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A VOLLEY FIRED OVER LAKE CAYUGA DURING CORNELL R. O. T. C. SERVICE PRACTICE

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FLASH-SOUND RANGING

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FLASH and sound ranging as employed at present were developed during the long period of stabilization in the World War. During this period these agencies proved their value in gathering information of hostile batteries, their locations and periods of activity. The organization and equipment that we have today have been improved in a number of details over those in use at the end of the war, but basically the methods of operation and the general organization are the same. The time required to install these units has been considerably reduced, so that whereas it required from 24 to 48 hours to establish the sound ranging equipment in a new area during the war, now under favorable conditions these units can be ready to operate within six hours after arriving at their positions. This is, of course, a decided advantage, and is a step in the right direction, looking to the adaptation of these units to warfare of movement.

The absence of good fire control maps would greatly complicate the work of sound and flash ranging units. No doubt operation would be possible in an unmapped area if time permitted an extensive survey to be made, tying in the location of all the corps artillery and the sound and flash ranging stations with an arbitrary system of assumed grid coordinates. So far as known this has never been attempted, and consequently the time it would require can only be estimated. An optimistic guess would place the time somewhere in the neighborhood of the World War requirement of 24 to 48 hours. When it is considered that these units will not generally arrive in the battle area until some time after contact with the enemy (since they are part of the corps artillery organization), it is easy to see that this additional delay of 24 to 48 hours might very seriously affect their usefulness. It is this consideration which has led to the attempt described below to adapt some of the principles of flash and sound ranging to a simplified method that can be employed by any artillery unit, from the battery up, to gather information of hostile batteries and to deliver effective fire on them.

Sound ranging employs the principle of the uniform travel of sound through the air to locate hostile batteries. Flash ranging uses the principle of intersection of two or more rays directed at the flash of a battery. For satisfactory operation sound ranging requires at least four accurately located stations, and flash ranging at least three, all connected by a system of telephone wires. Now suppose contact with the enemy is made and there has not been sufficient time before night to set up this elaborate system. Is it possible for the personnel of the various OPs to locate hostile batteries that fire during the night whose flashes are visible? We believe it is possible, using only the present equipment, to get a very satisfactory location, employing a combination of the principles of flash and sound ranging, which, for want of a better name, we will call "Flash-Sound" ranging. The direction of the hostile battery is determined by its flash and the range by the time it takes the sound to travel the unknown distance. The operation is simple and requires no expert training; a BC telescope laid on the flash will give the direction and an ordinary stop watch, or time interval recorder, will record the time with sufficient accuracy. By way of illustration we will work out a simple example.

Suppose a battalion RO sees the flash of a hostile battery. He turns his BC scope in the general direction of the flash and waits for the next one, with stop watch in hand ready to press the key. When he observes the flash again he starts the watch and turns the cross hair of the telescope to the exact point where the flash occurred. He then listens for the arrival of the sound and stops his watch the instant he hears it. Suppose the time is 10.4 seconds. He repeats this operation until he gets five more readings say 10.2, 10.6, 10.4, 10.4, and 10.2. He averages these and gets 10.37. Now he knows that sound travels 369 yards a second at a temperature of 50 degrees F. when there is no wind. He takes the temperature and finds it to be 40 degrees, and estimates the wind to be 8 miles an hour in the direction of the enemy battery. (Anyone with a little experience can estimate the ground wind closer than it can be obtained from a metro message which was taken in a different locality and some time previously). The velocity of sound decreases .37 yards for each degree the temperature is below 50 degrees and vice versa. Hence the correction due to the temperature is —3.7 yards. A wind blowing against the source of sound decreases the velocity of sound .5 yards for each mile per hour; hence the correction for wind is —.5×8=—4 yards/sec. Therefore the velocity of sound under the conditions assumed is 369—3.7—4=361.3 yards per second. The distance from our OP to the battery may now be determined by multiplying this velocity by the average time obtained: 361.3×10.37=3747 yards. Now draw a ray on our map or chart in the direction determined by the flash and scale off the distance 3747 yards, and we have the location of the hostile battery.

A number of questions will immediately present themselves to the mind of the thoughtful reader. What if the actual flash of the hostile battery is not visible but only the glow on the horizon? How can we distinguish the sound of other batteries that are firing from the one that we are working on? What accuracy may we expect by the method? Can we make use of the principle in adjusting our own batteries? Suppose we have no maps, can we make use of such a location? We will try to answer these questions.

By actual test it has been found by the flash ranging battery at Fort Bragg that but little loss in accuracy of location is caused by a battery being so well defiladed that only a glow on the horizon is seen by the observers. Batteries that cannot be seen from any ground OP might be located with flash-sound ranging by an observer in a balloon if he had available an accurate compass (Earth inductor or gyroscopic) with which to determine the direction. The location of the balloon at the time of the reading could easily be determined from a ground station. Balloons would thus be able to furnish information of value during the night as well as day.

The question of distinguishing the sound of the particular battery that we are ranging on might become very difficult in case there is a general bombardment, but in this case flash and sound ranging will fail anyway. With the average amount of night firing preceding an attack it is believed that it will be possible to pick out the battery we want in the following manner. Since we are starting our time with the flash of this particular battery, the time that the sound from this battery arrives at our station will always be approximately the same—10.4 seconds in the case of the example illustrated above. The sound of other batteries will come in at varying intervals but this particular time interval will be repeated each time. Hence if we simply read the time of the arrival of all sounds after starting our watch, it should be apparent after a few trials which interval is always repeating, and we will know then that it is the one we want. We can then go ahead and take the desired number of records, knowing that the sound which arrives approximately at the interval we have determined is the one from the battery we are locating. Of course, occasionally we might make an error but we will reject any time that varies more than one-fifth of a second from the mean time so the erroneous ones should be apparent. A mechanical time interval recorder on which any number of records could be accurately made would be a help, but is not necessary. An aid in eliminating sounds from other batteries besides the one we are ranging on might be devised on the principle used by the antiaircraft artillery in locating hostile planes at night by their sound. Something in the nature of a stethoscope, with a long narrow horn, might possibly serve to magnify the sound of the battery it is directed toward, and diminish sounds coming from other directions. The use of such an instrument would be necessary in case there is a great deal of firing going on all along the line, but the principle of the repetition of the sound interval discussed above would serve to distinguish one battery from a limited number of others that are firing.

With reference to accuracy, sufficient tests have not yet been made to obtain a practical value of the probable error of location, but from the limited number so far conducted the results have been surprisingly accurate. Theoretically we can arrive at an approximate figure for the probable error as follows: Since we are using a stop watch that records to the nearest fifth of a second only, there is a possible maximum error due to this source of 1/10 second, which corresponds approximately to 37 yards. The probable error is one-fourth of this, or 9 yards. Another source of error is the personal one; the variation in the time it takes for a man to react to a given signal (flash or sound). By actual experiments it has been found that the time required to press a key after seeing a flash or hearing a sound varies between one-tenth and two-tenths of a second for the average individual, but that there is no apparent difference in the time it takes to react to a sight signal and a sound signal. Hence there is a possible maximum error of one-tenth second due to this source, or a probable error of 9 yards as above. A third source of error is contained in the determination of the velocity of wind. The temperature is easily taken, and there should be no error here, but no matter how accurately the wind is determined its actual rate of travel varies considerably from time to time. Let us suppose that this rate varies as much as ten miles an hour, and that an error of five miles an hour may be made in determining the velocity; that is a total possible error of 15 miles an hour, or a probable error of 4 miles an hour. This corresponds to an error of $0.5\times4=2$ yds./sec. in the determination of the velocity of sound. Sound will travel a distance of 5,000 yards in 13.5 seconds; hence an error of 2 yards per second in the determination of the velocity of sound will introduce an error of $2\times13.5=27$ yards. Now to get the probable error due to the combination of these three possible sources of errors we apply the rule of combined errors (See Par. 8, Appendix I, TR 430-85). Our combined probable error is therefore $\sqrt{(9)^2+(9)^2+(27)^2}=30$ yards. Due to the fact that one of the errors affects the velocity of sound, the probable error will vary as the range, the variation being approximately 5 yards per thousand yards change in range. Therefore we may expect a probable error of 25 yards at 4,000 yards, and 35 yards at 6,000 yards. This probable error is for a single observation, and we know that the probable error of the mean of a group of observations will be this value divided by the square root of the number of observations. Assuming that we get four observations, the probable error should be one-half of the above. Take the illustrative problem given above, the probable error of a single observation is 24 yards (Range 3,747 yards. Since we had six observations the probable error of the final location should be $24/\sqrt{6}=10$ yards. The maximum error would be 4 times this, or 40 yards. This may seem a little optimistic but actual tests have demonstrated that the above figures are not far from what we may expect.

