional artillery consisted of:

84 75mm.
36 155mm. howitzers

Counter battery work was performed by the Corps, but it did not protect the Infantry from the enemy's numerous and well served batteries.

The density of the barrage and protective fire was:

75mm.—One gun for each 47 meters of front.
155mm. howitzers—One gun for each 110 meters of front.

The fighting was desperate, and the artillery support was pitifully inadequate, notwithstanding the fact that the guns were handled with boldness and that the cannoneers served them, day and night, with the most devoted zeal. Again, it was necessary to advance the Infantry by regiments, or by brigades, and to cover the echelons by all of the artillery.

The casualties of the Division amounted to about 9,400 men in 11 days, while advancing over 7 kilometers.

The 42nd Division relieved the 1st Division on October 11, but in order to increase the artillery support, the artillery of the 1st

Division was retained in the sector. The divisional artillery in consequence consisted of:

132 75mm
60 155mm howitzers

The front taken over amounted to about 6 kilometers, so that the density of the barrage and protective artillery was:

75mm—One gun for every 45 meters of front.
155mm howitzers—One gun for every 100 meters of front.

The 42nd Division attacked on October 14. One brigade made no progress, and sustained heavy losses; the other brigade made some progress against a wooded hill, but did not reach its objective. In two succeeding assaults the first named brigade failed, and the other made steady but slow progress, which continued through wooded areas over a period of several days, involving desperate hand to hand fighting. While there were contributing causes to the failure of the first named brigade, these would not have been determinative, if the troops had been adequately supported by artillery.

During the same time, the other division of the V Corps, the 32nd Division, which was supported by one artillery brigade, could only advance by exploitation of small gains through woods.

On October 19 the 32nd Division was relieved by the 89th Division which had no artillery. The artillery of the 32nd Division remained in support of the 89th Division, and towards the end of October another brigade of artillery was added to this Division.

On October 31 the 42nd Division was relieved by the 2nd Division, but in order to still further increase the supporting artillery for the attack of November 1, the artillery of the 42nd Division was retained in support of the 2nd Division.

Thus, for the assault of November 1, the artillery of the V Corps, was as follows:

Guns	*2nd Divn.*	*89th Divn.*	*Corps Artillery*
75mm	144	132	....
150mm howitzers	72	40	68
8-inch howitzers	8	16	....
105mm guns	12	20	....
155mm guns	....	....	84
Total	236	208	152

For the initial assault, the 2nd Division covered 5¼ kilometers, and the 89th Division 2¾ kilometers, making a total of 8 kilometers for the Corps front. The fronts of the divisions were approximately equalized after they had advanced about 2 kilometers. The artillery plan was prepared by the Corps so as to co-ordinate all tasks. The barrage and protecting fire for the Corps front was therefore as follows:

75mm—One gun for every 29 meters of front.

155mm and 8-inch howitzers—One gun for every 39 meters of front.

For counter battery:

105mm and 155mm guns—One gun for every 69 meters of front.

The assault was greatly assisted by the constant and well planned bombardment during the preceding days, and by the intense preliminary bombardment. All guns were devoted to enemy batteries and to those parts of the enemy's positions from which he could fire effectively upon our troops at the moment. A high rate of fire was employed. The Corps made a complete breach through, and the losses, though considerable, were not excessive.

On the night of November 10, the 2nd and 89th Divisions forced a crossing over the Meuse River on a front of about 8 kilometers against strongly organized enemy resistance. The crossing was effected largely by surprise. The Divisions had only their organic artillery, which was wholly inadequate to prepare and cover such a maneuver. The losses in the 2nd Division were excessive for the operation.

The defense of any position involves the occupation by the Infantry of successive lines of resistance. The first line is in close contact with the enemy, and may consist of trenches, islands of resistance, and machine guns or automatic rifles in mutual supporting distance. Its purpose is to prevent the enemy from advancing his lines, to give warning of any advance by the enemy, and to break his resistance in case of attack. It should be lightly held by combat groups with patrols and positions of observation in the intervals. The first line must be supported by sufficient artillery to fire normal and eventual barrages for the purpose of preventing raids, as well as subjecting the enemy to losses when he attempts a real attack. It is also essential to the morale of the Infantry that they always be covered by artillery fire.

There must be a second line, which may constitute the real line of resistance. It should be out of range of the mass of the enemy's artillery, so that it could not be brought under heavy fire of neutralization unless the enemy displaced his guns near his front line, or advanced them across our front line. The mass of the Infantry should occupy the second line, which should be strongly entrenched. The second line should be covered by sufficient artillery to establish an effective barrage of 200 meters for each 75mm battery. As far as practicable, all artillery should be in rear of the second line. Between the first and second line there should be islands of resistance, machine gun nests and antitank guns to offer resistance and to break the enemy's attack.

A third line should be established and held by reserves. A considerable portion of the artillery should be in rear of the third line, and this artillery should constitute a part of that required to fire in front of the second line. In addition to the light artillery firing barrages, a division should have heavy and light howitzers for harassing fire, for gas concentrations, and for concentrations upon areas over which the enemy's forces may advance. All counter battery work should be executed by suitable guns under the corps.

The number of guns required for the defense of a line is independent of the number of men in the line, but is fixed entirely by the front to be covered. In quiet sectors, American divisions have held fronts of about 8 kilometers. In an active sector, the front has been 4 kilometers. An active sector, however, differs little from offensive operations, and the amount of artillery for offensive operations is applicable.

The following artillery is considered the minimum for use with one of our divisions in a quiet sector having a front of 8 kilometers:

75mm Guns

For the first line:

75mm—One battery for every 800 meters of front, 10 batteries.

Second and third lines:

75mm—one battery for every 200 meters of front, 40 batteries.

Total: 50 batteries, 200 guns.

Light Howitzers

For the first line:

105mm howitzers, for harassing fire, gas concentrations and protective concentrations—12 batteries, 48 guns.

155mm Howitzers, 8-inch Howitzers and 9.2-inch Howitzers

For the first line:

For counter battery, harassing, interdiction and concentrations—3 batteries.

Second and third lines:

For concentrations and gas—9 batteries.

Total: 12 batteries, 48 guns.

155mm Guns and Other Types of Guns

For counter battery—12 batteries, 48 guns.

Total: 344 guns.

Any initial assault will involve the capture of a more or less prepared infantry position close to our front line, and this position will offer serious resistance by infantry and machine gun fire; a further penetration to the enemy's light gun lines; and a still further advance to his rear lines or to the positions occupied by reinforcements. All positions are echeloned in depth, with infantry and machine guns in successive lines extending at least as far back as the light gun lines. It must be expected that the enemy will make a strong, if not the strongest, resistance at a rear position, which may be almost as far back as the principal light gun lines. While the intelligence section furnished the best obtainable information as to these positions, it has always been that there were batteries, trenches, fox holes, and machine guns at many places not located before the advance. The capture of these positions involves suppressing the enemy by a superiority of fire, and then taking physical possession of the enemy's forces by our Infantry. The assault battalions are charged with the latter task, and it is, therefore, the duty of the other troops, especially the artillery, to suppress the enemy's fire and thus free the assaulting battalions to advance without firing and without serious losses. When this superiority of fire is not delivered, or is not delivered in the right place, the assaulting battalions must obtain it by the means with which they are provided. This causes a check in the advance, and may even stop it entirely.

If it could be definitely determined that the enemy occupied certain positions and did not occupy others, it would manifestly be proper to confine the artillery fire to the known targets and not waste ammunition upon unoccupied areas. No intelligence system has yet reached the state whereby such accuracy can be insured. As a matter of fact, the enemy's forward area in the case of any organized position is occupied in numerous places. He shifts his machine guns and even his infantry centers of resistance from time to time. Many machine guns, anti-tank guns, 37mm guns, and mortars never fire in order not to betray their position. These conditions prevail at least as far back as his light gun lines. If the defenders have no organized rear lines, they locate themselves in every kind of position, behind crests, in woods, in front of woods, along roads, in bushes, in grain fields, and even on open areas, wherever a favorable field of fire can be found. Under such conditions it is impossible to tell definitely the spots from which his fire will be delivered. The same conditions prevail as to the location of the hostile artillery. No portion of the enemy's territory can therefore be left untouched by our artillery fire, if we give proper protection to the infantry. The infantry will therefore best be served in all cases by a dense barrage. The barrage, however, can not consist of a single line of fire. The depth of the covering fire must, at every moment of the advance, embrace all positions from which hostile machine guns can fire upon our infantry. This may be assumed as extending to a depth of not less than 800 meters from the leading wave. The best combination of fire consists of a line of 75mm high explosive shells immediately in front of the infantry; a line of shrapnel 100 meters in front of the high explosive shells concentrations and lines of 155mm and 105mm howitzer shells 300 meters in front of the shrapnel; and concentrations of 8-inch howitzers and other types of heavy guns and howitzers from 300 to 500 meters in front of the 155mm and 105mm shells. The enemy's batteries must be neutralized throughout the advance by the assignment of not less than 2 counter battery or heavy howitzers to each hostile battery.

During the progress of the infantry, batteries must be displaced forward in sufficient numbers to maintain an adequate density of fire until the final objectives are reached. During such displacement the volume of fire is reduced by the guns in motion, and an allowance must be made in any plan for a sufficient volume of fire to exist while guns are in motion.

It may be assumed that the average front over which one of our World War divisions attacked was 4 kilometers; for such a front the following proportion of guns is considered a minimum:

75mm—One gun for each 15 yards of front, 66 batteries, 264 guns.

Light howitzers—One gun for each 45 yards of front, 22 batteries, 88 guns.

155mm howitzers, 8-inch howitzers, and 9.2-inch howitzers—one gun for each 50 yards of front, 20 batteries, 80 guns.

4.7-inch guns and 155mm guns—One gun for each 100 yards of front, 10 batteries, 40 guns.

Total: 118 batteries, 472 guns.

While these figures are not exactly divisible into our organizations, the difference is not material. There must also be a certain number of super-heavy guns and howitzers for distant bombardment and the destruction of strong trench systems, command posts, etc.

To be successful in the offensive it is necessary to break the enemy's line over a front sufficiently broad to permit maneuvering. This will require, as a minimum, that the center of the attacking troops shall not be seriously affected by hostile artillery fire from the flanks. With the present range of guns, an attack to break through should cover at least 24 kilometers. Our normal attacks placed two divisions in line in each corps, and the army attacked on a front of 3 corps. It would appear, therefore, that the army front might properly constitute a basis for calculating the amount of artillery required, and for determining upon its organization and distribution among the divisions, the corps, and the army.

There is no limitation to the amount of artillery that may be assigned to a division. The war has shown conclusively that the idea of any fixed ratio of guns to men is fallacious. Artillery has been added to divisions regardless of the number of men in the divisions, and, in fact, when a division is reduced in strength the necessity for artillery increases. The infantry do not care whether the proportion is 8 guns to a thousand, or any other figure, but they do demand and rightfully so, that they shall be protected by their own artillery whether in defense or in the attack. The essential principle involved is to have sufficient guns, and to have them so administered that they can be placed where and when they are needed. The following discussion presents only one of many arrangements that might be proposed with equal advantages. The organization of the battery, the regiment, and the brigade should be preserved and is sound. It is of little consequence whether a battalion has two or three batteries, or whether a regiment has two or three battalions, or whether a brigade has three or four regiments. Our present organization of these units, however, is well understood, and it has been found satisfactory and effective. Needless changes are undesirable.

It is believed that the number of guns in each divisional artillery should be increased to *two* brigades or to 144 guns. In an army corps with 2 divisions in line and one in support, the artillery of the 3 divisions should be engaged. This would provide 432 guns of divisional artillery for the corps front. The remainder of the guns required by the army front might be apportioned as follows:

To each corps, 3 brigades or 216 guns.

To the army, 12 brigades or 864 guns.

In accordance with the foregoing apportionment, the following organization is suggested:

One Division

1 brigade—3 regiments of 75mm guns	72 guns
1 brigade—1 regiment of 155mm howitzers	24 guns
1 regiment of 75mm guns	24 guns
1 regiment of 105mm howitzers	24 guns
Total	144 guns

One Corps

1 brigade—2 regiments of 155mm guns	48 guns
1 regiment of 4.7-inch guns	24 guns
1 brigade—1 regiment of 8-inch howitzers	24 guns
1 regiment of 9.2-inch howitzers	24 guns
1 regiment of 155mm howitzers	24 guns
1 brigade—3 regiments of 155mm howitzers	72 guns
Total	216 guns

Army

10 brigades—Each brigade, 3 regiments of 75mm guns	720 guns
1 brigade—1 regiment of 105mm howitzers	24 guns
2 regiments of 155mm howitzers	48 guns
1 brigade—1 regiment of 155mm guns	24 guns
1 regiment of 10-inch and 12-inch guns	24 guns
1 regiment of 12-inch and 15-inch howitzers	24 guns
Total	864 guns

The total of guns available for a Corps front of 8 kilometers would be:

75mm

3 Divisions	288 guns
Corps	0 guns
Army, 10 regiments	240 guns
Total	528 guns
For one division front	264 guns
3 divisions	72 guns
Corps	72 guns
Army, 10 regiments	240 guns
Total	528 guns
For one division front	264 guns

105mm howitzers

3 divisions	72 guns
Corps	72 guns
Army 1/3 of 24	8 guns
Total	152 guns
For one division front	76 guns

155mm and larger howitzers

3 divisions	72 guns
Corps	72 guns
Army, 1/3 of 48	16 guns
Total	160 guns
For one division front	80 guns

155mm and 4.7-inch guns

3 divisions	0 guns
Corps	72 guns
Army, 1/3 of 24	8 guns
Total	80 guns

For one division front	40 guns
Super-heavy guns and howitzers	
Army	48 guns
For one division front	8 guns

The Army Artillery thus becomes a reservoir to supply the needs of the corps, either in a quiet sector or in an active sector, or in offensive action. This is believed to be sound. The Army should plan, supply and coordinate, but all of the combat should be conducted by the Corps. All artillery in the Corps sector should be under the Corps, whether for local action or for distant interdiction and bombardment. The Army assigns missions, and the Corps executes through its own agencies and through the divisions. This was the method followed by the V Corps during the operations for the attack of November 1, and it is believed that a maximum of results was obtained.

All sound and flash ranging and all auxiliary services should be controlled by the corps and the divisions. In the sector, as in the offensive, the corps should function to supply all the needs of the divisions. Especially, should the corps suppress the hostile artillery by a superior counter battery under all conditions.

The air observation and reconnaissance units, both airplanes and balloons, should be permanently assigned to corps and divisions as an integral part of these commands. A liberal provision of tank units should constitute an integral part of divisions and Corps. While the Corps and the divisions under my command worked in the most cordial relations and with both the Air and Tank Services, it is elementary that the greatest success will flow from unity of command and permanency of official relations.

While the foregoing estimate may appear to be large, it is believed that the War has demonstrated the necessity for such provision. In fact, the counter battery artillery is probably greatly insufficient. It has been shown in the War that such masses of artillery can be placed in position, and can be abundantly supplied with ammunition. The War has also repeatedly demonstrated that any position, however strong, can be neutralized and captured, with a sufficiently powerful fire, and that invariably the lack of sufficient superiority of fire is paid for in losses to the Infantry and even failure.

GENERAL HENRY KNOX

BY COL. OLIVER L. SPAULDING, F. A.

GENERAL HENRY KNOX was born in Boston, July 25, 1750, the son of William and Mary Anne (Campbell) Knox. His father was born in St. Eustatius, West Indies, but joined a party from the north of Ireland which settled at Boston in 1729 where he became a shipmaster and wharf owner, and lived in a two-story wooden house near the foot of Summer Street. The first two names on the baptismal record of the new church established by this party were Knox and Campbell.