There are a number of different uses that may be made of this method of flash-sound ranging besides the location of hostile batteries. Assuming that there is no suitable check point that can be identified by a battery, a group of rounds of shell may be fired on any visible terrain and the range to the center of the group determined by the sound of the bursting shells. Transfers may then be made to any targets within the prescribed range and deflection limits of this point. Or if there is no suitable point on the ground visible we may fire by high burst ranging on an imaginary check point, using our times, rather than a lateral observer, to give the range. This is really a very simple method of doing a high burst ranging adjustment because it may be done by one observer at the battery position, without depending on a lateral OP and a long lateral telephone line. Take the case of the battery that we have assumed above to be located at a range of 3,747 yards. Assume that we want to fire on this battery and that it is night so that no visible check point is available. We know its site and range from our OP, so that the data for the guns can be computed. The battery is laid with this data plus a false site to get the bursts above the crest and a salvo of shrapnel is fired "By piece at my command." The time from the burst of each round to the arrival of the sound at the OP is taken, and the mean determined, which we will assume to be 10.25. Before starting the adjustment the BC scope that was laid on the hostile battery is set with a site corresponding to the false site used on the guns and the height of burst of each of the rounds is read as well as their deviations. We may now compute our data to fire for effect on the battery. By means of the deviations we correct the direction and distribution of our sheaf, and from the height of burst of the four rounds we compute a mean H of B, say—2.5 mils. The range to the burst center of the group of four rounds is the velocity of sound, which we will assume has not changed since the hostile battery was located, i. e., 361.3 yds./sec., times the mean time, 10.25, which gives 3,703 yards. The correction due to the mean height of burst being 2.5 mils below the line of site is obtained from the firing tables, and is 23×2.5=–51 yards. Hence if our corrector had been "zero" the range to the center of the group would have been 3,703–51=3,652 yards. The range that we want is the one previously determined by our flash-sound ranging, 3,747 yards, so our guns are shooting 95 yards short. Increase the range by this amount, subtract the false site we used to get the bursts in the air and we are ready to fire for effect on the hostile battery, with a reasonable assurance that our adjusted range is within fifty yards of the target. No map has been used. It is not essential to have our battery and OP accurately located on a firing chart, although this is a help in computing the initial data with which the battery fires. Accurate data, however, are unnecessary. In fact we might conduct a regular bracket adjustment on the enemy battery, using shell, ranging by means of the time interval from the flash of our shells to the arrival of the sound. A time which is less than the average time of 10.37 seconds would indicate a short range, and a time greater, an over. This requires more firing, however, and would generally lose the benefit of surprise. Another drawback to this is that a shell does not give a very bright flash when it explodes, and consequently if the target has any defilade our shell flash would probably be invisible at our OP. It is always possible to switch to shell after doing a high burst ranging with shrapnel, by means of data from the range tables, but some loss in accuracy is to be expected due to changing ammunition lots as well as changing to a different shape projectile with different ballistic qualities. When a satisfactory time fuze for shell is developed this switch in ammunition should be unnecessary.

There are other applications of this flash-sound ranging that should be noted in passing. A liaison officer can use it to locate on his map hostile infantry weapons that he can pick up from the infantry OP. It would even seem that a flash battery could use it to good advantage. One of the most difficult problems flash ranging has to solve is to get the different observers on the same battery when more than one is firing. This would be greatly simplified if an approximate location of the battery is known. If, therefore, an observer would report not only the direction of a new flash he picks up, but also the "sound interval," the central station could quickly get an approximate location, and direct the other observers in that direction for the flash. Another use is to determine the weather effects at different ranges by firing four rounds, say at 2,000, 4,000 and 6,000 yards. These may be shell if there are points on the ground at these ranges visible. Judging from the tests conducted so far, considerably better results can be obtained in this manner than by using map data corrected; in fact the results compare favorably with K and V transfers. One other possible use suggests itself—that is the determination of a scale of a strip mosaic which has just been delivered to a battalion in position where no maps are available. By having one battery fire on a terrain feature that can be identified on the photo we can determine the distance from our location to this point and compare it with the scaled distance on the photo.

The question as to whether we can make use of this system of gathering information in an area where there are no maps available has been partially answered above. It is apparent that the only requirement is that the artillery which is to use this information should, in general, be located with reference to the OPs where the information is obtained. This may be any unit from a single battery to all the artillery in a division. This requirement, however, is not essential, as illustrated in the case of the battery above.

This so-called flash-sound ranging is not advanced as a panacea for all the headaches, attacks of nervous indecision and many other ills caused by the well known fog of war. In fact we do not make any predictions as to just how valuable an agency it may prove to be in gathering information in a warfare of movement. However, the difficulty of obtaining information of the enemy in such warfare is admittedly greater than in the case of stabilized warfare, and it appears logical to develop every agency to the fullest that will aid in this mission. While flash-sound ranging is as yet in a more or less experimental stage, the results obtained in tests conducted in the Department of Gunnery at Fort Sill seem to justify further tests along this line. It is simple, requires no additional equipment, and but little training. Certainly, under these circumstances if it gives promise of even a very limited usefulness, it deserves consideration as another means that will increase the effectiveness of our artillery.

The following is a summary of the tests conducted at the Field Artillery School to date:

LOCATION OF BATTERIES

Range	*No. of observations*	*Error of location*
4100	7	55 yards
2500	5	46 "
3700	9	19 "
3200	5	30 "
2400	2	71 "
6000	5	28 "
2700	6	5 "

Note: The above locations were made on different days under variable weather conditions.

ADJUSTMENT BY FLASH-SOUND RANGING USING HIGH BURSTS

No. of problem	*Range*	*Error of adjustment*	(*Computed range*) (*for effect*)
1	2900	25 yards over	
2	3900	"Mixed over"	
3	3600	60 yards short	
4	4300	"Bracketing"	

COMPARISON OF FLASH-SOUND WITH REGULAR HIGH BURST RANGING TO DETERMINE A "K" IN FOUR NIGHT PROBLEMS

	1st Night	*2nd Night*	*3rd Night*	*4th Night*
Flash-Sound "K"	1.011	1.008	1.025	1.038
High-Burst "K"......................	1.002	0.895*	1.035	0.938*

*These two "K's" were found to be erratic and corrected by the battalion commander. Note that the flash-sound adjustments proved satisfactory in all four cases. The errors in the high burst adjustments were caused by mistakes on the part of the battery commander rather than by the method employed. Fire for effect on different targets following the above adjustments was observed by a range party and reported effective, except in the case of the two erratic "K's" before they were corrected.

FLASH-SOUND RANGING WORK SHEET

Temp. 65° F.
Correction is —.37 yds/sec per
1° F < 50° F
Temp. Cor.=+5.55

Normal speed of sound=369 yds/sec
Wind toward target —12 m/h
Correction is —.5 yd/sec for 1 m/h
Wind correction=+6

Corrected speed=369±temp cor±wind cor=380.5

COMMANDS:	Df	BD	DD	—	Site	+30
	Amm.	Kr	40			
	Btry	By Pc.	AMC	4000	(Rn)	

OBSERVATIONS

Gun	*Dev.*	*H B*	*Time*	*Df Corrections for parallel sheaf*
No. 1	5 L	+4	10.8	R 5
No. 2	12 L	+5	10.7	R 2
No. 3	6 L	+3	10.6	L 9
No. 4	18 L	+5	10.8	L 2
Totals	——	17	42.9	
Ave.	——	+4.2	10.7	

Ave. Time×Corrected speed±Mean HB Effect=Range.

10.7×380.5=4071+93=4164=Rn to Burst Center (Map Rn)

$$\frac{\text{Gun Range}}{\text{Map Range}} = \frac{4000}{4164} = K = .906$$

NOTE: If timer is located some distance from the battery allowance should be made for the difference in range.

REMOUNT DEPOT HORSES

Their Sale to Officers and Selection for Schools

THERE have been some changes of policy in the Remount service as regards issue and sale of government horses, due in part to congressional action which has reduced the number of authorized private mounts from two to one. It is believed that Field Artillery officers will be interested in the following explanation of the Remount service policy in this connection.

In June or July of each year all four-year-old depot raised animals, except those selected for breeding, are available for selection by representatives of the Cavalry and Field Artillery schools and by the Remount Depot Commanders who reserve a certain number for sale to officers. Prior to that date these animals are not available for selection for any purpose. The number of horses allotted to the Cavalry and Field Artillery schools and for sale to officers, will ordinarily be in proportion to the total number of horses available and selection is made in turn by the representatives of the schools and the Remount Depot Commanders, choice being determined by lot. Selection of particularly well-bred horses will not be made for sale to officers except upon special authority of the office of the Quartermaster General. An officer can purchase only one mount from the government and can not do that if he already has an authorized mount.