Henry attended a public school in Boston until he was twelve years old when his father died leaving him the sole support of his mother and a six-year-old brother. He found employment in the bookstore of Wharton and Bowers, in Cornhill. Availing himself of his opportunities here, he did much reading and especially interested himself in military history, biograpty and engineering. His mother died in 1771. A few months before his mother's death he had opened opened his own shop—"The London Bookstore, a little southward of the Town House, in Cornhill"—which became the fashionable place of resort for British officers and Loyalist society. His principal amusement was shooting and he lost two fingers of his left hand by the explosion of his gun while hunting on Noddle's Island, now East Boston. He was always sensitive about this injury and habitually carried a silk handkerchief wrapped loosely about the hand. In the Gilbert Stuart portrait of him in the Boston Museum of Fine Arts, his left hand rests on a cannon in such a manner as to conceal the loss.

In 1769 he joined the Boston Train of Artillery, a militia company made up chiefly of shopkeepers and mechanics of the South End. British artillery officers in garrison at Castle Island took an interest in the company, and gave it instruction. It possessed, among other ordnance, three brass three-pounders, cast expressly for it in England, bearing the arms of the province; these were kept in the "gun-house" in West Street. In 1775 the commanding officer, Captain Paddock, a Loyalist, proposed to surrender them to the British so members of the company stole them and smuggled them out to the "rebel" forces. These guns were in service throughout the war, and later Knox secured their return to

Boston. Upon construction of the Bunker Hill monument they were placed there. Paddock went to Halifax with the British troops and became captain and inspector of artillery stores.

In 1772 Knox, with others of the Train of Artillery, organized the "Boston Grenadiers;" the captain was Joseph Peirce, and Knox was the senior lieutenant.

He chanced to be present at the time of the "Boston Massacre," and attracted some attention by his efforts, both with the townspeople and with the British Captain Preston, to prevent a conflict.

In 1774 he married Lucy, daughter of Thomas Flucker, Secretary of the Province. Her family strongly opposed her marriage to a tradesman and one of pronounced "rebel" tendencies.

He was under surveillance on account of his known rebel sentiments and he was forbidden to leave Boston. He escaped in disguise April 19, 1775, with his wife, who carried his sword sewn in the lining of her cloak. Reporting as a volunteer to General Ward, who commanded at Cambridge, he was used as an engineer, and made the reconnaissance on Bunker Hill upon which Colonel Prescott's orders were based. After the battle there, he was employed upon fortifications; his most important work perhaps was the redoubt at Roxbury to command Boston Neck. His wife's brother was a British officer, and he was offered a British commission, but declined. He had for a long time been studying tactics and engineering, working with Nathaniel Green, and his work on fortifications was highly praised by Washington. He was much consulted by John Adams, who sought information on various military matters, and recommendations as to officers qualified for engineering and artillery duty.

After his departure from Boston, his store was conducted by his brother William, but the family was in bad favor in Boston, which resulted in his store being pillaged and his business ruined.

In November, 1775, upon his own suggestion, he was sent to Ticonderoga to bring back the guns captured there. He went by way of New York, taking twenty days en route. He stopped one night at a small cabin on Lake George and shared a room with the British lieutenant John Andre who had been captured by Montgomery at St. Johns and who was on his way, on parole, to Pennsylvania to await exchange.

GENERAL HENRY KNOX

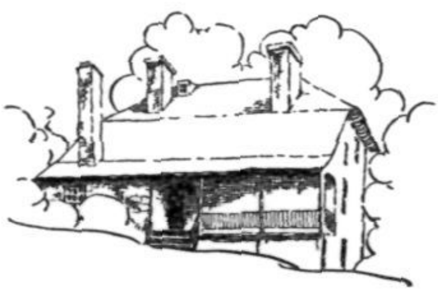
From Ticonderoga Knox brought back 55 guns and mortars, mostly heavy. The route was by water to the head of Lake George, then by sledges with oxen and horses, via Albany, Kinderhook, Great Barrington and Springfield, "by roads that never bore a cannon before and never have borne one since." He was delayed by lack of of snow, and by a thaw which prevented his crossing the Hudson River. The route is now marked by permanent tablets. Finally he reached Cambridge on January 24, 1776. His expense account shows a total of £520.15.8¾. Some of his detailed instructions for packing

and handling the property still exists. He was commissioned Colonel Commanding the Regiment of Continental Artillery, November 17, 1775, but the commission did not reach him until after his return from Ticonderoga.

The guns were at once mounted in batteries at Cobble Hill, Lechmere's Point and Roxbury and on the night of March 1, 1776, they opened fire. Under cover of this fire General Thomas occupied and fortified Dorchester Heights, completing the investment of Boston and compelling its evacuation on March 17. Of some local interest is the medal struck by authority of Congress to commemorate the evacuation. The name of the city appears in the form Bostonium, instead of Bostonia, as is more usual.

Knox went with Washington to New York, and upon the occupation of that place by the British, Knox superintended the removal of the ordnance stores. He was one of the last to leave, escaping in a boat.

At the crossing of the Delaware he was in charge of the embarkation of the army. Promoted Brigadier General and Chief of Artillery on December 27, 1776, he was engaged in the battles of Princeton, Brandywine and Germantown. With DeKalb and St. Clair he visited Forts Mercer and Mifflin which commanded the mouth of the Delaware and hampered the British communcations with Philadelphia and endeavored, but unsuccessfully, to put these forts in condition to maintain themselves. He particularly distinguished himself at the battle of Monmouth, receiving the formal congratulations of Washington. Then, under Washington's orders, he began the preparation of ordnance for an attack upon New York. Progress however was slow, and upon the arrival of the French fleet the army was moved south and the New York operations given up. Knox, being one of the few American general officers who could speak French, was with Washington in all conferences with Rochambeau. He went with the army to Yorktown, was active in that siege and was present at the surrender on October 19, 1781. He became Major General on March 22, 1782, and was one of the commissioners for the exchange of prisoners.



Headquarters of General Knox at Newburg, N. Y.

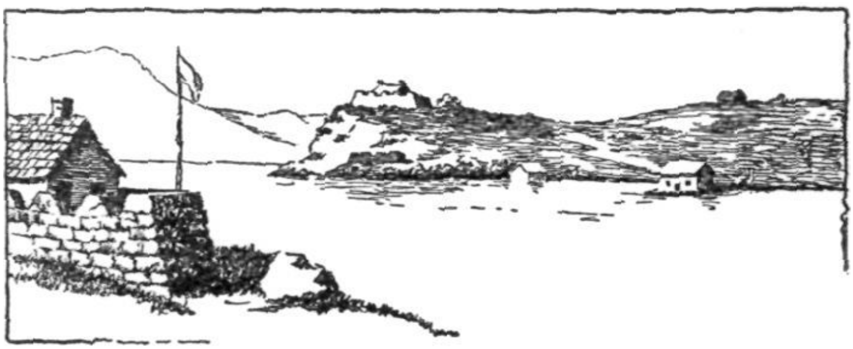
From August, 1782, to January, 1784, he was in command at West Point which was regarded as the "key of America" and strengthened the fortifications.

Throughout the war he was noted for his insistence upon a strongly centralized military organization and he put great emphasis on the establishment of arsenals and on military education. As early as September, 1776, he referred in correspondence to these matters and in the same month, he submitted to Congress a memorial on military affairs which included recommendations for the establishment of a military academy on the lines of the British college at Woolwich. During that winter he made recommendations to Greene and to Washington for the construction of workshops at Springfield, which were the beginning of the present arsenal there. During the winter of 1778-9 his artillery camp in New Jersey drew attention for its neatness and regularity. One side of a rectaigle was occupied by the gun park and the other three sides had huts for quarters of officers and men. On the central parade were workshops for repairs and for practical instruction, and an "academy" with a lecture hall 50 by 30 feet for theoretical instruction. While at West Point he drafted a plan for military organization which included three military academies, one for the Northern, one for the Middle and one for the Southern States. During the same period he founded the Society of the Cincinnati, of which he was Secretary, 1783-1800, and vice-president, 1805-1806. He was always much in evidence at Washington's headquarters, a very intimate and trusted friend. He was one of the biggest and most conspicuous men in that group of big and conspicuous men—he was over six feet in height and weighed 280 pounds.

Upon Washington's withdrawal from the army, Knox remained in command, and he had charge of its disbandment. When the British troops evacuated New York, November 25, 1773, he commanded the American force which took possession. Finally in January, 1784, he relinquished command at West Point and retired to Boston, taking up his residence in Dorchester. He was one of the commissioners sent to the present state of Maine to negotiate with the Penobscot Indians and to settle the eastern boundary of New England.

In 1785 General Knox became Secretary of War under the Confederation, and upon Washington's inauguration as President he retained this office in his cabinet. His department included both land and naval forces. He always urged a strong army and navy and a thorough system of coast defense. Knox drafted a plan for a Federal militia, with universal service, but was unable to secure its adoption. Indian affairs also were under his department; in 1790 he negotiated treaties with the Indians concerning lands in Georgia and Tennessee. Fort Knox, now Knoxville, was established at this time.

In 1795 he resigned, being unable to support his family on his pay. He took up his residence on a large tract of land near Thomaston, Maine, and engaged in real estate development. He lived pleasantly and even lavishly, but accumulated no large fortune. Many distinguished foreign visitors to the country were entertained on his estate. He died there October, 25, 1806.



West Point from Constitution Island, 1776

MOBILE RADIO FOR FIELD ARTILLERY

BY LIEUT. GEORGE F. WOOLEY, Instructor, The F. A. School

DURING the 1931 General Field Exercises, which were a part of the various courses at the Field Artillery School, a great deal of interest was exhibited by both student officers and enlisted specialists in the operation of radio wagons and radio trucks assigned units of the Field Artillery brigade. These vehicles which operated so efficiently have been developed and improved by various individuals who have been on duty at the School. Great credit should go to Master Sergeant C. Burleson, F. A. S. Det., for his clever work of installation. At the present time, the Electrical Laboratory boasts of three radio wagons and a radio truck, each of the School regiments has a radio wagon, and all of them see a great deal of practical service under varied conditions in the Spring of each year.

Field Artillery units have heretofore been issued a light spring wagon or a truck for the transportation of radio equipment, which has been unsatisfactory from a technical standpoint. High priced radio sets and equipment were loaded into this vehicle together with officers' bedding rolls, spare wire, hay bales, and various articles whose sole purpose was to hold down the white elephant of a radio set in going over rough roads. There has always been considerable delay in establishing the radio station from march formation, also in dismantling the station and packing preparatory to a change of location. As for keeping in touch continuously during a tactical displacement with organizations either in position or on the march, that was impossible without, of course, setting up the 175-foot V-type antenna furnished with the SCR 109-A.

There is urgent need for a change in the transportation of Field Artillery radio equipment. Whereas our present issue radio sets are antiquated, that is no valid reason why we should transport them in ox-carts or fail to use them to the fullest extent possible. One of these days we will receive the newer, more up-to-date sets, the SCR 131 and SCR 161 (the latter recently approved in its final form by the Chief of Field Artillery), and antiquated transportation methods should be promptly discarded if the proper tactical use is to be made of the new and contemplated radio equipment. Should the light artillery battalion ultimately find itself with six radio sets, there should be service experience behind our radio vehicles in order to provide at once without experimental tedium for the proper performance and tactical employment of these sets.

Now what constitutes a proper radio vehicle for a Field Artillery organization? Opinions may differ, but one having the following essentials would most certainly improve the use of radio as a signal agency.

1. Light in weight.
2. Extreme mobility.
3. Clearance high enough to overcome cross-country obstacles.
4. Distributed weight and low to prevent overturning.
5. Turning radius of 90 degrees.
6. Sufficient strength to carry required load (sets, radio operators, and driver) over all obstacles likely to be encountered.
7. Shock absorbers and good springs to minimize road shocks.
8. Camouflaged.
9. Efficient inside antenna eliminating use of regular type of outside antenna.
10. Suitable hand generator installed for inside use to replace storage batteries with present sets.
11. One radio set complete installed in the vehicle for use under any and all conditions. Storage space for one or two other sets and spare parts.
12. Sufficient artificial light, ventilation and comfort to permit radio personnel working safely at night in closed, light-proof vehicle during marches near hostile forces.

The radio vehicles of the Field Artillery School have few of the specifications listed in the preceding paragraph due to the shortage of proper material with which to experiment, but they have made a step in the right direction and results obtained from them are rather startling at times. It causes one to speculate as to the unlimited possibilities of a radio vehicle properly designed and constructed for the purpose. So many inquiries have been received from interested officers regarding constructional features of the School radio vehicles that the following description is passed along to assist in further experimentation and improvement of the radio transportation problem where the means and the necessary permission are available.

THE RADIO WAGON

The Body and Running Gear is that of the standard animal drawn army ambulance.

The Antenna consists of twenty-four wires, two inches apart, the full length of the top just under the bows. Cross connection is made about eighteen inches from the front end with lead-in wire to the center of the cross connection. Ends of wires are held in drilled bakelite strips bolted to the inside of the top at each end. The wires are kept from swaying by passing through holes in separator boards fastened to the bows. The antenna is protected by a false ceiling of three-inch wood strips, two inches apart, fastened to the separator boards.

The Counterpoise consists of twenty-four wires, two inches apart, running the full length of the body under the bed. The wires are fastened to drilled bakelite strips at each end of the wagon. Cross connection is made at the front end with lead-in wire soldered at the center of the cross connecting member. The swaying of wires is prevented by notched separator boards fastened to the cross members of the wagon body.

The Insulated Sound Ranging Wire is used for both antenna and counterpoise. This wire is composed of seven copper (tinned) strands, No. 21 B & S, with heavy rubber and fabric insulation.

A Transverse Partition, two inches in rear of the driver's seat, extends from the seat (extended) to the roof.

A *Shelf,* twenty-two inches wide and twenty-eight inches above the bed of the wagon, extends across the wagon just in rear of the front partition.

A *Wood Panel* is placed vertically at the left side of the shelf and fastened to the bow braces. This panel carries the various switches and connections necessary for the operation of the set. A similar wood panel on the right side of the shelf serves to prevent articles from slipping from that side of the shelf. Papers of interest to the radio operators may be posted upon this panel.

The *Radio Set, type SCR 109-A,* is mounted on the shelf, being held in place by cleats nailed to the shelf to fit around the carrying chest, type EE-49.

The *Battery Containers* consist of longitudinal box seats with hinged covers built against the sides of the body. These boxes extend from the tailgate forward to a point just below the rear edge of the shelf. Seven batteries are carried in each container. The bottoms of the boxes have wood strips nailed on to fit the type of battery used. These strips separate the batteries and prevent their shifting about. The interior of these containers is painted with acid resisting paint.

Wiring. The main control is by means of two double pole double throw switches mounted on the switch panel (left side of wagon). The upper switch controls the antenna equipment to be used, and the lower switch the bank of batteries to be used. The auxiliary terminals for the standard outside antenna and counterpoise are mounted in the upper left corner of the switch panel. For wiring diagram, see Figure 1.

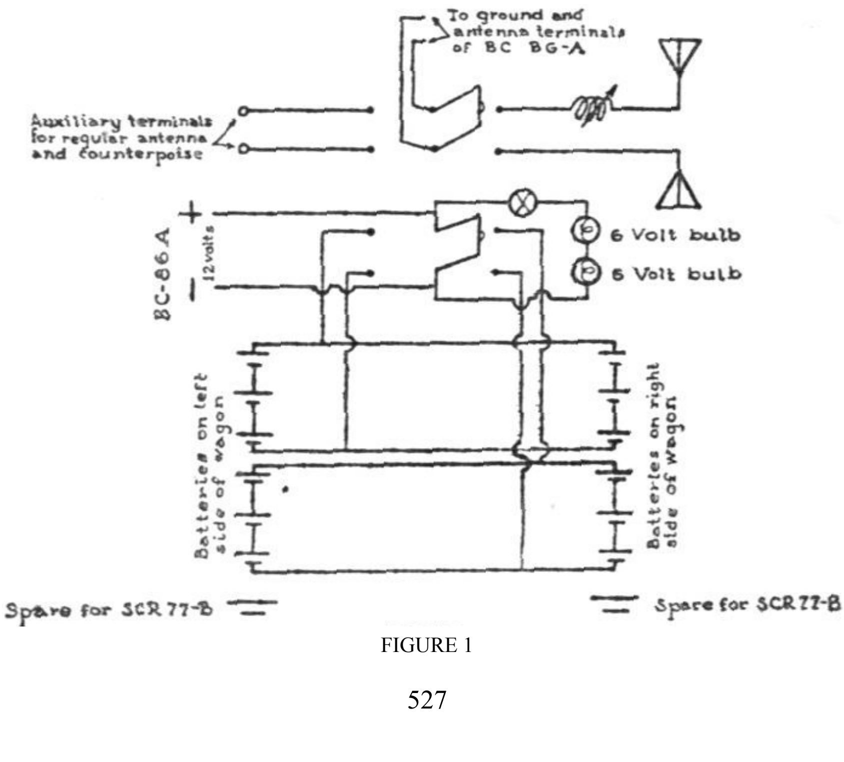


FIGURE 1

Wave Length Regulation. When using the antenna in the top of the wagon, it is necessary to add inductance to the antenna system in order to cover the normal wave-length band. A coil (part of a variometer, type VA-3A) is introduced into the lead from the antenna to the double pole, double throw switch. This coil has a sliding contact which permits tuning of the set over the normal wave-length band. This coil is mounted in the angle formed by the front partition and the switch panel.