Each year at the annual selection referred to above, those animals which were selected for sale to officers the preceding year and which still remain on hand will be added to the group of four-year-olds from which selection may be made, and thus they become available for re-selection providing however they have not been especially designated for issue to units or detachments such as Fort Benning or West Point.

In order that there may be a sufficient supply of animals available in the annual selection, Remount Depot Commanders during the year pick out certain animals from those they purchase and hold them for assignment to the Cavalry and Field Artillery schools and for sale to officers, in addition to the Remount raised four-year-olds.

Remount Depot Commanders, after the annual selection has been made, are required to submit a list of horses which they are holding for sale to officers to the Quartermaster General, giving name, brand number, breeding, size and rating of each animal. Approved applications of officers for the purchase of government animals are forwarded by the office of the Quartermaster General to Remount Depot Commanders, the date of approval in all cases determining the priority of an officer's application. Effective July 1, 1931, priority of application will only be considered for the calendar year in which it is submitted, that is to say January 1 to December 31, both date inclusive. Depot Commanders will indorse the officers' application blanks back to the Office of the Quartermaster General after selection and authority for sale have been approved and the entire transaction (payment, etc.) must be consummated within thirty days of the approval of the sale. Army Regulations 605-140 define whether an application may be considered.

All horses on the list for sale to officers will be shown to officers for selection. In addition any issue animals at the depot will be available for sale to officers unless they have already been selected for other purposes, or unless due to outstanding qualifications or training they are prohibited for sale by Army Regulations.

Any officer so desiring may delegate the selection of the horse he is about to purchase to the Depot Commander or another officer, or, of course, he can make his own selection if he can arrange to be present at the Remount depot. However, if the officer does not go to the depot to select his horse for some time after his application has been approved and he still desires to make his selection personally, he will lose his right of priority between the date of approval and the date he goes to the depot to make the selection.

An officer may designate a special animal for selection by mail or otherwise, and if the animal is available and the officer is entitled to the animal by priority his selection will be approved.

I-SEE-O, THE LAST OF THE FORT SILL INDIAN SCOUTS

BY MILTON O. BEEBE, Chaplain, U. S. Army

IT was decreed in Washington that I-See-O, the last of the Kiowa Indian Scouts in the Fort Sill Detachment, should never be retired, never reduced in rank and should, thereby, rank as the senior duty sergeant in the entire United States Army. That is a reputation and standing that would make happy many a soldier to-day. He was the last of the Fort Sill Indian Scouts to die in active service. He stands out in the history of his tribe and country as having never raised his hand against the United States in battle. It was to pay some portion of the obligation which the white people of America owe to I-See-O and other heroes of his race who have served their country well, that on June 7, 1931, there was a ceremony in that beautiful and historic house of worship, the chapel at Fort Sill, to unveil a tablet to his memory, that future generations might know his historic service and that his spirit might live in the lives of those who to-day wear the uniform of their country.

Authority was granted by the Secretary of War to enlist I-See-O in the Fort Sill Detachment, Indian Scouts, as a sergeant and to re-enlist him regularly throughout the entire period of his life.

I-See-O was of Kiowa parentage and was born on an Indian reservation near Fort Larned, Kansas, about 1851. During the years of his youth he was subject to his parents and the laws of his tribe. When but fifteen years of age he joined the Kiowa braves who were allied with the Comanche and Arapahoe tribes in war against the Navajos of New Mexico. While on this expedition he participated in the now famous Medicine Lodge Council. Sixty years later (1926) when the Medicine Lodge Council Memorial Association desired to place a tablet-marker on the spot where the treaty was held, I-See-O located the exact position for them.

Sergeant I-See-O left Kansas shortly after the Custer massacre, coming to Fort Sill where he was enlisted as a scout. At that time he served as a military courier between Fort Sill and other distant garrisons. Later he served an enlistment period of five years in Troop L, the Indian troop of the 7th Cavalry.

I-See-O and Maj Gen. Hugh L. Scott were very close friends, the intimacy beginning when the General was a troop officer of the 7th Cavalry commanding Troop L. Lieutenant Scott became profoundly impressed with the loyalty and devotion of I-See-O and appointed him First Sergeant of his troop of Indian Scouts. The friendship grew and ripened through the years, cherished by both warriors. As it can be said that I-See-O, with only his tribal background to his credit, looked to Lieutenant Scott for his training, it must also be admitted that I-See-O was the instructor of that young and somewhat inexperienced subaltern. Facing hazardous duty, I-See-O was the main support of the youthful troop commander. He also taught Scott the ways of the Indian, the spoken language and the universal sign language that was understood by all tribes and peoples of the western country, as well as the various tribal customs. Ever grateful for this, General Scott, as Chief of Staff, was able to repay his former First Sergeant and Indian friend, in a time of need, for service previously rendered and for value received.

I-See-O was not a hero of the battle field. He often worked so quietly as to deceive the uninitiated into the belief that he was doing nothing of real value. Master Sergeant Morris Swett, F.A.S. Detachment (White), librarian at Fort Sill and an eminent authority on local Indian tribes and customes, said of I-See-O, "His services have never been measured by heroism in the face of fire, nor by prowess with rifle and pistol but by the struggles he averted and the lives he saved. * * * His whole life was dedicated to the creation of a better understanding between the white and red men. Wherever -I-See-O appeared, bloodshed and struggle were conspicuously absent."

On at least one occasion, I-See-O determined to leave the military service. He desired to return to his tepee and enjoy the quiet and peace of his tribal life. It was unfortunate for I-See-O's plans at that time that war should have been declared by the United States against Spain, for I-See-O was among the first to return to colors. Unable to speak English he could hardly be of great service to a regiment in the field, so he was stationed at

Fort Sill during the entire Spanish-American War to care for the public animals that were kept there. He remained a scout until 1913 when the Fort Sill Detachment, Indian Scouts, was transferred to Arizona, at which time he again left the Army and returned to his family.

But I-See-O had grown old in the military service. He was no longer able to share in an existence that, at its very best, was closely competitive. He was astounded at the complexities of modern economic life and unable, because of his age and infirmities, to serve the country as a scout. He seemed destined to live and die in abject poverty. It was at this time that his beloved and intimate friend, Major General Scott, Chief of Staff, United States Army, came to his assistance and support. Hearing of I-See-O's difficulties, the General made a personal appeal to the Secretary of War for his old Kiowa friend with the result that authority was obtained to create a detachment of Indian scouts at Fort Sill in which I-See-O was to be a sergeant and the only member. He was the last Kiowa scout to die in active service though a number of others still live near Fort Sill, having been retired.

In writing to General Plummer, General Scott said of I-See-O, "He is one of the old time Indians. * * * His services in the past have been such that any pay he receives has been more than earned years years ago." I-See-O was supremely loyal to the people he so ably represented and "to the arms of his country." No distance was too great for him to travel in the interest of maintaining peace and no task too difficult for him to attempt in service to his country.

The life of I-See-O, during his last enlistments, was not without certain humorous aspects. Colonel Brewster, writing to General Scott, said of him, "He is fixed up with a nice little house on Medicine Creek, east of the railroad. He has everything he needs and a few things he does not. For example, a range was placed in his house, but I notice that he does all his cooking out-of-doors." He used his new range as a dresser in which all his toilet articles and other personal possessions were neatly arranged. Occasionally he would visit organization mess halls, where he was always welcome, for the sake of variety. The attractive cottage provided for him in the woods served him better as a storehouse than a shelter for he lived and slept in his old fashioned tepee in all kinds of weather.

The final illness of I-See-O occurred in January, 1927, when he was stricken with pneumonia, culminating in his death on March 11th of the same year. A great throng of friends and admirers gathered for the service in the little mission church near Fort Sill. Kiowas, Comanches and whites united in honoring one who had been an excellent soldier. The military service was conducted the following day in the Old Post Chapel under the direction of Chaplain Rilph C. Deibert. It was one of the largest funerals ever conducted at Fort Sill. All that is mortal of Sergeant I-See-O sleeps in the peaceful post cemetery at Fort Sill but his spirit is ever an inspiration to all who would selflessly serve their country.

One of the most interesting and colorful gatherings ever held at Fort Sill or in Comanche County, Oklahoma, was the unveiling ceremony of the beautiful bronze memorial tablet erected to the memory of I-See-O, Sergeant, United States Army, the last of the Fort Sill Indian Scouts, June 7, 1931. The tablet was erected by friends of the garrison and the Lawton Chapter, Daughters of the American Revolution, of which Mrs. Paul R. Smith is the Regent.