The *Coil* used consists of eighty-eight turns of bare copper wire, No. 18 B & S, space wound on a fiber tube 3.95 inches in diameter, length of coil five and one-half inches. A sliding contact permits varying the number of turns from zero to the total of eighty-eight. The inductance of the coil is approximately 375 microhenries.

Electric Lights are supplied directly from the bank of batteries in use, two 6-volt bulbs in series being employed. These bulbs are suspended from the ceiling in such a manner as to light the face of the set.

The *Dynamoter and Wavemeter* are carried on the shelf at the right of the set.

The *Jockey Box* is divided by a transverse partition four inches in front of the rear wall. Space in rear of the partition is used for panel equipment and that in front for the antenna and counterpoise bags.

The *Carrying Chest,* type BE-50 is carried under the shelf. Adequate room remains for carrying two SCR 77-B sets.

The *Mast Sections* for the issue antenna equipment are carried in the litter brackets on the outside of the ambulance.

As to results obtainable from a wagon such as this, the following has been obtained at Fort Sill under average conditions.

Between radio wagon and fixed ground station

Voice	Limit—about	20 miles	Gait—trot	Good results
CW and ICW		30 miles	Gait—trot	Good results

Note: Limit for CW not definitely established. Limit for ICW about 30 miles.

Between two radio wagons

CW, ICW, Voice	6 miles	At walk and trot	Good results

Note: Limits not definitely established.

Between radio wagon and airplane

ICW, Voice	8 miles (limit of test)	Good results

It was found also during these tests that the radio wagon is slightly directional, transmitting and receiving best in the direction of travel. Signal strength is materially affected by location in or passage under thick foliage or by passage through metal structures, such as a steel truss bridge.

The principles employed in the construction of a radio truck follow closely those already described for the radio wagon. Certain differences due to the basic difference between vehicles are described below.

THE RADIO TRUCK

The *Body and Running Gear* is that of the standard GMC motor army ambulance.

The *Antenna* is similar to that used in the radio wagon.

The *Counterpoise* consists of twenty-six wires spaced one inch apart. These wires run beneath the floor and extend from the wood cross brace in rear of the gas tank to the wood brace at the rear of the body.

The *Battery Containers* rest on the raised portions above the rear wheels. The construction of the box seats and wiring differs slightly in principle from that used in the radio wagon.

A *Charging System* has been incorporated in the radio truck. A standard Dodge 12-volt generator is securely fastened to the left side of the engine body. This generator is driven by a belt from the fan pulley. The positive side of the generator is connected to a voltage regulator mounted under the shelf. This voltage regulator is connected to one of the center contacts of a double pole double throw switch mounted on the switch panel. The negative side of the generator is connected to an ammeter (10 amp. DC) mounted on the switch panel. The ammeter is connected to the other center contact of the switch mentioned above. The outer connections of the charging switch are connected to the battery switch, pair by pair. The wiring diagram of the charging system is shown in Figure 2.

Operation of the Charging System. Normal running of the truck will keep the batteries charged. When the set is being used the charging and battery switches are thrown in opposite directions.

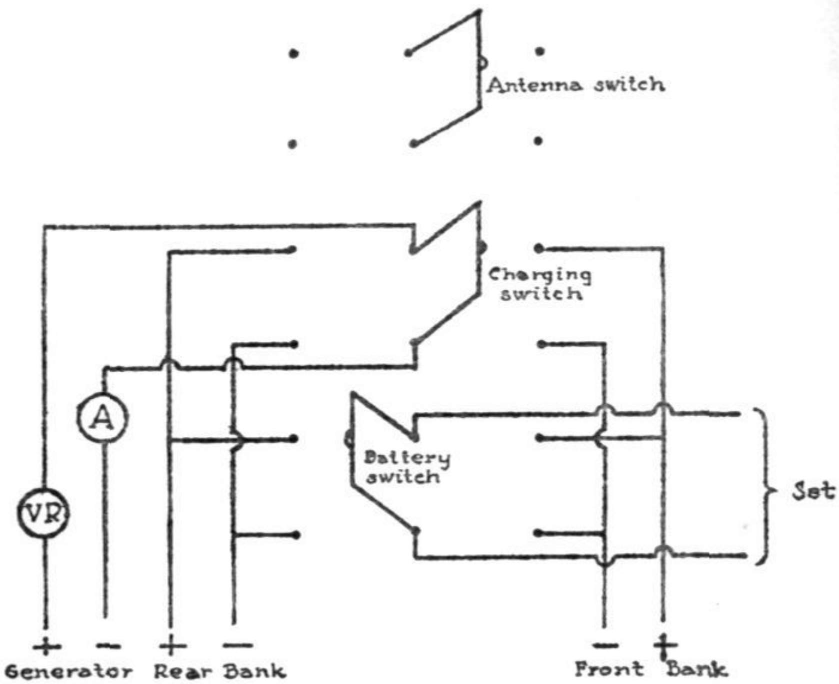


FIGURE 2—WIRING DIAGRAM

For instance, when the front bank of batteries is being used to operate the set, the rear bank is on charge.

Operation of the Radio Truck. A slight hum is heard when the charging plant is in operation, but the noise is not sufficient to be objectionable except possibly in receiving a weak signal. The slight noise from the spark plugs is not of sufficient intensity to be objectionable. Better results have been obtained by grounding the frame of the truck by means of a drag chain. Two precautions should be observed:

(1) The battery charging switch should not be opened when the generator is charging at a high rate (8 amps.).

(2) If the truck is to be driven with the batteries out or the charger not in use, the fuse on the generator should be removed.

Experience to date has been that the truck gives just as satisfactory results as the wagon and, owing to certain constructional advantages of the body, is generally favored by the student radio operators over the wagon. During the progress of a General

Field Exercise at this School, the storage batteries were kept in serviceable condition throughout the week by means of the radio truck's charging system. Some charging, however, was necessary while in camp in addition to the running of the radio truck on the road. The radio truck handled a large volume of radio traffic throughout the entire period.

MODIFIED RADIO TRANSMITTER, TYPE BC 86-A

The SCR 109-A transmitter, as modified by the School, is used in the radio wagons and trucks described in preceding pages. Trouble has always been experienced with the buzzer furnished as part of the SCR 109-A equipment. The use of CW in radio nets is, of course, normal, but there are times at the School when radio traffic has to be cleared during marches or field exercises when CW cannot be read; as, for instance, during or preceding a storm when ICW sent slowly stands the only chance of being understood at the receiving station through the static. At such times, the buzzer, due to mechanical troubles, has a bad habit of stopping in the middle of a transmission and causing exasperating delay while the key operator taps or adjusts it before it will again function. The Field Artillery School has eliminated this trouble entirely by substituting for the buzzer a motor alternator type GN-33 which takes up very little room at the rear of the transmitter.

The motor alternator is mounted below the aluminum container for the two biasing batteries. Four holes are drilled through the bottom of the container and the motor alternator is suspended by machine screws. A small resistance unit, of sixty ohms is mounted with screws to the bakelite strip forming the top of the battery container.

In the figures which follow, Figure 3 shows the lower right portion of Figure 8 of Radio Communication Pamphlet No. 27 (Sets, Radio Telephone and Telegraph, Types SCR 109-A and SCR 159-A).

Figure 4 shows in broken lines the connections to be removed.

Figure 5 shows the connections removed.

Figure 6 shows schematically the transmitter completely wired with motor alternator replacing the buzzer.

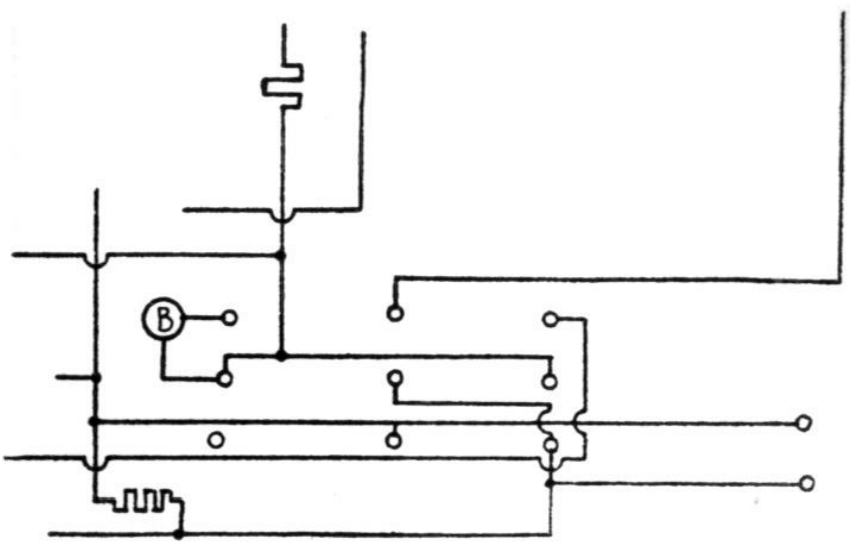


FIGURE 3—SCR 109-A BUZZER CONNECTIONS

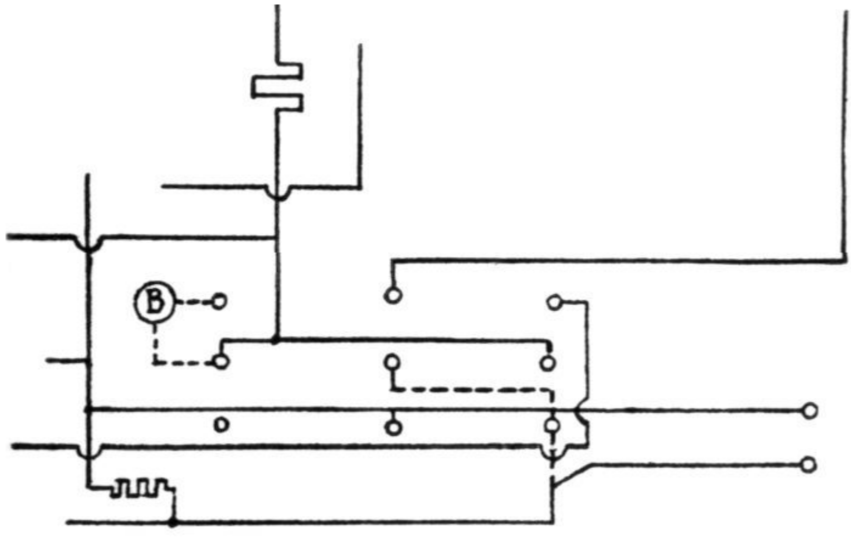


FIGURE 4—CONNECTIONS TO BE REMOVED

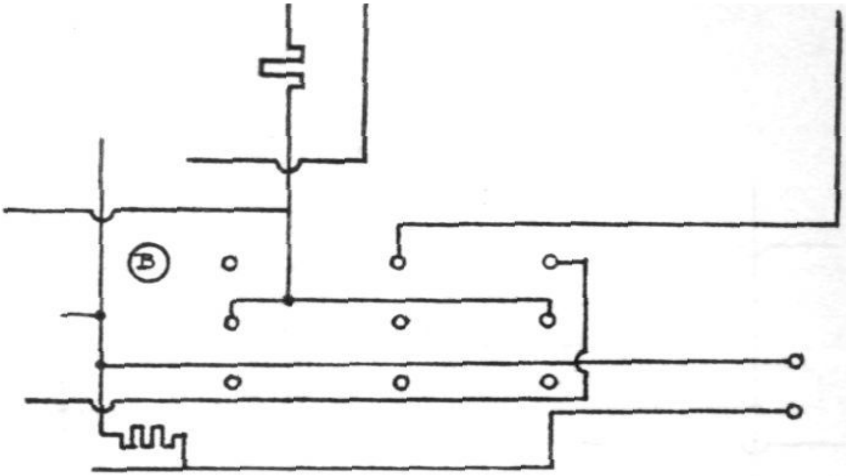


FIGURE 5—BUZZER CONNECTIONS REMOVED

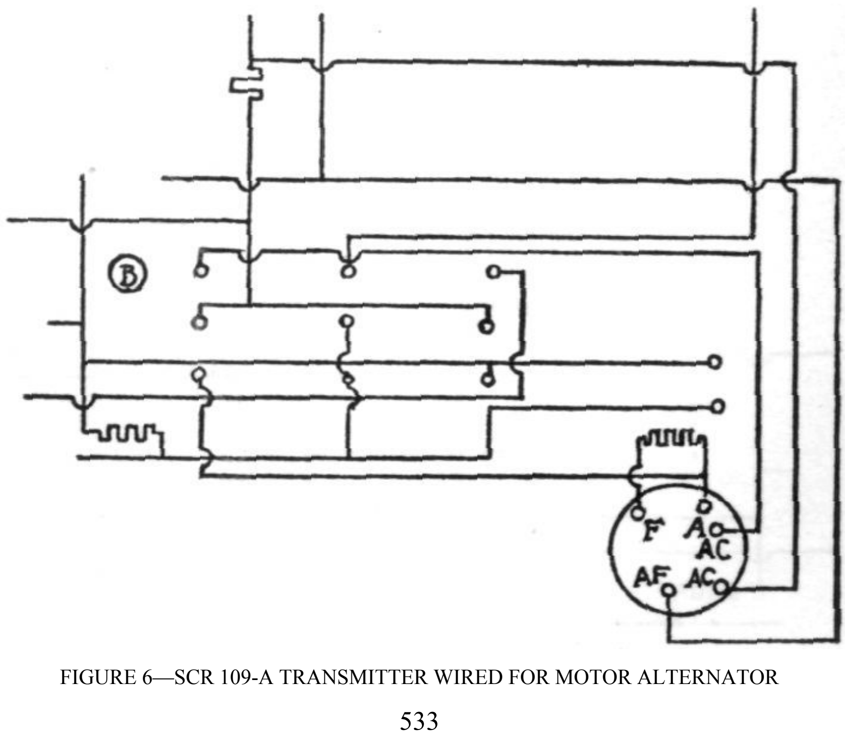


FIGURE 6—SCR 109-A TRANSMITTER WIRED FOR MOTOR ALTERNATOR

The modified set is operated in the same manner as the normal set. When the small three-pole, double throw switch is thrown to the right, the motor alternator is used in place of the buzzer. Using ICW, the modified set is found to function perfectly.

CONCLUSION

The Field Artillery has a crying need for new and improved means of transporting its radio equipment. Next to the replacement of our antiquated radio sets with up-to-date equipment, the problem of radio transportation justifies prompt action if we are to keep abreast of the times.

The old spring wagon furnishes meager transportation facilities adequate possibly for stabilized warfare, but inefficient and inadequate for a war of movement. As examples of what may be accomplished with a mobile radio set and self-contained antenna, take the following. In an advance guard action, the artillery battalion commander may, where the situation permits, send his battalion radio wagon to a battery which has dropped out of column for action, and by means of airplane adjustment, cause fire to be brought down immediately on enemy targets, breaking up their formations, and expediting the progress forward of our own forces. In the forward displacement of units of the Field Artillery brigade during certain situations, the commanders can keep in constant touch with each other or with airplanes on surveillance missions, provided the units are equipped with a mobile radio set.