The tablet is of cast bronze and not unlike the Indian arrowhead in design. Following is the inscription on the tablet:

In memory of
I-SEE-O
Sergeant, United States Army
the Last of the Fort Sill Indian Scouts
Loyal to his Race
and to the Arms of
his Country

Erected by
Garrison Friends
and by
the Lawton Chapter,
Daughters of the
American Revolution

One-half of the seating capacity of the chapel was reserved for the members of the family of I-See-O and others of his tribe (Kiowa). The tablet was unveiled by Miss Edith Rowell, who was dressed for the occasion in a beautiful doe-skin costume of the Kiowa tribe and Robert Larson, Troop No. 37, Boy Scouts of America, Fort Sill. Miss Lutie Goombi, also a member of the Kiowa tribe, interpreted the hymns, "Nearer My God to Thee," as sung by Mrs. Russell G. Barkalow, and "We Sing to God's Son," sung by the Kiowas in their native tongue, into the Indian Sign Language. Mrs. Smith, representing the Lawton Chapter, Daughters of the American Revolution, presented the tablet to Brigadier General William M. Cruikshank, who accepted it for the garrison.

Courtesy of Dr. Fred W. Hammond, Lawton, Okla.

I-SEE-O (1851-1927)
KIOWA INDIAN

CLOSE SUPPORT

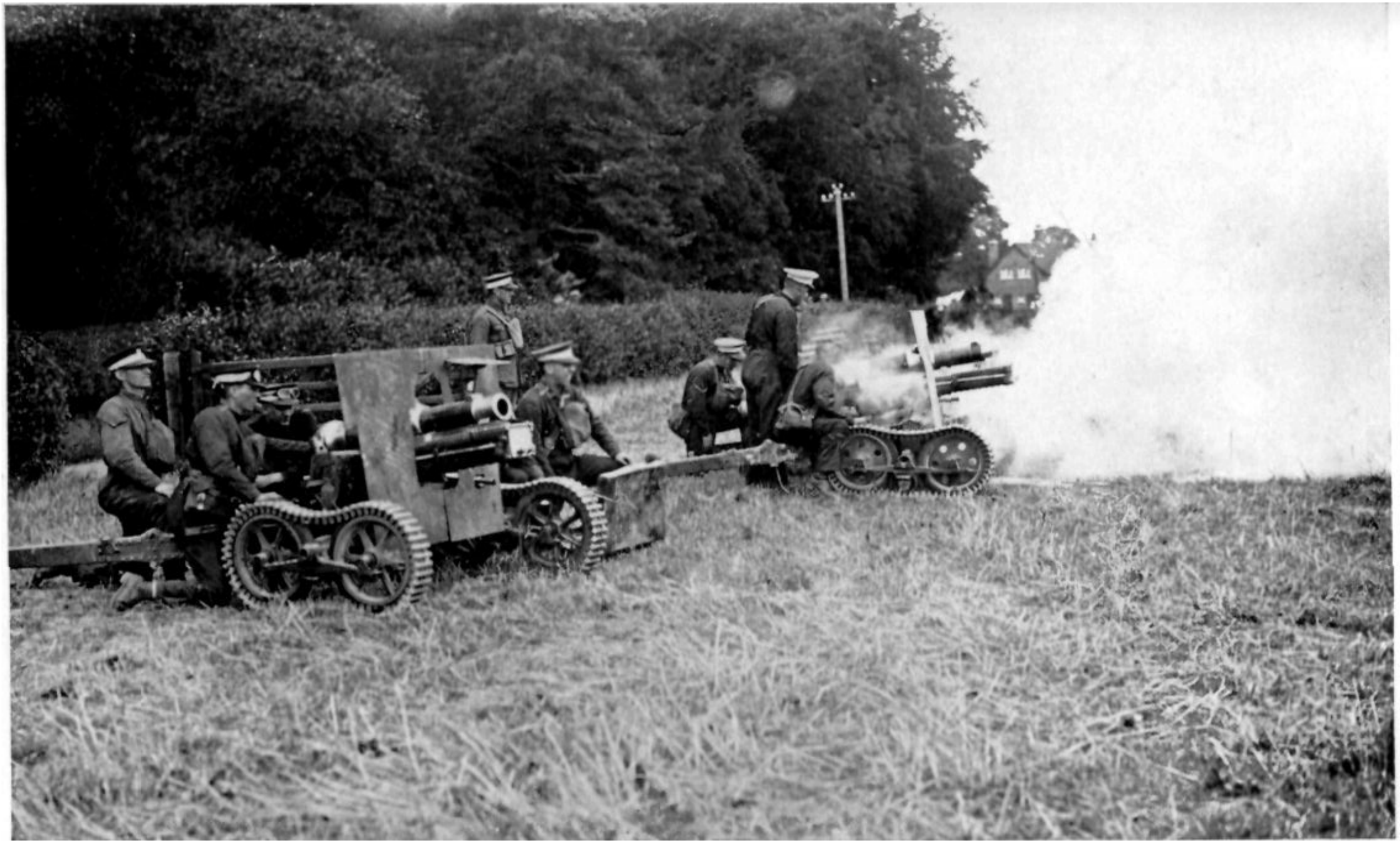
BY CAPTAIN C. A. P. MURISON, M. C.
Royal Artillery, British Army

THE PROBLEM

"The lesson to be learnt from the fighting up to date is that attacks are not carried out with an intimate combination of infantry and artillery.

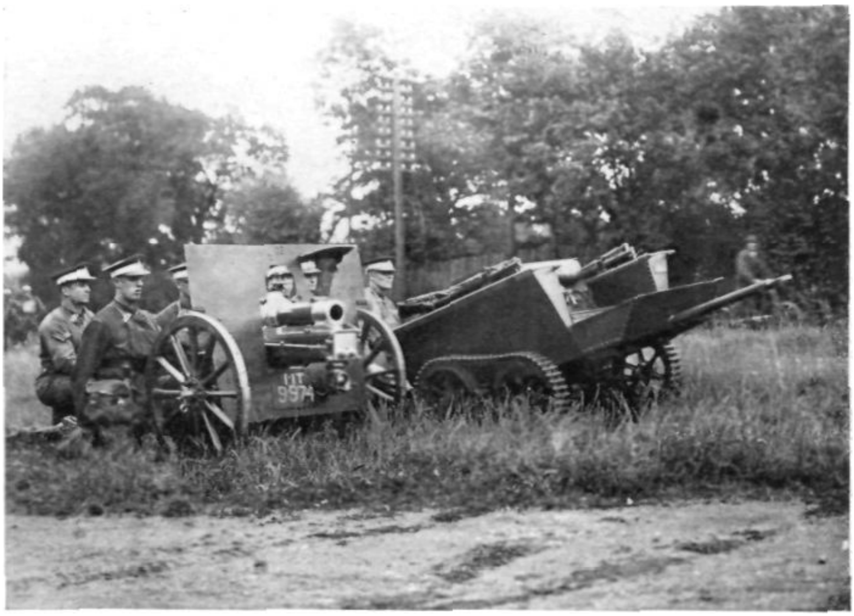
"Every combined operation comprises a series of minor operations which have as objective the gaining of points d'appui. Whenever it is desired to occupy a point d'appui the attack must be prepared by artillery, the infantry must be held back and the assault must be launched from such a distance as will permit the objective to be reached with certainty. Whenever the infantry attack has been launched at too great a distance, and without artillery having had time to make itself felt, the infantry has fallen under machine gun fire and has suffered losses which might have been avoided."

So wrote Marshal Joffre to his armies on August the 24th, 1914.