There are innumerable advantages of the mobile set with self-contained antenna as distinguished from the present "fixed type" of radio set which must be out of action until the regulation antenna is set up and the set unpacked. For present Field Artillery use, we need mobile radio for command, liaison, and adjustment; fixed radio for work with the Infantry when the Artillery is in position. Such an arrangement would give us available facilities, where the enemy situation permits, for clearing radio traffic on the march as readily as in bivouac, thus saving the slower messengers for emergencies; of bridging the gaps during a wire installation or where wire has to be recovered incident to a move; and permit a much more flexible and efficient use of radio than at present.

AUTOMATIC RIFLES FOR DEFENSE AGAINST AIRCRAFT

BY MAJOR ROBERT G. KIRKWOOD, 3rd Field Artillery

THE increased effectiveness of aircraft and the probable extensive use of attack aviation in war have added impetus to the study and development of antiaircraft defense. Friendly aircraft, in sufficient strength, used offensively, should constitute a strong air defense; but defense against air attack by ground troops cannot be neglected with safety.

Antiaircraft artillery has made great strides since the World War. Its effectiveness has been materially increased. Although it will no doubt be used to protect troops in forward areas and on the march as well as rear areas and establishments, there is a growing realization that ground troops must be prepared to defend themselves against air attack with their own weapons. The effect of an attack from the air on the morale of ground troops will be lessened in proportion to the confidence those troops have in their ability to protect themselves with the weapons at hand.

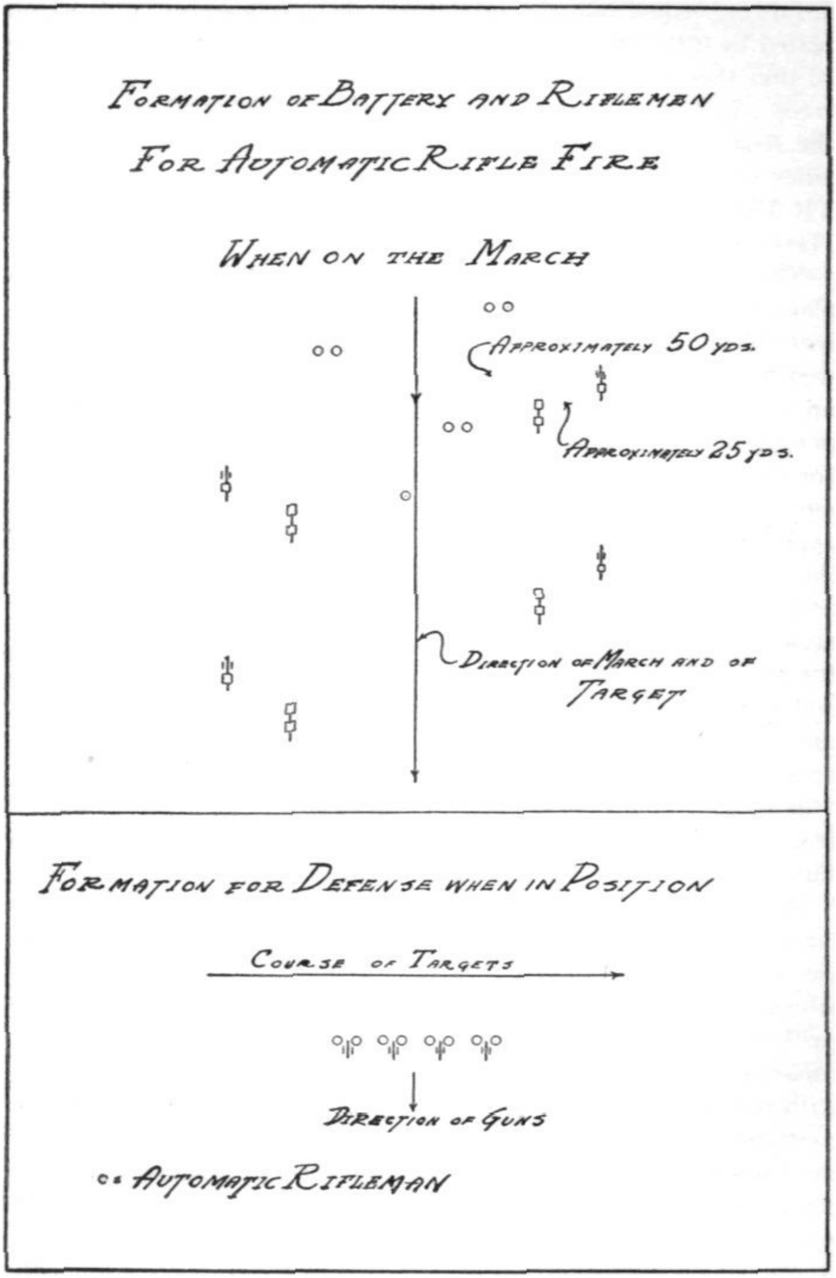
It has been demonstrated that Infantry, trained in the use of rifles and machine guns against ground targets, can, with additional training, use these same weapons effectively against low flying aircraft. Field Artillery has been equipped with machine guns for antiaircraft defense for some time. Recently Browning automatic rifles were issued to certain Field Artillery units in each corps area for use in the study and development of means of defense of Field Artillery troops against low flying airplanes.

In the Fifth Corps Area, Battery "B," 3rd Field Artillery, Captain C. D. Parmelee, commanding, was designated to make the tests. An automatic rifle detachment was organized, consisting of 2nd Lieutenant J. H. Rothschild, two non-commissioned officers and ten men. This detachment was trained progressively. The instruction covered five phases or periods of varying lengths. The first period, based on TR 320-25, familiarized the men with the mechanism and operation of the Browning automatic rifle. The second period was used for position and aiming drills and sighting exercises, based on TR 150-10. The antiaircraft instruction proper began with the third period which was devoted to target practice with .22 caliber rifles, borrowed from the 11th

Infantry, using moving miniature airplane targets as contemplated by TR 300-5. The targets were improvised and arranged so that they moved along inclined wires which were strung from trees. In the fourth period, in addition to reviewing the work of the first and second periods, target practice with the automatic rifles was conducted on the 1000-inch range, as provided for in TR 150-30. The first four periods were held at Fort Benjamin Harrison, Indiana.

The last or fifth period was the most interesting. It took place at Camp Knox, Kentucky. All the preceding instruction was in preparation for it. In this period the detachment first went out with the mounted battery. The battery practiced taking up scattered formations from the march; and the detachment practiced dismounting from the carriages and taking position for firing on hostile airplanes. Klaxons, borrowed from the motor transport, were tried out as signals to give warning of approaching airplanes. They proved unsatisfactory because they could not be heard throughout the battery column above the noise of the carriages. There is need for a device, which can be attached to caisson chests and which will give a sharp shrill noise, for use as a warning signal. The battery commander used whistle and arm signals with satisfactory results. After blowing a warning blast on the whistle, the arm signal—large horizontal arcs made rapidly with the extended arm—was given. The arm signal to have the battery resume the normal order of march from the scattered formation, was large vertical arcs made slowly with the extended arm.

With the battery in march, at the signal to take up the scattered formation for defense against low flying airplanes, which we will call *formation for air defense,* the alternate sections wheeled sharply to the right and left, respectively, as far off the road as practicable up to a distance of one hundred yards. The caissons did not follow their pieces in trace, but were staggered with respect to the pieces. After clearing the road the march was continued as soon as practicable. The controlling idea in forming the march column for air defense was to clear the road, keep scattered, and, whenever practicable, continue the march. With a route of march along roads with fences on either side, mounted troops will not, in the time available, be able to leave the roads


FORMATION OF BATTERY AND RIFLEMEN
FOR AUTOMATIC RIFLE FIRE
WHEN ON THE MARCH
APPROXIMATELY 50 YDS.
APPROXIMATELY 25 YDS.
DIRECTION OF MARCH AND OF TARGET
FORMATION FOR DEFENSE WHEN IN POSITION
COURSE OF TARGETS
DIRECTION OF GUNS
○ = AUTOMATIC RIFLEMAN

far enough to obtain the protection offered by a scattered formation. In any case, troops should be armed and trained to "shoot it out" with the attacking airplanes.

In these tests automatic riflemen were mounted on caissons throughout the column. At the warning signal, or upon arm signal by the battery commander, automatic riflemen jumped to the ground and immediately took position for firing on approaching airplanes. With a little practice automatic riflemen jumped to the ground from carriages moving at a trot with no bad effects to man or rifle. However, this part of the instruction emphasized the need for a lighter automatic weapon. The weight of the Browning automatic rifle was an encumbrance and handicap to men dismounting rapidly from carriages. Having dismounted, the automatic riflemen made no effort to leave the road, but prepared to fire immediately. Airplanes attacking columns will do so from the rear when possible, with a suddenness and speed which will permit no avoidable delay, if their fire is to be returned. Fire from moving caissons is impracticable because of the unsteadiness and resulting inaccuracy.

Firing at free balloons and at sleeve targets towed by airplanes was also part of this last phase of training. Eighteen-inch balloons were used, and although they bobbed around considerably when moving with the wind the men soon learned to take the proper lead to hit them. In the first trial, out of nineteen balloons released sixteen were hit. Seven men were firing. In the second test, twelve balloons were released, and, firing at distances from one hundred to three hundred feet, all were hit.

On June 3, 1931, the final tests, firing at sleeve targets towed by an airplane, were witnessed by the Corps Area Commander, Major General Dennis E. Nolan, the Camp Commander, Brigadier General George H. Jamerson, and a representative of the Office of the Chief of Field Artillery, Lieutenant Colonel William Bryden.

In these tests the battery first took up the air defense formation from the march. Because the automatic riflemen were scattered in depth along the column, for safety, they were dismounted and in place before the plane arrived over the battery. The plane approached from the rear of the column and towed the sleeve about two hundred feet above the ground at the end of an eight-hundred-foot cable. The speed of the plane was approximately eighty-five miles per hour. The men with the automatic rifles—there were seven of them—were given the signal to fire by an officer when the plane itself was above the battery. They fired at the sleeve until it was nearly over their heads, when cease firing was given. The plane made one "dry run" during which no shots were fired. In three "live" runs, in this formation, a total of eighty-four shots were fired by the seven men and twenty-eight hits were scored; that is, one-third hits. The lead used was about twice the length of the sleeve as observed by the automatic riflemen. A little more lead probably would have put more of the hits in the forward part of the sleeve which represents the more vital part of the airplane.

The battery then took a position in line, unlimbered, and prepared for action. The plane approached from the right flank and towed a sleeve target slightly in rear of the battery and about two hundred feet above the ground. In three "live" runs ninety rounds were fired by the seven men armed with automatic rifles, and thirty-three hits were scored; that is, more than one-third hits. The lead taken was one sleeve length and was about right because fifteen of the thirty-three hits were in the forward third of the target.

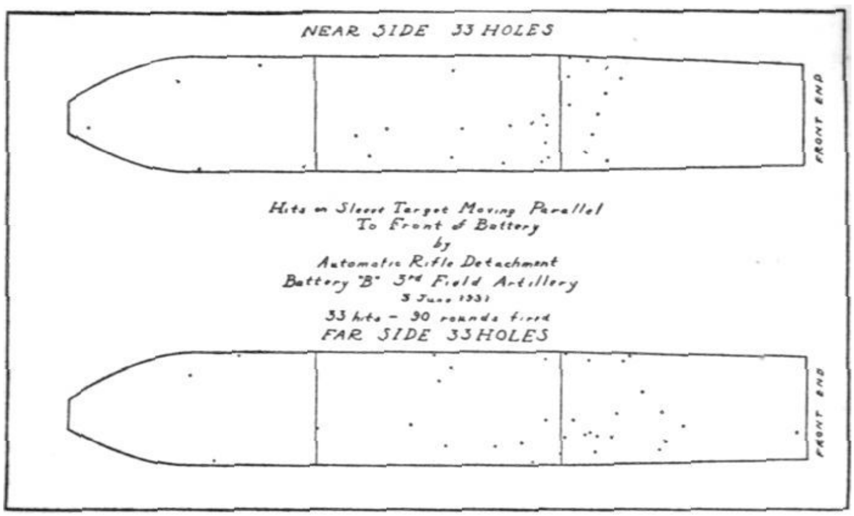
The detachment showed keen interest and considerable skill in their work. All present were intensely interested in the shooting and the results obtained. Major General Nolan and Brigadier General Jamerson both took an active part in pointing out the holes in the sleeve target as the hits were counted.

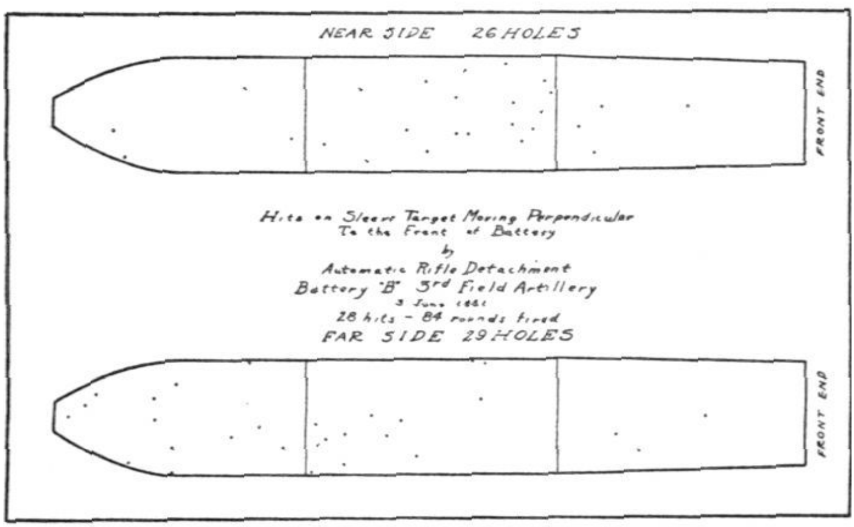
General Nolan complimented the work of the detachment and stated that the results showed careful preliminary training.

The success of the tests was furthered materially by the excellent cooperation from the Air Officer of the Fifth Corps Area, Major H. C. Kress Muhlenberg, and the pilot of the plane used, First Lieutenant Stanton T. Smith, A. C.

As a result of the tests, it was concluded that an automatic rifle could be used effectively by Field Artillery troops against hostile low flying airplanes, but that the Browning automatic rifle, as issued, was too heavy. A lighter weapon with similar fire power could be handled to much better advantage by men jumping off carriages and firing at high angles.

One excellent result of the tests was the evident confidence aroused in the men in their ability to defend themselves against attacks by low flying airplanes. If the moral is to the physical as three is to one, such confidence will be a vital asset in war.





TYPE PROBLEMS

Precision Lateral (Large T)

(T.R. 430-85, 1930 Edition)

Target Description: Concrete machine gun emplacement. Mission: To destroy. Materiel: French 75mm gun Model 1897. Visibility: Excellent. Wind: Negligible. Initial data obtained: Deflection and range by plotting. Observer on the right. T = 400, R = 5.1, r = 4.8, s = 8, d = 9, c = 7, c/d = .8, c/s = .9 from tables.

Initial Commands:

Base deflection Left 45
Shell Mk I
Fuze Long
No. 3, 1 rd.
Quadrant 220.

c/s c/d
9/10 8/10

Commands	Elev.	Rd. No.	Dev. from O.P.	Sensing Rn.	Sensing Df.	Remarks
No. 3, 1 rd. Quad.	220	1	12 Right	+	?	12 × .8 = 10
	210	2	Line	+	+	30 × .9 = 27
Rt. 30	183	3	4 Left	–	–	4 × .8 = 3; on line at 186
Lt. 15	198	4	Line	–	–	
Lt. 8	204	5	Line	–	–	
Lt. 4, 3 rds	207	6	3 Right	+	?	Fork = 8
		7	10 Right	+	?	
		8	Line	+	+	
Rt. 2, 2 rds.	203	9	3 Left	–	?	
		10	Line	–	–	
Lt. 1, 6 rds.	204	C. F.				