BRITISH EXPERIMENTAL ACCOMPANYING GUN

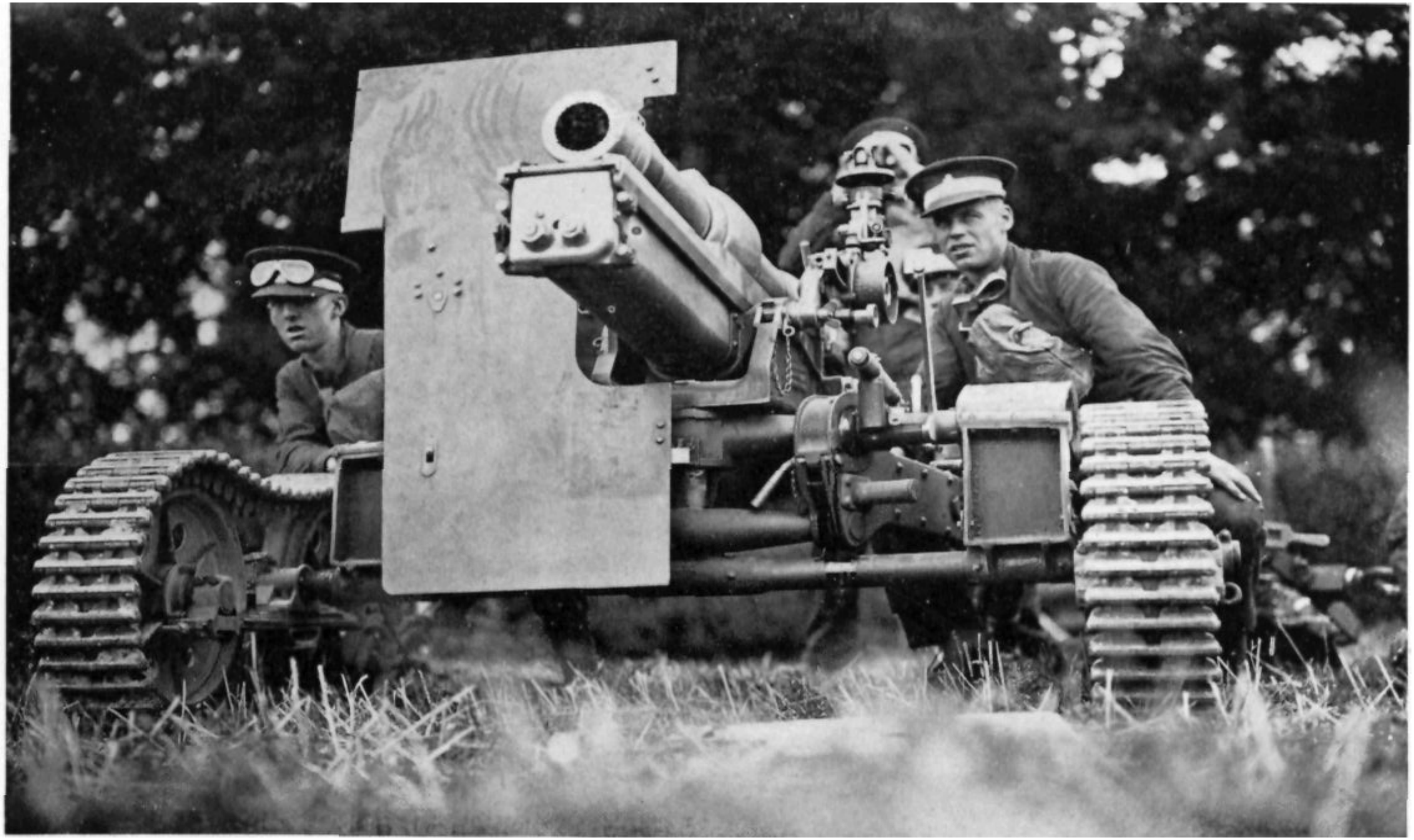
From that day to this the devising of ways and means of ensuring the "intimate combination of infantry and artillery" has been the constant preoccupation of every general staff, and the magnitude and importance of their task has not been diminished since the war by the enormous increase in the number of automatic weapons on the one hand and by the reduction in the quantity of artillery on the other.



The consequence of this two-fold change is that, compared with 1918, the forward impulse of the leading troops has to be maintained in the face of approximately four times as many machine guns by only about one-half as much artillery.

The implication is obvious. If the "intimate combination of infantry and artillery" was necessary in the years 1914-1918 it is now essential.

This close association of the two arms can be, and of course is, ensured to a great extent by the selection of suitable objectives and the careful co-ordination of the fire plant; but when all this has been done something more is required to deal with those machine guns and centres of resistance which have escaped the



BRITISH 3.7″ HOWITZER ON CATFRPILLAR TREADS

initial preparation and the pre-arranged programme of covering fire. Unless these can be quickly subdued they will create a series of sudden and unexpected crises whose cumulative effect will be to destroy the impetus and cohesion of the attack.

One of the means devised to provide this "something more" is the close support weapon.

If it is to carry out its task efficiently its support must be both immediate and effective—that is, its fire must be controlled by direct observation, and communication between the infantry, the artillery observer and his guns must be quick and reliable. In essentials therefore the problem of close support is a problem of communications. Given reliable communications the position of the weapon itself is immaterial.

Unfortunately, however, as we all know, the reliability of artillery communications is in inverse ratio to their length. Consequently the conditions of reliability can only be satisfied by siting the close support weapon near the observation post. By doing so telephone communications can be reduced to a minimum or replaced by voice control or visual.

It follows that the location of the observation post is a matter deserving careful consideration. The best position is near the

BRITISH 3.7″ PACK HOWITZER BEING USED AS A MOTOR-DRAWN AND AS AN ANIMAL-DRAWN ACCOMPANYING GUN

THE PACK HOWITZER IS PARTICULARLY EASY TO MOVE BY MAN POWER. IT CAN ALSO BE BROKEN DOWN INTO EIGHT LOADS

commander of the troops who are being supported, for this facilitates liaison. Whenever possible therefore this commander should site his headquarters near the close support observer, on the principle that since the Mountain can't come to Mahomet, Mahomet must go to the Mountain. The worst position for the observation post is up with the foremost troops, for here the intensity of small arm fire prevents movement, handicaps observation, and interferes with fire control. Within these limits the actual position will depend upon the ground. Enclosed country will force the observation post—and therefore the weapon—to the front; open country will keep the weapon—and therefore the observation post—farther back.

The important thing to bear in mind in all close support work is that whenever possible the observation post, the weapon itself, and the commander of the troops it is covering should be sited in close proximity to one another.

So far the problem has been looked at mainly with reference to the infantry, because it is with that arm that it assumes its greatest importance. What has been said, however, applies with equal force where the close support of cavalry is concerned, for the two cases are so closely related that they constitute to all intents and purposes one problem, and as such it is proposed to treat them. No attempt will be made, however, to consider the close support of mechanized formations such as armoured forces. That is quite a different problem governed by an entirely different set of conditions and is really beyond the scope of the present article.

THE WEAPON

Any weapon that is to carry out a close support role successfully should be able to meet certain minimum requirements as regards Range and Accuracy, Rate of Fire and Shell Power, Crest Clearance, Mobility, Invulnerability and Simplicity. Perhaps the best way to determine what those requirements are is to consider them under these several headings.

Range and Accuracy.—Machine gun fire is undoubtedly the principal obstacle to the advance either of infantry or of cavalry. The neutralization of machine guns will in consequence be one of the main tasks of the close support weapon. More often than not these machine guns will be sited to the flank of the troops they are holding up, so that the machine gun target of the close support weapon will often be situated outside the front allotted to the battalion it is supporting, perhaps by as much as 500 yards or so. Ranges of the order of 1500 yards will therefore be quite common to a close support weapon sited near, say, battalion headquarters. Given a range of 2000 yards it should be able to meet all contingencies.

The degree of accuracy required depends on the situation. Great precision will seldom be necessary where machine guns are being neutralized since these will rarely be accurately located. But in carrying out its role the close support weapon will often be called upon to engage targets in close proximity to its own troops, and for this a small 50% zone is essential.

A reasonable conclusion under this heading is that any close support weapon should have a range of 2000 yards and a 50% zone of the order of 3% of the range.

The sighting arrangements must be such as to enable the weapon to engage targets successfully by indirect methods.

Rate of Fire and Shell Power.—Being a weapon of opportunity the close support weapon will not as a rule be called upon to fire for more than a brief period at a time, but during these periods it should be able to maintain a rate of fire of four rounds per gun per minute and of firing at least twice that rate for short bursts.

Its shell-power must be sufficient to breach ordinary buildings and to create an effective smoke screen. Subject to these requirements the lighter the shell the better, in order to ease the problem of ammunition supply.

Crest Clearance.—Great crest clearance is essential to enable the weapon to make all possible use of cover, to reduce dead ground, and to permit of its firing over the heads of troops close in front of it. Great searching effect is also necessary. The weapon should therefore have a high angle of departure at short ranges.

Mobility.—The weapon must be able to keep up with the troops it is supporting. Consequently its mobility, in the sense of speed over the ground, must be greater than theirs, in order that it can catch up again after coming out of action; and its mobility, in the sense of power to surmount obstacles, must be as good. This means in effect that the weapon's mobility should be at least equal to that of the machine guns of the unit it is supporting—a condition that can only be satisfied if in the last resort the weapon is capable of being carried by hand.

Vulnerability.—Vulnerability and mobility are closely related.

Since bullets are an obstacle to movement protection from bullets is one way of ensuring mobility. This protection can be obtained by speed, which is one aspect of mobility, by concealment, and by armour. Protection by armour is positive and is made possible by mechanization, but armour increases the weight and this leads either to a reduction of speed or to an increase in motive power and therefore in the size of the vehicle. This in turn militates against concealment on the move, an important factor if the weapon is to reach its position unseen and so escape the risk of destruction by shell fire when in action.

The weapon should therefore be inconspicuous both in action and on the move. This postulates among other things a low silhouette, a small crew, and a compact unit of maneuver—to include the weapon together with its means of traction, its crew, and its ammunition. On the whole it seems better to seek invulnerability in this way rather than by using heavy armour and producing an inferior substitute for a tank. Light armour, providing the weapon and its tractor is not made conspicuous thereby, is of course a great advantage.

Simplicity.—Simplicity is an advantage in any weapon. It is particularly desirable in the case of one designed for close support. Owing to the nature of its employment material losses will doubtless be heavy, so that quick and cheap production is important. The difficulties of movement in the forward zone make it undesirable to employ a weapon with mechanisms liable to become deranged by rough handling, dust, and mud, while speed both in getting into and out of action can only be assured by having simple and easy assemblies.

A moment's consideration of these requirements compels the admission that there is really only one type of weapon that can satisfy them all—a light mortar.

On the other hand a light howitzer, such as the 3.7, is a not entirely unsatisfactory substitute, and a great deal of useful experience can be, and has been, gained from its use in this role; though designed for quite a different purpose it can, if skilfully handled, carry out close support tasks with considerable success. Moreover it has two advantages denied the mortar in that, being a fully fledged artillery weapon, it can be used either as an antitank gun or to reinforce the divisional artillery.

It can be transported in a number of ways each of which has its advantages as well as its disadvantages. In pack it can go practically anywhere, but is very vulnerable; moved by animal draught it is inconspicuous, presents a comparatively small target, and with a certain amount of manhandling can get over most types of country; in both these cases, since the detachments are dismounted, its rate of movement is slow. With mechanical traction or porterage it is very inconspicuous and presents an extremely difficult target on the move; but, though its speed over good going is considerable its obstacle-crossing capacity is somewhat smaller than when animal draught is used. In spite of this disadvantage, however, the high speed obtained by mechanization is a necessity when the weapon operates with mobile troops and an undoubted asset when working with infantry. If required it can be dismantled and carried short distances by hand.

EMPLOYMENT

The light howitzer only will be considered under this heading. But practically all that is said applies with equal force to the light mortar, though the use of the latter presents fewer difficulties.

A battery organization for the light howitzers is administratively convenient and, since they may be required for divisional artillery tasks, tactically necessary; but when employed in their close support role in the forward zone it will rarely be possible and seldom desirable to use them as complete batteries. For this reason the organization must readily permit of detachments being made which are self-contained from a tactical point of view. It is a distinct advantage also if these detachments are self-sufficient from the administrative standpoint for short periods. The most suitable detachment is the section (two guns).

One or more of these may be allotted to a battalion according to circumstances—the usual number being one.

The employment of a single section presents a nice problem for the consideration of the battalion commander. If the ground is such that the whole of the battalion front can be seen from one place the solution is comparatively simple. That place becomes the observation post and both guns and battalion headquarters are placed near it. The battalion commander himself shares the observation post with the section commander and everything is ready to deal with situations as they arise.

There are many types of country however in which it is quite impossible to obtain a view of a whole battalion front from any one point. Here a real difficulty arises in the handling of the close support weapon. The battalion commander in this case must either commit the section to the support of one of his leading companies—thus depriving the others of the possibility of close artillery support—or he must keep the section in reserve ready to assist any company that is held up. In this case the support may not be immediately forthcoming.

The actual method adopted by the battalion commader must, as always, depend upon the situation. Frequently he will be able to foresee where support will be required and in this case the close support weapons can be ordered to assist a definite company—for instance the vanguard company in an advance; in other instances it will be better for him to avoid committing them too soon.

The ideal solution perhaps is to have sufficient weapons to enable an allotment to be made to all the leading companies. This might be possible with mortars but not with howitzers.

No matter how the infantry commander, or cavalry commander for that matter, decides to employ the close support section, the difficulty still remains of discovering the machine guns that are holding up the advance. More often than not these will be defiladed from the front and invisible to the close support observer, while the infantry actually being fired at will seldom have more than a hazy idea as to their position. Even if the infantry can locate them approximately they will have to get the information back and this will take time. The close support section must rely therefore to a great extent on its own resources for information, and the best solution seems to be for it to send out patrols to watch the situation, send back reports, and if required, observe fire. One of these patrols should go with each of the leading companies and should consist of an observer and a signaller provided with a lamp. They should be sent out even if the section is being kept in reserve since the information they obtain may enable the section to act in anticipation of orders and so save time.

If cavalry instead of infantry are being supported the methods to be pursued are much the same. In this case, however, the resistance encountered will seldom be so serious; on the other hand the artillery available to support the attack will certainly be less. Under these circumstances it will usually be necessary to use the close support weapons from the outset to supplement the horse artillery. By making use of the mobility conferred by mechanization they can be transferred rapidly from one part of the front to another, and in this way can be used to assist in attacks on several different localities. They are also eminently suitable for increasing the fire power of small bodies of cavalry, such as squadrons assigned to special tasks. Owing to this possible use as "Supplementary" artillery the light howitzer, on account of its greater range and shell-power, seems to be a more satisfactory weapon for the close support of mobile troops than the mortar.

In close support work the supply of ammunition presents difficulties. There is a danger, by no means negligible, that in pushing forward with the leading troops the weapons may become cut off from their source of replenishment by a fire-swept zone across which their ammunition can only be transported with difficulty. This applies with particular force to non-mechanized units, and on occasion it may be necessary to keep the weapons further back in order to ensure a continuous supply.

Another factor that plays an important part in close support work is rest for the men. Owing to the demand for close support there is always a temptation to leave a section which has been operating with one unit to carry on with the next when a relief takes place. This temptation is a natural one but it should be resisted. Close support work is arduous, especially when animal draught is used and detachments walk, and the men employed on it must have opportunities for rest or they will soon break down. For this reason it is important to keep a portion of the weapons in recerve to provide reliefs.

CONCLUSION

This does not pretend to be more than an outline of some of the aspects of close support. The problem is not a new one, but it is one which, owing to the multiplication of automatic weapons, must receive ever increasing attention. It is, as we have seen, primarily a problem of artillery communications—a special weapon being necessary only because these, if lengthy, cannot be relied on; and the whole question may eventually be solved by the evolution of wireless. That remains to be seen; but one thing is certain—that in any future with which we are concerned success in battle will depend, as it has in the past, on the "intimate association in infantry and artillery," in other words—on close support.

EDITOR'S NOTE.—The photographs which illustrate this article were obtained through the courtesy of Major W. E. de B. Whittaker, editor of the *Army, Navy and Air Force Gazette* (British) and the author, Captain Murison. Except for the illustration of the British experimental self-propelled field piece on page 366, the photographs which go with this article depict various tests of the British 3.7″ pack howitzer employed as an Infantry accompanying gun with motor and animal draft.

LEST WE FORGET

ON April 6, 1917, the day war was declared on Germany, the Field Artillery of the Regular Army was composed of 14 Colonels, 14 Lieutenant Colenels, 32 Majors, 136 Captains, 145 First Lieutenants, 69 Second Lieutenants.

During the war, in addition to many lesser promotions, the following advancements among these officers occurred:

1 Colonel rose to the rank of General and Chief of Staff of the Army.
9 Colonels rose to the rank of Major General.
3 Colonels rose to the rank of Brigadier General.
2 Lieutenant Colonels rose to the rank of Major General.
8 Lieutenant Colonels rose to the rank of Brigadier General.
7 Majors rose to the rank of Brigadier General.
21 Captains rose to the rank of Brigadier General.

None of these officers suffered a reduction in rank during the war, and, with only a few exceptions, all served in the A. E. F.—a majority of them on combat duty. Since the war, one Field Artillery officer was advanced to the rank of General and Chief of Staff of the Army, one to the rank of Deputy Chief of Staff of the Army, eleven to the rank of Major General, and five to the rank of Brigadier General in the permanent establishment.

A brief of the records of these officers follows (star indicates that the officer is now deceased; the others are entitled to the address of "General" and to retirement with the highest rank held by them during the war):

Name	*Grade in Regular Army Apr. 6, 1917*	*Highest Grade Attained in World War*	*Principal World War Duties*
Millar, E. A.	Colonel	Brig. Gen., N. A. (2-6-18)	C. G., F. A. Brig., 6th Div.
Sturgis, S. D.	Colonel	Maj. Gen., N. A. (8-28-17)	Division Comdr.
Berry, L. G.	Colonel	Brig. Gen., N. A. (9-11-17)	C. G., F. A. Brig., 36th Div.
*McMahon, J. E.	Colonel	Maj. Gen., N. A. (2-6-18)	Div. Comdr.