Summary: Errors in initial data: Deflection 4 mils; Range 200 yds. or 4%. Time from identification of target to announcement of first range, 2 minutes 15 seconds. Average sensing and command, 18 seconds. Total time of problem, 6 minutes 10 seconds. Ammunition expended 10 rounds. Classification: Satisfactory. General comments: Procedure excellent, time very good.

Precision Lateral (Large T)

Target Description: Concrete bridge over small stream. Mission: To destroy. Materiel: French 75mm gun Model 1897. Visibility: Excellent. Wind: Down Range. Initial data obtained. Deflection: Prismatic compass. Range: Estimated. Observer on the right. r = 3, R = 4, T = 600, c = 5, c/d = 5/20, = ¼, c/s = 5/15 = 1/3.

Initial Commands:

No. 3, adjust
Compass 4880
Shell Mk. I
Fuze short
No. 3, 1 rd.
Quadrant

Commands	Elev.	Rd. No.	Dev.	Sensings		Remarks
				Rn.	Def.	
	130	1	100 L	?	?	
	155	2	30 R	?	?	c/d = 25/130 = 1/5
	149	3	Line	–	–	
Left 120	189	4	15 L	?	?	
	192	5	5 R	+	+	
	(191)		(On the line)			Not fired
Right 60	170	6	5 R	+	+	
	(169)		(On the line)			Not fired
Right 30	159	7	Line	–	–	
Left 15	164	8	5 R	+	?	
	163	9	2 L	+	?	Unnecessary to shoot over, forced def. (+)
	163	10	Line	+	+	
Right 8, 3 rds	161	11	4 L	–	?	
		12	3 L	–	?	
		13	Line	–	–	
Left 4, 1 rd.	164	14	Line	+	+	Unnecessary
Right 2, 3 rds.	162.5		Cease firing, end of problem.			

Summary: Error in initial data: Deflection, 39 mils. Range, 582 yards. Time from identification of target to announcement of first range, 2 minutes 15 seconds. Average sensing and command, 28 seconds. Total time of problem, 12 minutes. Ammunition expended, 14 rounds. Classification: Satisfactory. General comments: The officer firing was slow in sensing and command. It was unnecessary to shoot 163 over again (tenth round) as he had a forced deflection sensing. Also it was unnecessary to shoot the fourteenth round 164 as he had two overs at 163 and one at 164, which could all have been assumed fired at 164.

Percussion Bracket (Large T)

Target Description: Enemy machine guns in the open. Mission: To neutralize. Materiel: French 75mm gun Model 1897. Visibility: Very good. Wind: Left to Right. Initial data obtained. Deflection: Estimated. Range: Estimated. Observer on the right. r = 3, R = 4, T = 640, s = 16, d = 21.

$\frac{1}{s} = \frac{100}{16}$

$\frac{1}{d} = \frac{150}{21}$

Initial Commands:

Base deflection, Left 140
Shell Mk. I
Fuze long
No. 2, 1 rd.

Commands	Range	Rd. No.	Dev.	Sensings Rn.	Sensings Def.	Remarks
	4,000	1	20 R	+	+	Deviations noted, but not sensed
	(3,900)		(On the line)			Not fired
Right 100	3,300	2	35 R	–	(–)	Forced deflection
	(3,100)		(On the line)			Not fired
Left 50 B.R.	3,500	3	10 R	?		
		4	Line	+		
		5	Line	+	+	
		6	8 L	?		
Right 25						
On No. 2, open 4						
Btry. 1rd. Zone	3,300		Cease firing, end of problem.			
	3,500					

Summary: Errors in initial data. Deflection, 75 mils. Range, 600 yards. Time: No timekeeper used. Ammunition expended, 6 rounds. Classification: Satisfactory. General comments: An excellent problem. The officer firing took all possible sensings and acted promptly on them.

Percussion Bracket (Large T)

(T.R. 430-85, 1930 Edition)

Target Description: Machine guns in the vicinity of a small bush. Mission: To neutralize. Materiel: French 75mm gun Model 1897. Visibility: Very good. Wind: From left to right, about 10m.p.h. Initial data obtained: Deflection and range by plotting on a "relocator sheet." Observer on the right. T = 475 mils, R = 4.8, r = 3.6, s = about 10, d = about 15.
Initial Commands:

Base deflection Right 75

on no 2 op 3

Site +5
Shell Mk. I
Fuze long
No. 2, 1 rd.
4800

$\frac{1}{d} = .7$ $\frac{1}{s} = .10$

Commands	Range	Rd. No.	Dev. as seen but not announced	Sensing Rn.	Sensing Def.	Remarks 40/15 = 3
No. 2, 1 rd.	4,800	1	40 Left	?	?	
	5,100	2	10 Right	+	+	
	(5,000)		(On the line)			Not fired
Rt. 25						
Btry. R.	4,800	3	10 Right	?	–	25/10 = 2 or 3
		4	Right	?	–	5,000 – 200 = 4,800
		5	Line	–	–	
		6	10 Left	–	–	
Lt. 15	5,000	7	10 Right	?		
		8	Line	–	All Correct	Open 13/R = 3
		9	5 Left	?		
		10	Line	+		
On No. 2, Op. 3						
Btry. 1 rd.	5,100					
Zone	4,900		Cease firing, end of problem.			

Summary: Error in initial data: Deflection, 10 mils. Range, about 200 yds. shows advantage of plotting data in saving ammunition. Time from identification of target to announcement of 1st range, 2 min. 5 secs. Average sensing and command, 15 seconds. Total time for problem, 4 minutes and 20 seconds. Ammunition expended, 10 rounds. Classification: Satisfactory. Time: Excellent, Initial data: Excellent.

OFFICERS ASSIGNED TO REGULAR ARMY F. A. UNITS (As of September 1, 1931)

1ST FIELD ARTILLERY BRIGADE HEADQUARTERS (FORT HOYLE, MD.)

Brigadier General James B. Gowan
Major Dean Hudnutt
Major A. R. Ives
Captain C. M. Thirlkeld

6TH FIELD ARTILLERY—(FORT HOYLE, MD.)

Colonel L. L. Lawson
Lt. Col. J. W. Downer
Lt. Col. W. R. Henry
Major D. E. Cain

CAPTAINS:
- J. H. Fye
- H. P. Gantt
- G. G. Heiner
- L. T. McMahon
- R. C. Mallonee
- J. P. Ratay
- V. R. Woodruff

FIRST LIEUTENANTS:
- A. C. McAuliffe
- C. D. Daniel
- C. L. Dasher
- N. H. Smith

SECOND LIEUTENANTS:
- R. L. Carmichael, Jr.
- P. Clark, Jr.
- G. M. Cole
- G. C. Duehring
- H. C. Gibner, Jr.
- J. E. Holley
- E. J. Murphy
- B. C. Patrick

GRADUATES, 1931 CLASS, U.S.M.A. SECOND LIEUTENANTS:
- W. W. Dick, Jr.
- A. A. Greene
- R. Hackett
- C. F. McNair
- G. M. Wertz, Jr.

BATTERY A, 6TH FIELD ARTILLERY (MECHANIZED FORCE, FORT EUSTIS, VA.)

Captain W. J. Egan

FIRST LIEUTENANTS:
- M. H. Burckes
- R. K. Haskell

7TH FIELD ARTILLERY, LESS 2ND BATTALION
(FORT ETHAN ALLEN, VT.)

Colonel E. D. Scott
Lt. Col. J. F. Barnes
Lt. Col. G. A. Taylor
Major A. J. Betcher

CAPTAINS:
- C. A. Bennett
- R. L. Greene
- J. Hunt
- D. J. Sabini
- J. M. Sanderson
- M. C. Shea
- F. H. Timmerman

SECOND LIEUTENANTS:
- H. J. Coyle
- F. S. Gardner
- A. Lang

FIRST LIEUTENANTS:
- D. D. Caldwell
- L. O. Field
- R. G. Gard
- K. L. Johnson
- R. S. Marr
- J. B. Rasbach
- A. E. Smith
- F. W. Watrous

2ND BATTALION, 7TH FIELD ARTILLERY (MADISON BARRACKS, N. Y.)

Major J. D. VonHoltzendorff

CAPTAINS:
D. O. Hickey
N. C. Manley
R. J. Sothern
W. B. Walters
M. L. Young

SECOND LIEUTENANTS:
L. C. Davis
F. C. Foster

FIRST LIEUTENANTS:
L. H. Bixby
C. R. Carlson
G. DeGraaf
R. F. Hallock
H. D. Kehm
F. G. McGill
H. K. Palmer, Jr.
K. S. Sweany
W. W. Webster

2ND FIELD ARTILLERY BRIGADE HEADQUARTERS (AND UNASSIGNED) FORT SAM HOUSTON, TEXAS

Brig. Gen. Samuel D. Rockenbach
Lt. Col. C. R. Norton
Major E. B. Edwards

CAPTAINS:
J. J. Atkinson
C. H. Brammell
A. E. Carmichael
C. R. Hall
Z. E. Lawhon
J. A. Smith, Jr.

FIRST LIEUTENANTS
W. R. Hensey

SECOND LIEUTENANTS
R. H. Booth
J. F. Greco

GRADUATES, 1931 CLASS, U.S.M.A.
SECOND LIEUTENANTS:
J. A. Barclay, Jr.
G. K. Cusack
E. H. Eddy
J. W. Hansborough
L. V. Hightower
C. W. McConnell
M. M. Magee
J. N. Raker
S. Smellow
O. C. Troxel, Jr.

12TH FIELD ARTILLERY (FORT SAM HOUSTON, TEXAS)

Colonel J. S. Herron
Lt. Col. R. C. Burleson
Major G. A. Pollin
Major J. A. Sheridan

CAPTAINS:
W. P. Bledsoe
C. E. Boyle
M. M. Montgomery
S. H. Needham
E. A. O'Hair

FIRST LIEUTENANTS:
W. H. Hill
E. H. Lastayo
F. H. Morse

SECOND LIEUTENANTS:
W. H. Allen, Jr.
T. W. Dunn
G. G. Garton
A. C. Goodwin, Jr.
C. Hamlett
J. C. Hayden
C. I. Hutton
S. L. Morrow

OFFICERS ASSIGNED TO REGULAR ARMY F. A. UNITS

2ND BATTALION, 15TH FIELD ARTILLERY (FORT SAM HOUSTON, TEXAS)

Major B. R. Peyton

CAPTAINS:

A. M. Harper
W. R. Philp
H. F. Schoonover

FIRST LIEUTENANTS:

- E. M. Edmonson
- S. Edwards
- R. P. Huff

SECOND LIEUTENANTS:

- M. W. Brewster
- P. H. Brown, Jr.
- G. W. Gibbs

3RD FIELD ARTILLERY BRIGADE HEADQUARTERS, (FORT LEWIS, WASH.)

Brig. Gen. Henry G. Learnard

Major F. A. Prince

3RD AMMUNITION TRAIN (FORT SILL, OKLAHOMA)

Captain J. M. DeVine
Captain M. C. Wilson

1st Lt. M. W. Daniel

10TH FIELD ARTILLERY, FORT LEWIS, WASH.

Colonel R. H. McMaster
Lt. Col. A. Boone

Major C. H. Hayes
Major R. D. Johnson

CAPTAINS:

- W. W. Crawford
- J. J. France
- T. W. Jones
- W. B. McCollum
- M. M. Potter
- M. J. Rockwell
- N. P. Walsh
- J. G. White

FIRST LIEUTENANTS:

- F. R. Brisack
- W. D. Brown
- G. J. Gjelsteen
- R. C. Hendley
- H. T. Molloy
- B. A. Tormey
- J. S. Winn

SECOND LIEUTENANTS:

- E. Berry
- T. J. Counihan
- C. L. Heitman, Jr.
- H. B. Packard
- D. W. Traub

GRADUATES, 1931 CLASS, U.S.M.A.
SECOND LIEUTENANTS:

- J. W. Cave
- R. H. Harrison
- P. H. Lash, II
- J. W. Park
- H. M. Peyton
- C. W. Raymond

1ST BATTALION, 9TH FIELD ARTILLERY (FORT LEWIS, WASH.)

Major B. Frankenberger

CAPTAINS:
- E. A. Erickson
- K. K. Jones
- H. F. Long
- J. R. Williams

FIRST LIEUTENANTS
- J. G. Anding
- W. H. Bertsch
- H. Cort
- F. E. Coyne
- L. M. Johnson
- C. J. Kanaga
- C. K. McAlister
- E. C. Ringer

76TH FIELD ARTILLERY (LESS 2ND BATTALION)
(FT. F. E. WARREN, WYO.)

Lt. Col. A. F. Brewster   Lt. Col. A. D. Budd   Major R. F. Hyatt

CAPTAINS:
- G. B. Haddock
- J. M. Hamilton
- C. G. Holmes
- A. M. Post
- G. H. Stuts
- H. W. Turner

FIRST LIEUTENANTS:
- J. E. Adkins, Jr.
- R. C. Cameron
- P. R. Covey
- T. E. Lewis

SECOND LIEUTENANTS:
- R. L. Brunzell
- P. A. Gavan
- A. E. Solem
- R. W. Timothy

GRADUATES, 1931 CLASS, U.S.M.A.
SECOND LIEUTENANTS:
- G. E. Dietz
- A. V. Dishman
- R. S. Pratt, Jr.
- J. V. Zimmerman

2ND BATTALION, 76TH FIELD ARTILLERY,
(PRESIDIO OF MONTEREY, CALIF.)

Major E. J. Dawley

CAPTAINS:
- T. T. Haley
- J. C. Hughes
- G. O. Kurtz
- R. S. Perrin

FIRST LIEUTENANTS:
- R. H. Coombs
- W. H. Drummond
- M. Pierson
- W. R. Schaefer
- C. H. Swartz

SECOND LIEUTENANTS:
- None

GRADUATES, 1931 CLASS, U.S.M.A.
SECOND LIEUTENANTS:
- G. R. Huffman
- C. R. McBride
- T. W. Parker
- C. C. Smith, Jr.
- G. S. Speidel, Jr.
- J. F. Stroker

13TH FIELD ARTILLERY BRIGADE HEADQUARTERS
(FORT BRAGG, N. C.)

Brig. Gen. Manus McCloskey

MAJORS:
- K. S. Perkins
- A. C. Sullivan

CAPTAINS:
- R. Hirsch
- A. S. Quintard
- S. White

FIRST LIEUTENANT:
- C. M. Hallam

OFFICERS ASSIGNED TO REGULAR ARMY F. A. UNITS

BATTERY A, 1ST OBSERVATION BATTALION (FORT BRAGG, N. C.)

CAPTAINS:
- F. M. Crist
- P. A. Reichle

FIRST LIEUTENANTS:
- W. S. Nye
- E. T. Owen
- J. M. Works

5TH FIELD ARTILLERY (FORT BRAGG, N. C.)

Colonel J. R. Thomas

Lt. Col. E. R. Coppock

MAJORS:
- S. F. Bryan
- R. L. Burnell

CAPTAINS:
- J. C. Butner
- J. G. Coxetter
- G. H. Cushman, Jr.
- L. M. Haines
- W. L. Kluss
- J. S. Mallory
- Buhl Moore
- H. W. Tarkington

FIRST LIEUTENANTS:
- C. S. Berrien
- H. L. Berry
- A. Brill
- H. C. Dayton
- K. N. Decker
- D. Q. Harris
- B. F. Hayford
- R. T. J. Higgins
- E. V. Kerr
- T. E. Meyer
- G. S. Whitmore
- W. L. Wright

SECOND LIEUTENANTS:
- C. E. Margrave
- E. C. Reber

17TH FIELD ARTILLERY (LESS 3RD BATTALION) (FORT BRAGG, N. C.)