*Menober, C. T.	Colonel	Maj. Gen., N. A. (12-2-17)	Div. & Corps Comdr.
Hinds, E.	Colonel	Maj. Gen., N. A. (5-12-18)	Chief of Artillery, AEF
March, P. C.	Colonel	General (Emergency comm.) (5-25-18)	Chief of Staff, U. S. Army
*Kenly, W. L.	Colonel	Maj. Gen., N. A. (5-16-18)	Chief of Air Service, AEF; Dir. of Milit. Aeronautic, W. D.
McGlachlin, E. F., Jr.	Colonel	Maj. Gen., N. A. (6-2-18)	Chief of Artillery, 1st Army, AEF; C. G., American Forces in Germany.
Lassiter, Wm.	Colonel	Maj. Gen., N. A. (8-27-18)	Chief of Artillery, 2nd Army, AEF; Div. Comdr., March to Germany.
*Irwin, G. LeR.	Colonel	Brig. Gen., N. A. (8-29-17)	C. G., F. A. Brig., AEF
McNair, Wm. S.	Colonel	Maj. Gen., N. A. (9-2-18)	Chief of Artillery, Corps & Army, AEF.
Snow, Wm. J.	Colonel	Maj. Gen., N. A. (7-9-18)	Chief of Field Artillery, U. S. Army.
*Gatley, G. G.	Lieut. Col.	Brig. Gen., N. A. (8-25-17)	C. G., F. A. Brig., AEF.
*Lyon, LeR. S.	Lieut. Col.	Maj. Gen., N. A. (5-30-18)	Div. Comdr.
*Horn, T. N.	Lieut. Col.	Brig. Gen., N. A. (2-7-18)	C. G., F. A. Brig., AEF.
Summerall, C. P.	Lieut. Col.	Maj. Gen., N. A. (7-12-18)	C. G., F. A. Brig., Div., Army Corps, AEF.
Cruikshank, W. M.	Lieut. Col.	Brig. Gen., N. A. (7-11-18)	C. G., F. A. Brig., Chief of Arty., Army Corps, AEF.
*Aultman, D. E.	Lieut. Col.	Brig. Gen., N. A. (5-2-18)	C. G., F. A. Brig., AEF.
Fleming, A. S.	Lieut. Col.	Brig. Gen., N. A. (5-12-18)	Comdt., Sch. of Fire for F. A.; C. G., F. A. Brig., AEF.
Bowley, A. J.	Lieut. Col.	Brig. Gen., N. A. (7-11-18)	C. G., F. A. Brig.; Chief of Arty., Army, Corps, AEF.
Bishop, H. G.	Lieut. Col.	Brig. Gen., N. A. (7-10-18)	C. G., 3d F. A. Brig., 3d Div. with 1st Army, AEF.
McCloskey, M.	Lieut. Col.	Brig. Gen., N. A. (8-26-18)	C. G., F. A. Brig., AEF.
*Stephens, J. E.	Major	Brig. Gen., N. A. (6-26-18)	C. G., F. A. Brig., AEF.
Conner, F.	Major	Brig. Gen., U. S. A. (8-8-18)	Asst. C. of S., G-3, AEF and C. of S., AEF.
Butner, H. W.	Major	Brig. Gen., U. S. A. (10-21-18)	C. G., F. A. Brig., AEF.

Holbrook, L. R.	Major	Brig. Gen., U. S. A. (8-27-18)	C. G., F. A. Brig., AEF.
Starbird, A. A.	Major	Brig. Gen., N. A. (5-30-18)	IGD; C. G., F. A. Brig., AEF; C. O. Post, Brest, France, with Base Section No. 5, SOS, AEF.
Spaulding, O. L., Jr.	Major	Brig. Gen., N. A. (7-10-18)	Asst. Comdt., S. of F. for F. A., U. S.; IGD; C. G., F. A. Brig., U. S. & AEF.
Austin, F. T.	Major	Brig. Gen., N. A. (5-30-18)	C. G., F. A. Brig. & FARD, Camp Taylor, Ky.
Moseley, G. V. H.	Captain	Brig. Gen., N. A. (7-11-18)	Chief 4th Section, GS, AEF.
*Donnelly, E. T.	Captain	Brig. Gen., N. A. (5-1-18)	C. G., F. A. Brig., AEF; Actg. Chief of Artillery, Army Corps.
Westervelt, W. I.	Captain	Brig. Gen., N. A. (6-1-18)	Chief Material Section, Army Arty.; Asst. to Chief Artillery, AEF.
McIntyre, A.	Captain	Brig. Gen., N. A. (5-1-18)	C. G., F. A. Brig., US & AEF.
Briggs, R. W.	Captain	Brig. Gen., U. S. A. (8-26-18)	Chief, Remount Service, AEF; C. G., F. A. Brig., U. S.
*Craig, D. F.	Captain	Brig. Gen., U. S. A. (10-15-18)	C. G., F. A. Brig., AEF.
Burt, W. H.	Captain	Brig. Gen., U. S. A. (8-27-18)	C. G., F. A. Regt. and F. A. Brig., U. S.
Lawson, L. L.	Captain	Brig. Gen., U. S. A. (10-12-18)	Comdt., Sch. of Fire, F. A.
Kilbreth, J. W., Jr.	Captain	Brig. Gen., U. S. A. (12-14-18)	Director Dept. of Firing Sch. of Fire, F. A.; C. G., F. A. Brig., AEF.
Bryson, J. H.	Captain	Brig. Gen., U. S. A. (12-17-18)	Director Dept. of Tactics Sch. of Fire, F. A.; Cmdg., F. A. Rgt. & Brig., AEF.
Ennis, W. P.	Captain	Brig. Gen., U. S. A. (8-27-18)	Director Dept. of Materiel, Sch. of Fire, F. A.; C. G., F. A. Brig.
*Currie, D. H.	Captain	Brig. Gen., U. S. A. (10-11-18)	G. S.; C. G., F. A. Brig.; Comdt., F. A. School.
Browne, B. F.	Captain	Brig. Gen., U. S. A. (8-26-18)	Army Arty. Staff, AEF; Comdg., F. A. Brig., AEF.

DeArmond, E. H.	Captain	Brig. Gen., U. S. A. (8-29-18)	C. of S., Div., AEF; Chief F. A. Section, Off. Ch. of Arty., AEF; O. C. F. A., Washington, D. C.
Churchill, M.	Captain	Brig. Gen., U. S. A. (8-27-18)	C. of S., Army Arty., AEF; Director M. I. D.; G. S., AEF.
McNair, L. J.	Captain	Brig. Gen., U. S. A. (10-13-18)	G. S. with 1st Div., AEF and GHQ, AEF as Sr. Arty Off. Training Section.
Allin, G. R.	Captain	Brig. Gen., U. S. A. (10-1-18)	Inst. S. of F., F. A.; Exec. and Director of Training, O. C. F. A., Washington, D. C., Comdg. F. A. Regt. & Brig.
Glassford, P. D.	Captain	Brig. Gen., U. S. A. (10-1-18)	Secy. & Comdt., Saumur Artillery School; C. O., F. A. Regt. & Brig., AEF.
Bryden, Wm.	Captain	Brig. Gen., U. S. A. (10-1-18)	Director, Dept. of Gunnery & Asst. Comdt., S. of F., F. A.; C. G., F. A. Brig.
Blakely, C. S.	Captain	Brig. Gen., U. S. A. (10-1-18)	Insp. F. A. from O. C. F. A., Washington, D. C.; Comdt. F. A. B. Firing Center, Camp Knox; Comdg. F. A. Brig.
Danford, R. M.	Captain	Brig. Gen., U. S. A. (8-27-18)	Comdg. F. A. Regt., In O. C. F. A., Washington, D. C.; Comdt., F. A. Replacement Depot, Camp Jackson, S. C.

DIVISION ARTILLERY

BY GENERAL CULMANN, French Army

THE composition of division artillery depends upon the role of the division in the corps. The kind of weapons and number of different types of artillery matériel which should be allotted to the artillery of the division depends, above all, on the mission to be assigned to the division, and consequently also upon the prevailing ideas about the tactical employment of the corps to which the division belongs.

It is evident that if, as in France, the *corps* conducts the fighting, this large unit must necessarily be endowed with powerful artillery of its own. The Corps Commander may then coordinate the action of his division by means of his corps artillery and his infantry reserves. Division artillery thus would consist of only the necessary types of matériel for the current support of the infantry, and corps artillery is given weapons of greater range and power and of less mobility.