Colonel J. A. Moss

Lt. Col. W. F. Jones

MAJORS:
- S. G. Brady
- H. D. Higley

CAPTAINS:
- H. Boone
- F. Camm
- L. A. DesPland
- W. C. Green
- F. E. Kauffman
- A. R. Reeves
- A. L. Warren

SECOND LIEUTENANTS:
- J. B. Evans
- J. S. Neery
- T. L. Rich

FIRST LIEUTENANTS:
- A. S. Bennett
- T. E. Binford
- W. L. Carr
- F. W. Crary
- G. J. Deutermann
- P. H. Enslow
- B. J. Furuholmen
- W. J. Klepinger
- L. L. Lesser
- H. M. Manderbach
- P. H. Ringsdorf
- M. B. Stokes
- W. E. Watters
- J. M. Whistler
- W. D. Williams

3RD BATTALION, 17TH FIELD ARTILLERY, (FORT LEAVENWORTH, KANS.)

Major M. Procter

CAPTAINS:
- P. G. Black
- C. R. Doran
- W. H. Maris
- W. W. Woodbridge

SECOND LIEUTENANTS:
- None.

FIRST LIEUTENANTS:
- R. T. Beurket
- C. L. Booth
- A. Bratton
- F. H. Canlett
- R. C. Conder
- H. J. Crigger
- J. B. Kraft
- G. W. Vaughn

1ST FIELD ARTILLERY (FORT SILL, OKLA.)
Colonel C. M. Bundel

MAJORS:
O. E. Beezley
J. A. Crane
J. M. Lewis
G. M. Peek

CAPTAINS:
E. Y. Argo
B. C. Anderson
J. H. Carriker
J. C. Cook
G. L. Danforth
R. D. Delehanty
H. J. Gaffey
W. C. Goessling
H. H. F. Gossett
H. Harding
B. M. James
W. L. Kay
C. M. Lucas
E. R. Roberts
R. P. Terrell

SECOND LIEUTENANTS:
D. F. Brown
F. Q. Goodell
J. M. Moore
F. M. Steadman
F. G. Stritzinger
E. B. Thayer
C. O. Wiselogel
J. R. Wheaton
S. Wood

FIRST LIEUTENANTS:
D. S. Babcock
J. D. Balmer
O. M. Barton
S. A. Beckley
J. F. Bird
E. C. Burkart
G. E. Burritt
J. M. Callicut
J. A. Cella
R. P. Clay
V. H. Connor
F. Dorn
N. J. Eckert
H. C. Fowler
W. N. Gillmore
L. J. Greeley
G. L. Holsinger
E. O. Hopkins
B. F. Luebberman
S. Y. McGiffert
P. L. Martin
J. Massaro
W. B. Palmer
D. P. Poteet
W. W. Scott
L. J. Stewart
L. J. Tacy
R. L. Taylor
R. P. Turner

1ST BATTALION, 3RD FIELD ARTILLERY
(FORT BENJAMIN HARRISON, IND.)

Major R. G. Kirkwood

CAPTAINS:
L. H. Bixby
F. H. Hollingsworth
W. B. Leitch
C. D. Parmalee
H. F. Searight

FIRST LIEUTENANTS:
R. S. McClenaghan
E. M. Quigley
E. A. Routheau

SECOND LIEUTENANTS:
F. D. Atkinson
T. I. Edgar
K. H. Ewbank
M. Faulhaber
J. H. Rothschild
W. W. Sisson
F. G. Terry

RADUATES, 1931 CLASS, U.S.M.A.
ECOND LIEUTENANTS:
J. J. Davis
H. A. Hughes
C. P. Westpheling

OFFICERS ASSIGNED TO REGULAR ARMY F. A. UNITS

2ND BATTALION, 3RD FIELD ARTILLERY (FORT SHERIDAN, ILL.)

Major W. E. Burr

CAPTAINS:
- W. E. Ard
- C. B. Cole
- A. M. Goldman
- T. C. McCormick
- O. M. Marshburn

FIRST LIEUTENANTS
- J. Hinton
- C. E. Hixon
- D. V. Johnson
- J. H. Lewis, Jr.
- H. D. Reed
- S. E. Stancisco
- A. Vepsala

SECOND LIEUTENANTS:
- C. W. Wesner

GRADUATES, 1931, CLASS, U.S.M.A.
SECOND LIEUTENANTS:
- W. F. Gallup
- A. R. Hercz
- F. H. Tapping

2ND BATTALION, 4TH ARTILLERY (FORT ROBINSON, NEBR.)

Lt. Col. O. L. Brunzell

CAPTAINS:
- R. L. Allen
- A. C. Berry
- E. S. Brewster
- R. L. Gervais
- J. L. McIlhenny

SECOND LIEUTENANTS:
- G. P. Harrison
- C. M. Mathews
- A. P. O'Meara

Major O. M. Moore

FIRST LIEUTENANTS:
- E. L. Andrews
- J. J. Deery
- S. H. Hasbrouck
- H. L. Ingham
- R. K. Quekemeyer
- H. E. Sanderson, Jr.
- R. D. Waring

1ST BATTALION, 16TH FIELD ARTILLERY (FORT MYER, VA.)

Lt. Col. C. P. George

CAPTAINS:
- H. W. Blakeley
- H. T. Brotherton
- S. McLeod
- R. V. Maraist
- G. D. Shea

FIRST LIEUTENANTS:
- A. R. S. Barden
- G. B. Barth
- J. L. Chamberlain
- G. D. Crosby
- L. B. Downing
- A. T. McCome
- C. P. Summerall, Jr.

SECOND LIEUTENANTS:
- C. A. Billingsley
- A. G. Stone
- A. Watson, II

GRADUATES, 1931, CLASS, U.S.M.A.
- 2nd Lt. J. Hagood, Jr.
- W. H. Hoover

2ND BATTALION, 16TH FIELD ARTILLERY (FORT BRAGG, N. C.)
Lt. Col. C. S. Blakeley

CAPTAINS:
D. L. Crane
P. C. Fleming
C. W. Glover
D. L. Ruffner

FIRST LIEUTENANTS:
C. Cavelli, Jr.
L. C. Friedersdorff
G. K. Williamson
L. F. Young

SECOND LIEUTENANTS:
A. R. Fitch
H. W. Wilkinson

GRADUATES, 1931, CLASS, U.S.M.A.
SECOND LIEUTENANTS:
C. F. Buck, Jr.
M. Moses
M. O. Perry
F. R. Redden

1ST BATTALION, 18TH FIELD ARTILLERY (FORT SILL, OKLA.)

CAPTAINS:
W. W. Belcher
J. R. Bibb
H. R. Evans
A. V. Gair
S. Marshall
O. N. Schjerven
J. A. Wallace

FIRST LIEUTENANTS:
V. F. Burger
B. Evans
J. R. Lindsay, Jr.
R. F. McEldowney
P. R. M. Miller
G. E. Wrockloff

SECOND LIEUTENANTS:
D. P. Armstrong
J. M. Burdge
R. Condon, Jr.
S. F. Crawford
J. Ganahl, Jr.
F. A. Granholm
C. H. Jark
J. A. McFarland
G. W. Peake
J. E. Theimer
L. A. Vickrey
J. S. Walker

2ND BATTALION, 18TH FIELD ARTILLERY (FORT DES MOINES, IOWA)
Major T. G. M. Oliphant

CAPTAINS:
R. H. Bacon
W. F. Pride
R. H. Slider

FIRST LIEUTENANTS:
H. Crawford
W. H. Jaeger
S. F. Little

SECOND LIEUTENANTS:
H. E. Brooks
P. W. Carrithers
C. H. Gunderson

BATTERY F, 18TH FIELD ARTILLERY (FORT SNELLING, MINNESOTA)

Captain W. S. Bryant
1st Lt. R. D. Powell

SECOND LIEUTENANTS:
H. H. Goeffrey
F. N. Leakey

OFFICERS ASSIGNED TO REGULAR ARMY F. A. UNITS

BATTERY D, 18TH FIELD ARTILLERY (FORT RILEY, KANSAS)

Captain E. H. Brooks

FIRST LIEUTENANTS:
- C. C. Blakeney
- T. A. Roberts, Jr.

SECOND LIEUTENANT:
- M. S. Davis

1ST BATTALION, 82ND FIELD ARTILLERY (FORT BLISS, TEXAS)

MAJORS:
- L. C. Sparks
- C. L. Clark

CAPTAINS:
- C. A. Beaucond
- A. F. Doran
- S. C. Hilton
- W. Hitzfeldt
- W. B. Weston
- L. J. Whitlock

FIRST LIEUTENANTS:
- G. B. Conrad
- W. W. Ford
- L. R. Garrison
- J. L. Langevin
- R. G. Miller
- E. J. McGaw
- G. B. McReynolds

SECOND LIEUTENANTS:
- J. Q. Brett
- R. J. Handy
- J. P. Holland
- G. F. Lillard
- J. J. MacFarland
- P. C. Wehle

GRADUATES, 1931, CLASS, U.S.M.A.
SECOND LIEUTENANTS:
- M. L. Fisher
- D. A. Herman
- A. H. Hogan
- W. Taylor, Jr.

1ST BATTALION, 83RD FIELD ARTILLERY (FORT BENNING, GA.)

Major C. A. Selleck

CAPTAINS:
- W. L. Bevan
- J. G. Brackinridge
- I. L. Foster
- F. H. Gaston
- R. C. Mangum

FIRST LIEUTENANTS:
- H. D. Baker
- H. E. Baker
- W. H. Bartlett
- L. W. Haskell
- C. D. Leinbach
- G. B. McConnell
- C. H. Studebaker
- W. A. D. Thomas

SECOND LIEUTENANTS:
- W. H. Draper
- W. E. Grubbs
- J. J. Heriot
- D. C. McNair
- R. A. Ports

GRADUATES, 1931, CLASS, U.S.M.A.
SECOND LIEUTENANTS:
- J. R. Beishline
- C. E. N. Howard, Jr.

24TH FIELD ARTILLERY (PS), (CAMP STOTSENBURG, P. I.)

Colonel U. Birnie, Jr.
Lt. Col. D. C. McDonald
Major J. E. Mort
Major H. L. McBride

CAPTAINS:
- H. B. Allen
- S. F. Clark
- L. J. Compton
- M. H. Doty
- J. P. Eckert
- W. Hayford
- G. P. Hays
- J. H. Keatinge
- F. B. Lyle
- J. B. Matlack
- W. W. Murphey
- J. E. Ray
- S. F. Reyes
- J. W. Russey
- F. V. Segundo

FIRST LIEUTENANTS:
- C. F. Burbach
- R. M. Cannon
- S. L. Cowles
- T. A. Doxey, Jr.
- W. J. Epes
- D. G. Erskine
- W. J. Eyerly
- A. D. Garcia
- V. Z. Gomez
- J. L. Graves
- L. V. Harris
- S. F. Kirkpatrick
- J. Mesick
- W. D. Paschall
- P. Sather
- W. T. Sexton
- A. N. Stubblebine
- M. S. Sulit
- J. A. Sullivan
- W. D. Webb

SECOND LIEUTENANTS:
- F. H. Chaffee
- G. M. Lindsay
- R. R. Mace
- F. P. Munson
- D. N. Sundt
- H. P. Storke
- P. S. Thompson
- J. P. Woodbridge
- S. F. Yeo

2ND FIELD ARTILLERY (CANAL ZONE)

Colonel W. C. Webb
Major J. B. Wogan

CAPTAINS:
- L. S. Arnold
- H. B. Dawson
- E. A. Hyde
- L. McHale
- H. E. Tisdale
- E. S. Van Benschoten

FIRST LIEUTENANTS:
- F. J. Achatz
- J. H. Baumann
- J. W. Black
- J. C. Campbell
- C. H. Day
- C. G. Follansbee
- E. F. Hammond
- R. B. Hart
- E. O. Hopkins
- G. R. Scithers
- J. E. Slack
- T. C. Wood, Jr.

SECOND LIEUTENANTS:
- C. R. Hutchinson
- O. W. van den Berg
- T. M. Watlington

11TH FIELD ARTILLERY BRIGADE—(HAWAII)

Brig. Gen. Henry W. Butner

1st Lieut. T. A. Jennings
2nd Lieut. J. S. Nesbitt

OFFICERS ASSIGNED TO REGULAR ARMY F. A. UNITS

OFFICERS ORDERED TO FOREIGN SERVICE IN HAWAII (NOT YET JOINED)

LIEUT. COLONELS:
- Wm. Bryden
- R. S. Pratt

MAJORS:
- H. L. C. Jones

CAPTAINS:
- J. H. Ball
- F. H. Boucher
- J. E. Bush
- F. G. Chaddock
- E. T. Hayes
- A. E. King
- L. F. Kosch
- C. R. Lehner
- P. E. Shea
- A. W. Shutter
- M. A. Stuart
- A. B. Wade
- W. N. Weiner
- T. R. Willson

FIRST LIEUTENANTS:
- W. G. Bennett
- G. C. Benson
- P. A. Berkey
- C. G. Blakeney
- A. Bliss
- C. D. Calley
- M. P. Chadwick
- J. B. Clearwater
- W. L. Coughlin
- N. C. Cureton
- R. H. Donaldson
- D. Dunford
- J. K. Gibson
- H. Y. Grubbs
- J. L. Hardin
- C. E. Hart
- J. G. Howard
- E. F. Kollmer
- J. L. Lewis
- R. L. Mabie
- F. A. March, II
- O. W. Martin
- V. R. Smith
- W. C. Stout
- L. M. Vocke
- W. N. White

SECOND LIEUTENANTS:
- J. F. Ammerman
- V. B. Barnes
- J. L. Beynon
- T. Calhoun, Jr.
- W. P. Connally
- J. B. Daly
- J. G. Harding
- R. E. Hatton
- B. P. Heiser
- E. H. McLemore
- D. M. Perkins
- R. C. Ross
- J. C. Strickler
- J. O. Taylor
- W. J. Thompson

8TH FIELD ARTILLERY (HAWAII)

Colonel J. P. Barney
Lt. Col. T. P. Bernard
Major H. G. Fitz
Major C. G. Helmick

CAPTAINS:
- A. C. Donovan
- H. M. Findlay
- H. J. Guernsey
- H. N. Lockwood, Jr.
- D. S. McConnaughy
- L. L. Partlow
- M. V. Patton
- W. N. Tenney
- D. S. Somerville
- R. C. White
- H. S. Whiteley

FIRST LIEUTENANTS:
- E. H. Barr
- F. F. Carpenter
- H. F. Handy
- T. B. Hedekin
- L. E. Jacoby
- S. S. Koszewski
- H. C. Larter, Jr.
- E. M. Link
- W. F. Millice
- E. S. Molitor
- G. J. Reid
- J. H. Sampson, Jr.

SECOND LIEUTENANTS:
- F. J. Brown
- R. E. Chandler
- D. G. Dwyre
- P. A. Gavan
- H. S. Isaacson
- M. D. Masters
- F. H. Sinclair

11TH FIELD ARTILLERY (HAWAII)

Colonel E. Swift, Jr.

Lt. Col. G. E. Nelson

Major R. M. Milam
Major G. W. Sliney
Major R. T. Tompkins
Major L. R. Woods

CAPTAINS:
- A. Brumage
- J. A. Corridon
- J. P. Crehan
- H. C. Harrison
- D. F. Jones
- J. Nash
- V. L. Oleson

FIRST LIEUTENANTS:
- W. H. Barksdale, Jr.
- R. G. Duff
- D. J. Oyster
- C. D. Palmer

SECOND LIEUTENANTS:
- J. F. Collins
- E. G. Farrand
- F. E. Fellows
- W. T. Kirn
- W. E. Kraus
- F. P. Miller
- J. D. F. Phillips
- R. D. Wentworth
- W. W. Whelchel
- A. N. Williams, Jr.

13TH FIELD ARTILLERY (HAWAII)

Major C. Andrus

Major F. B. Prickett

CAPTAINS:
- A. E. Billings
- L. H. Frasier
- T. L. Futch
- M. H. Greene
- H. R. Hanson
- W. S. Roberson
- P. P. Rodes
- M. Ross

FIRST LIEUTENANTS:
- C. L. Boyle
- H. F. Conrey
- W. H. DeLange
- D. F. Healy
- K. W. Hisgen
- J. P. Kennedy
- S. V. Krauthoff
- J. T. Loome
- H. VanWyk

SECOND LIEUTENANTS:
- G. B. Coverdale
- D. R. French
- R. W. Goldsmith
- L. H. Ham
- J. T. Hannigan
- C. E. Hughes
- M. F. Stober
- M. O. Walter
- R. J. West, Jr.

TRAINING OF POLO PONIES

BY LIEUT. GUY C. BENSON, F. A.

POLO although a sport is considered by the War Department as of paramount importance to the mounted officer in developing the prime requisites of quick thinking, bold and fearless riding, and in furnishing wholesome recreation. In order to get the most out of this sport it is necessary to have a fundamental knowledge of the training and schooling of polo ponies. It is my purpose to discuss a method of training polo ponies which has worked out with a surprising degree of success although in slight variance to the usual method of training employed by the average army officer.

The object of all polo pony training is to have the animal conform to the rider's will at all speeds on the polo field without excitement. All training must have this end in view and any training conflicting with this principle must be considered as ineffective and harmful.

Before commencing the discussion of the polo pony's training it might be well to mention that he should be of proper conformation in addition to being sound. Officers waste many hours each year in the training of unsuitable animals. In many instances the pony is never able to play a period, while in other cases the pony is a confirmed "puller" after a few months of play. Many times this fault can be traced directly to the animal's conformation. Although the selection of the proper type of polo pony, which in itself is a large subject, is outside the scope of this thesis, I wish to mention in passing, that too much thought cannot be given to the selection of the proper type of animal. Personally I lay great stress upon the appearance of the head and neck. The underline of the horse's neck, with the head held in the natural position, must be concave; the upper line of the neck must be straight or with a slight crest. The throat latch must be fine and at the junction of the head and neck there must be sufficient space behind the cheek bone to permit the insertion of two fingers. An animal with this conformation will be easier to train due to the fact that flexion will be easy for him. In the excitement of fast play it will be natural for him to give to the pressure of the bit, whereas the animal poorly constructed about these regions has the tendency, when pressure is applied to the bars of his mouth, to tighten and run away.

The first training that the polo remount undergoes has, for its prime object, the gentling of the animal. Consequently for the first three or four days the animal is simply led beside an old horse. However the walk is of no value if the animal is handled in the stable area by a nervous or excitable groom. Consequently I always assign an old and experienced groom to handle a young remount. This leading period continues throughout the horse's training and the time of the morning walk is gradually increased from forty minutes the first day to two hours at the end of the second week. The morning exercise is conducted habitually at a walk, both to develop muscle and to quiet and gentle the animal. As soon as the animal will permit himself to be saddled quietly he should be led out for the morning exercise with a saddle, stirrups detached, upon his back. Besides getting the animal accustomed to the weight and feel of the saddle, it toughens his back. The remount's back so hardened will be less susceptible to saddle galls. After three or four days of leading the remount should be bitted. The first bit that is introduced into the pony's mouth should discourage any attempt that he might make either to withdraw his tongue from under the bit or to "ball up" his tongue so that only the lower and thinner portion of his tongue is under the bit. This feature of the pony's training is most important and cannot be stressed too strongly. These two pernicious habits are formed within the first few days after the first bit is introduced into the animal's mouth and when once formed, they are very disagreeable to combat. Many more horses withdraw their tongues from under the bit than is usually realized, and this action usually happens when pressure is applied to the bar of the bit. Then the full pressure of the bit, instead of being cushioned by the tongue, is applied directly to the bars of the animal's mouth. At slow work the effect is to make the animal restive and unresponsive to training, while at faster gaits the horse becomes absolutely unmanageable. This habit can be absolutely prevented by using the proper type of bit at this stage of the pony's training. A suitable bit for this purpose may be made by sewing to an ordinary broken snaffle bit on either side of the mouthpiece two pieces of stiff harness leather. The leather projections must extend, to be effective, about two inches above and below the mouthpiece and about an inch to either side of the link of the mouthpiece. To prevent the leather projection from sliding along the mouthpiece it must be sewed tightly around the link.

Up to this point the remount has been handled by a groom. Now he and the officer who is going to play him are introduced to each other in the afternoon in the riding hall through the medium of a cavesson and longe. During the period that the officer is longeing his remount the horse is saddled and bridled, but without stirrups. Although some training may be accomplished by longeing a remount, due to limited facilities of a riding hall, I have found it advantageous to have this period extend only long enough to gentle the animal so that the rider may mount without undue excitement.

The next two weeks of the remount's afternoon training follow that usually employed in most organizations. At the end of this time the pony is still equipped with a remount bit. He has been taught the action of the leading rein and he will move forward and stop at the sound of the rider's voice. However the objects of this period are to permit the pony to accustom himself to carrying the additional weight of the rider and to install confidence in the remount. Consequently no aids are taught except those necessary to steer him about the riding hall.

At the end of the third week the horse has been galloped three or four minutes each afternoon at intervals during the period. No attention is paid to his leads and the point is made to have him gallop at a relatively slow speed without excitement on a loose rein. By these short galloping periods the horse begins to develop his wind and he begins to balance himself while ridden at faster gaits.

At the end of this time I find it advisable to replace his mouthing or preliminary training bit with a mild pelham with a large mouthpiece and with the curb chain adjusted very loosely. The first and foremost reason for this change is to acquaint the pony with the bit that he will use on the polo field and the second reason is the psychological effect it has upon the individual training the remount. At Fort Myer where there were eight or ten officers riding remounts every afternoon during the winter season, I found that the average officer has a great distaste for riding with a snaffle bit. He believes that when he is required to train a remount with a bit of this nature he is subjected unnecessarily to a form of hazing which he experienced during his first days of riding. When he is required to ride and train animals with the snaffle bit for several months or more at a stretch he does so unwillingly. Consequently he is loath to volunteer to train a polo remount and the resultant effect upon the horse is not as beneficial as it would be if he were in the proper frame of mind. Even if he does not understand the action of the curb bit it does him no good to make him realize his deficiency by keeping the bit a mystery to him. I maintain that by proper instruction and proper supervision any officer can be taught to adjust correctly and use properly his curb bit. It is the bit that he must use on the polo field and to keep from wrecking the pony's mouth it is essential that he be taught its action and effect early in his own training.

In the weekly periods that follow the proper application of the aids is emphasized. In teaching an animal to turn the use of the leading rein applied low and wide and the inside leg at the girth are used. By the use of these aids the animal is taught to bend his spinal column from his head to his croup in the direction of the turn. Common sense must be used and the turns required from the remount for the first few weeks must be large. Otherwise, the animal's haunches will fly out to the outside of the turn and he will spin around in a stiffened manner on his forehand. Naturally the first turns are made at a walk and as the remount becomes more proficient the gait is increased until, towards the end of his training, he is making the turn at a run.

Ordinarily, to turn a horse, keeping him true on an arc, the rider is told to apply his outside leg behind the girth to keep the haunches bent in and following the arc. Theoretically, if it were possible to apply this outside leg directly to the haunches, near the rear of the head-to-croup arc, it might have the desired effect. Actually, it is physically possible to apply the leg only near the center of the arc in which the horse's spinal column is bent; it is unifomly applied too severely, and results only in straightening and stiffening the arc, just as thumping the outside of any curve will tend to straighten it. Now in order for the horse, in such an unnatural and constrained position, to turn, he must do so by excessively inclining his body to the inside of the turn and pushing himself around on the turn by shoving his forelegs to the outside. Then, instead of the horse bending his head and body and reaching out with his forelegs in the direction of the turn, he travels around the circle by successive tangents. In the first case he pulls himself around the turn while in the latter case he pushes himself around the turn. A polo pony of the latter type has two great disadvantages; he cannot turn as fast and while turning he has a tendency to slip and fall. One has only to ride horses of these two different types, especially at fast gaits or on slippery turf, to realize at once the difference. Therefore, in training, instead of applying the outside leg back, both legs are held steady on or near the girth, maintaining the impulsion forward and supporting the center of the arc, and the bending is secured by keeping the horse supple and relaxed and using the inside leading rein to bend the horse around the inside leg.

After the remount has accustomed himself to bending his body, to some extent, on the turns, he is required to start flexing his head and neck to the right and left. This is accomplished by placing the animal on a circle at a walk with his spinal column bent. After he has placed his head in the proper position in response to a leading rein applied low and wide, he is required to "duck his chin" by a movement of the inside rein caused by a slight movement of the little finger. To accomplish this flexion the palm of the hand should be up with the fingers relaxed. Then by alternately opening and closing the little fingers the flexion is accomplished. After the animal will flex his jaw at a walk and slow trot, he is required to flex at a canter and slow gallop, always on a turn.

When the horse will flex his jaw and his head and neck at the poll both to the right and to the left, and not before, he is taught direct flexion. In this way the evil of having a horse "break" behind the poll is avoided. This method has the added feature that it is easier for the remount to flex to the sides at first than to flex directly. Consequently he is irritated less and he is more responsive to his schooling.

At this same time he is taught the meaning of the bearing rein by having it associated with the leading rein, the latter predominating. In all of the training, in order to keep the horse's nose in the proper position, the leading rein is the stronger one.

When the animal will run at an extended gallop without excitement in the riding hall, he is required to turn at speed in the direction opposite to the one in which he is leading. If the horse is given plenty of room and not interefered with, he will change his leads to conform to his change in direction. This is a movement which comes natural to the horse provided that he has plenty of propulsion with his hind legs when required to perform the movement. The only aids that are given to him are those for a change of direction. It is insisted, further, that initially the rider requires the movement only at speed. After several weeks' training in this maneuver the horse will be able to change leads at even the slowest canter.

Perhaps more horses are ruined for polo every year by stopping and turning than by any other single cause. Most players have the popular fancy that the fastest manner to return in the reverse direction is to stop and then turn. Although a straight line is the shortest distance between two points, on the polo field in a hard fast game it is never the most rapid. The loss of time required to bring a pony to a stop or even to check him, turn and then start, is more than it is for the same horse to turn on a small circle with little loss in his speed. Ordinarily when the average player wishes to stop his pony prior to turning him around he hits the horse a terrific jolt on the bars of the mouth by a jerk on the reins. This is supposed to stop the animal instantly. The action of the bit in a maneuver of this sort causes a severe pain to the bars of the remount's mouth and, in many cases, the bars are bruised, splintered or broken. The first few times that the animal is so hurt he will stop out of force of habit established by his previous training, but later he stops unwillingly so that in a few months' time, especially if he is an animal with any courage, he becomes so unmanageable he is unfit for play.

This evil may be avoided by not requiring the animal to stop. If the horse is schooled to turn properly, as I have indicated in the above paragraphs, he will not only do so without injury but he will be able to out-turn the pony that is required to stop.

After the remount is able to handle himself at all speeds without excitement, I start riding him with the reins in one hand. Then he is acquainted with the polo stick, first at the walk, then at the canter, and then swinging at an indoor ball at slow gaits. When the horse permits the stick to be swung at all gaits at an indoor ball he is used for stick and ball with the outdoor ball.

It must be realized that all of this work is performed inside of a riding hall with eight or ten other riders similarly occupied. All of this work is confirmed by work outside of any enclosure. Consequently from the first moment of his training he is accustomed to have other horses about him. He is familiar with other animals passing him and cutting in front of him; with chasing another pony and then turning. Consequently he does not require any special training to be rated. When he gets on the polo field he is not excited by the presence and milling about of other animals, for all of this has taken place in his schooling period. He is not worked in the riding hall at a twelve mile gallop and expected to play at a gait twice as fast. He is always worked and schooled as fast as he will go without excitement. As soon as he shows the least signs of nervousness his gait is reduced until he goes freely and smoothly. Whips and spurs are never permitted.

By making use of these principles at Fort Myer we were unusually successful. We were able to school and play at least 90 per cent of all the polo remounts issued to the battalion, and, in addition, were able to reclaim 75 per cent of the ponies that were given to us by other teams because they were unmanageable. During this time not one pony was returned to another organization because he was unmanageable. In 1929 this string formed the bulk of the Army Junior Team's ponies of that year and Mr. Cooley, the polo critic, remarked that he had never seen an Army team as well mounted.

As an aid a schedule is attached to show what should be accomplished with a green pony in six months' time. The popular superstition that it requires two years' time to school a polo pony is very much in error. Otherwise all of the polo pony dealers would be bankrupt from feed bills, or they would be unable to sell any animal for less than two thousand dollars. By having the remounts walked every morning for two hours and by an hour's intensive training in the afternoon, six days a week, a green animal will play a very creditable period of polo in six months' time.

CONCLUSIONS

1. Only animals of proper conformation should be selected for training.

2. A polo pony must be thoroughly gentled and absolutely quiet before any training is attempted.

3. The first bit that the pony uses should be equipped with a tongue loller.

4. The proper method of turning should be taught the remount. The aids that are used are the leading rein applied low and wide and the inside leg applied at the girth. As soon as the horse will turn correctly he is flexed to the right and left. After these flexions he is flexed directly.

5. The horse should be worked progressively at fast gaits until he is able to perform at a dead run without excitement.

6. To change direction the horse should not be required to stop. He should be required to turn only.

7. Performance and progress should conform approximately to the attached schedule.

SCHEDULE

1st Week	A.M.	One hour leading, after third day with saddle and bridle with tongue loller.
	P.M.	One hour longeing, after third day with saddle and bridle.
2nd Week	A.M.	Two hours leading with saddle and bridle.
	P.M.	One hour longeing, gentling, mounting and riding at the walk.
3rd Week	A.M.	Same as 2nd Week.
	P.M.	Gentling, mounting, riding at walk and slow trot.
4th Week	A.M.	Same as 3rd week except without saddle and bridle.
	P.M.	Gentling, mounting, riding with pelham bit at walk, trot and if the pony is perfectly quiet, short period of slow canter, no attention paid to the leads.
5th Week	A.M.	Same as 4th week.
	P.M.	Flexion at walk and slow trot for few minutes at a time. Increase the period of cantering as the nervous condition of the pony permits.

6th, 7th and 8th Weeks	A.M.	Same as 5th week.
	P.M.	Same as 5th week except the canter is increased to a gallop if the nervous condition of the pony permits.
9th, 10th 11th and 12th Weeks	A.M.	Same as 8th week.
	P.M.	Flexion right and left, turning about on small circle at the walk, trot, and canter, turning the same direction that the pony is leading.
13th, 14th 15th and 16th Weeks	A.M.	Same as 12th week.
	P.M.	Same as 12th week except the speed at the gallop is increased and the pony is required to change his leads and turn in the direction opposite to his original lead.
17th, 18th 19th and 20th Weeks	A.M.	Same as 16th week.
	P.M.	Turning at walk, trot, gallop and dead run. By this time the pony should be able to run and turn at his fastest speed without encitement.
21st, 22nd 23rd and 24th Weeks	A.M.	Same as 20th week.
	P.M.	Same as 20th week and in addition, carry polo stick at the walk and trot; no stroking for the first week. The 2d, 3d and 4th weeks of this period use indoor ball for light stroking at all speeds making strokes on both near and off side, as well as forward and backward.
25th and 26th Weeks	A.M.	Same as 24th week.
	P.M.	Stroking the wooden ball outdoors at all speeds being careful not to hit the ball straight ahead more than two strokes while at speed.

FIELD ARTILLERY NOTES

Range Finders

The Chief of Field Artillery has arranged to have several types of range finders of recent design sent to Fort Bragg for use in firing on fast moving targets both terrestrial and aerial, and particularly in connection with the firing of the T2 and T3 all purpose guns.

These range finders are both coincident and stereoscopic types and their bases are of varied lengths. The test is for the purpose of determining which types and sizes are best suited for Field Artillery use.

C.S. West

For over twenty years Mr. C. S. West has been employed by the United States Field Artillery Association. Recently his health has been poor and in order to get as much rest as possible he has had to leave his work with the Association.

During his long service with the U. S. Field Artillery Association, which began about the time the Association was formed, Mr. West has worked with untiring interest and outstanding loyalty. It was General Snow, then Major and Secretary-Treasurer, who brought Mr. West to the Association. During the early years of the Association's existence, and particularly during the strenuous days of the World War, Mr. West was invaluable. In fact it was largely through his efforts that the Association was kept going and the publication of the FIELD ARTILLERY JOURNAL at that important time was continued.

The best wishes and gratitude of the Association accompany Mr. West.

1¼-Ton Truck Tests

The Field Artillery Board has recently been conducting tests at Fort Bragg, N. C., with the 1¼-ton Franklin powered truck, both as a prime mover for the 75mm gun and as a reconnaissance vehicle.

As a prime mover it has been towing the 75mm gun on the trailer developed by Captain Cox at Fort Sill, Oklahoma, which was described and illustrated in the May-June number of the FIELD ARTILLERY JOURNAL. It has also been using a similar trailer developed by the Ordnance Department. A run of 160 miles, of which 48 miles were on improved sand clay roads, was made. The gross load was 12,700 lbs., of which 9,100 lbs. were on the truck and 3,600 lbs. trailed. The country traversed was rolling, but steep hills were encountered from Deep River to Haw River. Speeds up to about 50 miles per hour were obtained at favorable places on the road. Total time for the trip was 6 hours, 50 minutes with approximately 45 minutes out for lunch. A few days later a trip was made across the Fort Bragg range with the same loads in order to test the cross country ability of the unit. Two hours were required to make 17 miles, a performance which was most satisfactory considering the nature of the terrain and the fact that the load on the truck was made excessively heavy purposely during this test. At an early date a cross country test will be made on which the load on the truck including drivers will be limited to 2,500 lbs. It is estimated that thirteen of these trucks would carry all the personnel and equipment necessary for a portée battery.

This same 1¼-ton Franklin truck was tested as a reconnaissance vehicle carrying 14 men and their equipment. On this test the vehicle accompanied Battery A, 1st Observation Battalion, on a 100-mile march. The men who rode in it reported favorably on its riding qualities. The trip was from Fort Bragg to Wilmington, N. C., and took 7 hours including a halt of 1 hour at noon. This same distance was covered by the Franklin reconnaissance truck on a return trip to Fort Bragg, where it operated alone, in 3 hours and 5 minutes.

The 1¼-ton Franklin truck has eight forward speeds and two reverse speeds through a 2-speed transfer case. The body has longitudinal seats facing towards the center of the truck. The truck is four-wheel drive.

10-Ton 6-Wheel Prime Mover

Battery A, 1st Observation Battalion, recently tried out a 10-ton Sterling 6-wheeled 6-wheel-drive truck at Fort Bragg, which had been sent to the Field Artillery Board for test. It is equipped with 44″ × 10″ heavy duty tires mounted singly in front and dual on the four rear wheels. The motor is a 185 h.p. Sterling, capable of sustained operation at 1,600 r.p.m. The power is transmitted through a conventional commercial 4-speed transmission to a transfer case equipped with three speed ranges. Thus there are twelve forward speeds and three reverse speeds. In the high speed range the vehicle is capable of sustaining speed of 33.2 m.p.h. and for short periods can be speeded up to 45.6 m.p.h. In the intermediate range the vehicle is capable of sustained speed of 25.2 m.p.h. and may be speeded up to 34.6 m.p.h. for a short spurt. The low range is used when pulling a heavy load. This vehicle made an excellent showing on the run from Fort Bragg to Wilmington when it carried a load of 5 tons and trailed another load of 8 tons. This test march was the same as that taken by the 1¼-ton Franklin reconnaissance vehicle referred to above.

The tests of this heavy cargo truck are for the purpose of determining its qualifications as a prime mover for medium and heavy artillery. A general study of the operation of this truck indicates a marked advance has been made in the design of trucks which can be used as prime movers for heavy artillery.

Battery Charging Sets

The Field Artillery Board has completed its test and report on the Homelite charging set. While generally satisfactory for the purpose for which it was designed the advisability of its adoption for Field Artillery purposes is questionable. The tendency, in view of present developments in radio equipment, is to eliminate storage batteries altogether from Field Artillery radio equipment and to substitute for them hand generators.

Tests of Superimposing Telegraph on Telephone Circuits

The Field Artillery Board is investigating and testing a new type field telegraph buzzers, developed by the Signal Corps, which utilizes simplexed telegraph superimposed upon telephone circuits. The Board is determining the desirability of adding this agency of signal communications to the present authorized signal equipment of certain Field Artillery units. The use of the telegraph for transmittal of routine and code messages, while the same wire system is available for telephonic communication, would doubtless relieve the load of messages which heretofore has been quite difficult to handle at times. It is contemplated, for the present at least, that the use of the telegraph circuits be confined to transmission by the larger headquarters.

Drill Cartridges

At Fort Bragg new type drill cartridges for the 105mm howitzer and 75mm gun are now being tested with generally satisfactory results. The new 75mm drill cartridge weighs the same as the service round of ammunition and is designed to overcome the difficulties of breakage of bases and extractors when withdrawing the cartridge from the chamber by having the bulk of the weight of the cartridge attached to its base by means of a spring. Thus the process of extracting the drill cartridge will be less abrupt due to the play allowed by the spring.

Fiber Containers

Tests are being held at Fort Bragg to determine the suitability as regards ruggedness of fiber containers for the 75mm gun and 105mm howitzer ammunition.

75mm Howitzer (Tandem Draft)

Recently a 75mm pack howitzer section consisting of the howitzer drawn by two animals in tandem and an Infantry cart (M2) made a 95-mile march in five days. During the first four days the section marched across the Fort Bragg reservation, averaging approximately 19 miles per day. This portion of the march was made under adverse conditions as regards heat and flies as well as over heavy sand roads. The last day's march, some 21 miles, was made over hard surface roads under favorable conditions. Upon completion of the test the animals were in excellent condition.

Citroen Tractor

The Citroen tractor, equipped with Kegresse-Hinstin half tracks, which was secured from the manufacturer in France, has recently been undergoing tests at Aberdeen Proving Ground, Maryland, and will later be sent to Fort Bragg to ascertain its suitability for use with light and accompanying artillery. A description, with illustrations, of this tractor and its track arrangement was given in the January-February, 1931, FIELD ARTILLERY JOURNAL. With the tractor there was also purchased the type of bogie used in France for trailing their 75's at high speed.

This Citroen tractor has a 30 h.p. four-cylinder motor, speed 25 m.p.h., cargo rating one ton with ability to trail one 75mm gun.

Four Foreign Officers to Attend Courses at the Field Artillery School

The Secretary of War has authorized Captain Anton Bechtol Sheim of the German Army to attend the 1931-1932 Advanced Course, Captain Kwang-Ming Zan of the Chinese Army to attend the 1931-1932 Battery Officers' Course, Lieutenant Camron Sudafua, Siamese Army, to attend the 1931-1932 Battery Officers' Course and Second Lieutenant Jose M. Plasa, Reserve Corps, Ecuadorian Army, to attend the National Guard and Reserve Battery Officers' Course from September 14 to December 12, 1931, at the Field Artillery School.

Reports on Marches

Army Regulations (Par. 12 AR 345-105) require that "journals of marches will be kept by the adjutant of the command or by an officer detailed for that purpose. The journal will contain an historical record of the march, facts as to equipment, clothing, supply, shelter, roads, weather, health of troops and incidents of any kind that may have value. Journals of marches pertaining to provisional commands will be forwarded to the headquarters of the Corps Area or District in which the march terminates, for file, and a copy furnished the Adjutant General; those of permanent organizations will be retained at the headquarters of the organizations to which they pertain and a copy furnished the Adjutant General. In campaign, journals of marches are replaced by war diaries."

During recent years a large number of reports on marches made by Field Artillery units have been received by the Chief of Field Artillery. Some of these reports have been interesting and valuable. Others have given very little idea of the march reported upon. With a view to giving officers who prepare these march reports an idea of the information they should contain, the following is an enumeration of the topics which should be touched upon. It is not intended as a form to be filled in, in a routine manner; to use it so would detract from the value of the report. It is suggested rather as a guide which might be used to check up and make sure that no important features of the march have been omitted in describing it: GENERAL INFORMATION—authority; purpose; strength of command; losses during march; gains during march; itinerary with map if available; any other troops making march. DAILY MARCH REPORT—time and place of departure; time and place of arrival; distance marched; rate of march; condition and kind of roads; weather. Remarks—any unusual condition of health, morale; casualties, if any; any other pertinent data. SUMMARY—total distance marched; total time of march; average rate of march in m.p.h.; number of days marched; number of days of rest; condition of men, animals and motors as a result of the march. REMARKS—(along the following lines) *General*—Preparation for the march. How was march supervised? How are cannoneers transported? How were animals or motors taken care of at the short halts? Was there any instance in which the Field Artillery was unable to keep up with the troops with which they were marching? If so, the reasons therefor. Was the same carriage always in the lead or were carriages alternated?

Equipment—Amount taken and how carried; weight of ammunition or other load carried on caissons and limber; clothing; supply, shelter.

Animals—Age; weight before and after march; shoeing; cuts and abrasions; how many pairs per carriage; were horses alternated in the pair or pairs in the team? Times of feeding and watering during and after the march with amounts of feed and water. Was the battery and store wagon taken on the march? Did it keep up? What steps were taken to preserve the pliability and softness of breast collars against dirt and sweat? Was a veterinarian along to observe the condition of animals and treat those needing attention? Was camphorated oil or other medicine administered in any cases to tired or exhausted animals? Were astringents used on shoulders and backs of animals? What special care was given animals at the end of the march and at halts? What was the condition of the animals at the end of the march? the next day?

Motors—Make and type and purpose for which used, speeds, age, repair hours, mechanical troubles. General condition before and after the march, method of refueling, lubricating, etc. Was equipment for refueling satisfactory? Were vehicles of organization segregated according to speed capabilities? What type of vehicle proved most effective as prime mover? As cargo carrier? Distances between vehicles on hills, on the flat? Precautions against jamming up? Precautions on steep hills. Supervision of march, repairs and adjustments on the march; responsibilities of officers, mechanics, and drivers; towing, with reasons; precautions against gasoline fires; examination of and strengthening bridges and culverts.

75mm Pack Howitzer Ammuntion

The service tests of high explosive shell T-4 armed with T-2 fuze (combination, super-quick, short-delay, point-detonating) for 75mm pack howitzers which were conducted at Fort Robinson, Nebraska, and in the Panama Canal Zone have been completed satisfactorily. About 800 rounds were fired. Steps have been taken to have this type of ammunition adopted as "substitute standard." It was recommended as "substitute standard" rather than "standard" in view of the fact that it only weighs 14 pounds 5 ounces, whereas the standard projectile for the pack howitzer will be 15 pounds. 7,500 of the new design 15 pound T-3 shell are being manufactured for service test as the standard round for the howitzer. They will be armed with T-2 fuzes.

The Field Artillery Board has prepared a schedule of firing tests relative to the accuracy, stability and shell fragmentation of the 75mm pack howitzer ammunition. The Pack Board at Fort Robinson has already conducted firing tests of this howitzer, but the Field Artillery Board is particularly concerned in obtaining data on the area effectively covered by the explosion of the shell, and also on the length of delay the fuze should have to give the most desirable results. Furthermore the Board will include ranges of over 6,000 yards in its tests whereas the Fort Robinson tests were all under that range.

Panoramic Sights for French 75mm Guns

The Field Artillery Board has submitted to the Chief of Field Artillery recommendations confirming a previous report made in 1928 adverse to the sight mount type E for the 75mm gun M1897. While the Board and the Chief's Office are still strongly in favor of equiping the French 75s with panoramic sights, up to the present time no satisfactory means of mounting the panoramic sight on them has been found.

Flash and Sound Ranging Training Regulations

The Field Artillery Board is preparing training regulations on this subject which will be called TR 430-130. TR 430-130 will contain a considerable amount of flash and sound ranging information now embodied in a carefully prepared monograph which was gotten up by the Field Artillery Board last year.

The Field Artillery Field Manual

This manual will be issued in two volumes. Volume I will be ready for distribution about December 1, and volume II will be ready about February 1. Both volumes have been passed by the Office of the Chief of Field Artillery and the General Staff and have been sent by the Adjutant General to the government printing office. The printing and correcting of proof will be undertaken shortly.

Colored Bursts and High Bursts for Target Identification

As a result of suggestions submitted by various Field Artillery officers the Field Artillery Board has undertaken a study of the practicability of using colored bursts or high bursts for the purpose of indicating targets which have been identified or adjusted upon by accompanying guns, but which have not been located by the bulk of the supporting artillery. An objection to this procedure has been brought up, namely, that if this method of identification of targets were used extensively it would be a fairly simple matter for the enemy to cause great confusion by shooting off the same colored bursts or high bursts. At present the only colored bursts available for this use are white, black and yellow.

Revision of Various Training Regulations

In view of the fact that many of the training regulations on the service of the piece for our various calibers and types of materiel have become more or less obsolete, the Field Artillery Board has been instructed by the Chief of Field Artillery to revise and rewrite certain training regulations. In order to avoid the numerous changes which it would be necessary to incorporate in the various training regulations, it has been decided to rewrite the following: 430-20, Service of the Piece, 75mm Gun, M1916; 430-25, Service of the Piece, 75mm Gun, M1917; 430-30, Service of the Piece, 155mm Gun; 430-65, Service of the Piece, 155mm

Howitzer. All of these training regulations will be re-written and submitted to the Chief of Field Artillery by November 15, 1931. It is not expected that they will be reviewed and printed before next year.

Field Artillery Troop Movements

The following organizations will change station in the near future, probably this fall: 5th Field Artillery, less 2nd and 3rd battalions, from Fort Bragg to Madison Barracks; 2nd Battalion, 4th Field Artillery from Fort Robinson to Fort Bragg; the Band of the 76th Field Artillery from Fort Robinson to Madison Barracks, where it will be merged with the 5th Field Artillery Band; 3rd Battalion, 17th Field Artillery, from Fort Leavenworth to Fort Des Moines.

These movements will be made by train, the personnel, materiel, animals and equipment accompanying the unit in each case, except some of the materiel for the 5th Field Artillery may be obtained upon arrival, and personnel about to leave the units for discharge, etc., may be left behind. As now constituted the Field Artillery Pack Board is entirely composed of officers of the 2nd Battalion, 4th Field Artillery, so the membership of this Board will soon all be at Bragg.

General Barrows Rides 100 Miles in 12 Hours

Major General David P. Barrows, commanding 40th Division, California National Guard, completed a hundred-mile ride by horse in 12 hours and 15 minutes while at the 1931 Camp at San Luis Obispo. In making this extraordinary ride, General Barrows used his three personal mounts, Yermak, black gelding given him by the late P. E. Bowles; Seal, thoroughbred black mare, a gift from Arthur Tasheira, and Kentucky, large gelding, the gift of Harry Fair. He rode Kentucky 36 miles, Seal 44 miles and Yermak carried him the last 20 miles.

The route taken by General Barrows was from the National Guard camp, about four miles west of San Luis Obispo, to Santa Margarita, El Paso, Atascadero, through the Santa Lucia range to the sea below Cayucos, thence by Morro and the Los Osos Valley to camp. The truck and trailer, carrying the spare horses accompanying General Barrows, was in charge of Lieut, Daugherty. Although the horses suffered from the unusual heat prevailing during the early part of the 100-mile ride, all returned to camp in perfect condition.

General Barrows, a graduate of the Mounted Service Schools and a lover of fine horses, in emulating the army officer requirements of Rooseveltian days, declared, following his ride, that it could be made in comparative ease with two good horses if they were able, by fast trotting or lope, alternating over short stretches of slow trotting to cover nine miles an hour, but that the use of three horses adds greatly to the ease of the undertaking, especially if the saddle is shifted every 20 or 25 miles. So conducted, he declared, a hundred-mile ride is a much less severe test than it might seem.

New Meteorological Tables

After much study and correlation, the meteorological division of the office of the Chief Signal Officer has issued a booklet entitled "Instructions for Computing Ballistic Winds and Ballistic Air Densities." This pamphlet represents the first published exposition of the methods used in computing ballistic winds and ballistic air densities for military purposes. The pamphlet also contains revised tables of factors employed in the computations. The publication has been distributed to all Signal Corps meteorological stations.