If on the contrary, as in Germany, the *division* is the unit which conducts the fighting its artillery must include more guns and more varied types of matériel.

Two examples will illustrate these statements: In Germany since the end of the Nineteenth Century the army corps has been considered simply as the sum of two or more divisions. Thus the Germans did away with corps artillery notwithstanding the excellent service it rendered in 1870, and the corps artillery batteries were divided up among the divisions. Even today the hypothetical "grosse division" which is used in map problems and in skeleton maneuvers awaiting the day when it can actually be put into effect after the expiration of the military clause of the Treaty of Versailles, contains all of the following types of matériel: an accompanying gun to go with the Infantry; a field piece of 77mm caliber; a light howitzer of 100mm caliber; gun and howitzer of 150mm caliber; anti-aircraft artillery. Of these, certain units are horse-drawn and others motorized.

The French school of thought is just the opposite. As an illustration of this a decree appeared a short time before the war

(October, 1913) on the "handling of large units" which didn't even refer to the division. The provisional instructions of 1931 on "tactical employment of large units," on which all other instructions along these lines are based, divides the roles of the corps and the division (articles 49 and 50) as follows: the corps is a unit which is able to engage the enemy on an extended front and to carry on the battle to a decision. The Corps Commander has at his disposition several divisions and also non-divisional organizations; he arranges and conducts the fighting of his division and intervenes directly in the fighting by prolonging or reenforcing certain ones of them by means of his non-divisional organizations. Since he has at his disposition completely organized units, the Corps Commander is able to receive and absorb a large number of reenforcing units and to utilize them properly in battle.

The Infanty division is the lowest unit which is susceptible of conducting with its own means an important attack, but it only has a restricted field of action and is only able to carry on for a limited time. Furthermore the Infantry division is the basic large unit within which are combined the action of its various arms. Altogether it seems to be a team which should not be disturbed by putting into it numerous reenforcing elements.

One must choose between the French and the German schools of thought. In many minds the latter is preferable. It is certain that the German way of organizing, especially towards the end of the war, led to a dispersion of efforts in battle. On the contrary the French corps arrangement enabled its commander to work most effectively and conduct the fighting in such a way as to be able to break up enemy resistance.

Why French division artillery has no light howitzers.—As we all know, the French divisions went to war in 1914 armed only with the 75mm gun, model 1897—one regiment of three battalions of three batteries each per division. Later as trench warfare developed it was necessary to give the division a curved fire weapon and the 155mm howitzer was chosen. It was copied from a model prepared for Russia by the Schneider (Creusot) Company.

In other countries the division had similar matériel with the calibers about the same, but in addition they had light howitzers of from 105 to 120mm caliber.*

The difference between the matériel assigned to French divisions and the light artillery of foreign countries is so striking that it deserves an explanation. The light howitzer question was put up to all armies as a result of the siege of Plevna (1877) where the Russian artillery had to deal with entrenched Turks. At this time Germany began to made a study which finally resulted, twenty years later, in their adopting a light howitzer of 105mm caliber. Its tube was very good but the carriage later had to be changed. In France, war experience caused us to adopt in 1877 two types of howitzer matériel—the 120mm howitzer and the 155mm howitzer. Major Baguet produced both of these and afterwards in 1914 he was Director of Artillery at the Ministry of War. These two different types of howitzers were to be used for different purposes. General Baguet intended the 120mm howitzer to provide above all plunging fire and at the same time have a mobility comparable to that of the 90mm flat trajectory weapon. That was exactly the same solution that was decided upon by the Germans as regards the light howitzer, but General Baguet had in mind using the 155mm howitzer to tear up the ground—in other words to destroy trenches. Repeated tests at the Proving Grounds at Bourges proved that the latter effect could only be obtained by a howitzer of at least 155mm caliber whose projectiles weighed from 40 to 43 kilograms. This idea became almost a principle in the minds of French technicians, who for fifty years clung to it. The 120 and 155mm Baguet howitzer carriages were not very stable in firing. Moreover their range, especially that of the former, was insufficient and inferior to that of the field piece then in use (Colonel DeBange's 90mm gun). These two types of howitzer matériel, however, were not utilized in divisions nor even in corps, but were relegated to armies and siege artillery parks.

*The Schneider Company has recently constructed three models of light howitzers all of the same caliber—105mm. They have muzzle velocities of 435, 470 and 550 meters per second, projectiles varying from 12 to 14 kilos, maximum range of 10, 9.5 and 12 kilometers, length of tubes from 1.87 to 2.46 meters, weight in battery of 1575, 1450 and 1930 kilos. Japan has adopted the third of these types which is of course the most powerful.

In 1904 Major Ramailho designed a weapon which retained the Baguet 155mm howitzer tube, but had a very ingenuous new carriage. This type was carried on two vehicles, a 3000 kilogram load on each, and it was accurate up to 4000 meters. Nevertheless its range was inferior to that of the new 75mm field piece, model 1897. Major Ramailho's howitzer was not used in division artillery. At that time warfare of rapid movement was the latest idea and it appeared that his howitzer had no place in campaigns of rapid movement. In the meantime the Superior War Council kept insisting in vain upon a light howitzer. No light howitzers were adopted either before or during the World War although excellent modern carriages were made for the old 90 and 95mm guns (model 1875), with a view to using them as light howitzers, the idea being that divisions could thus be rapidly furnished with good field howitzers without excessive expense. Trench warfare however caused us to turn to the 155mm howitzer, all on one carriage, which we are still using.

Thus of the two problems which we had in 1888, namely curved fire and fire for the destruction of trenches, only the latter was solved. The cause of this is to be found in the fact that our technicians obstinately contended that the 75mm gun was capable of giving the effect of plunging fire and consequently a light howitzer was not necessary. We will see later on that this opinion was completely wrong.

The composition of French corps artillery.—From the above we see why the French division artillery contains the 75mm gun and 155mm howitzer. The range of these two weapons has been progressively increased by perfecting the shape of the projectile and improving the propellants and fuzes. Furthermore they both have about the same maximum range—11 kilometers.

It is indispensable that the ranges of the artillery weapons of a division be approximately the same. Any considerable difference in range between types of artillery within the division would be troublesome on the battlefield and would lead to a tendency to employ the type of matériel which could shoot farther in situations in which it would not be appropriate.

The 155mm howitzer proved itself capable of tearing up the ground in trench warfare and was also very useful for the destruction of the enemy artillery. For this reason the 155mm howitzer is frequently used in counterbattery. But in order that this weapon might be as effective as possible against strongly constructed defenses it must be supplied with a certain proportion of shells with reenforced ogive and armed with delay fuzes. In one of the battles in Artois a battery of 155mm howitzers was unable to silence German machine guns which were firing from under heavy cover and the French artillerymen requested the aid of the battery of British howitzers which was in the neighborhood and which had the right kind of projectiles and fuzes. The British were altogether successful in a short time where the French had failed.

It should be a rule that all artillery, both guns and howitzers, of calibers of 130 milimeters and over (the caliber of an excellent German gun) be provided with a certain proportion of reenforced shell with delay fuzes not only for effect on trenches, but also to penetrate deeply into the ground before exploding in order to reach subterranean cover.

However, the presence of a 155mm weapon within a division presents serious drawbacks on account of its weight. As far back as the Eighteenth Century it has been admitted that with horse-drawn traction a weight of over 3000 kilometers must not be exceeded if the weapon is to follow Infantry on the road and across gentle slopes. Now the French 155mm howitzer exceeds this maximum by about one-quarter, and in battery it weighs about 3300 kilograms. Such heavy matériel is naturally restricted in mobility and is unable to utilize much terrain which can be used by the 75s. Furthermore its entry into action is slow and as its projectile weighs 43 kilograms the supply of ammunition is complicated and the rate of fire is reduced to two rounds per minute. Thus the 155mm howitzer has become a weapon for special employment which does not work in very well with the light field gun, and as a result the latter often has to do all the work. This is one of the principal reasons for regretting the absence of a light howitzer of about 105mm caliber whose weight would be very little more than that of the 75, but which could shoot a projectile weighing more than double that of the 75.

The French division artillery consists of 75mm guns and 155mm howitzers supported by the following corps artillery:

Two battalions (24 guns) of 105mm caliber.

Two battalions (24 guns) of 155mm caliber.

The first of these weapons is primarily for interdiction and harassing effect, and the second is primarily for counterbattery. The following data on these weapons is of interest:

	105mm gun (1913)	155mm gun (1918)
Maximum range	12,700 meters	13,500 meters
Weight of projectile	16-17 kilos.	40-44 kilos.
Muzzle velocity	550-420-360 ms.	Max. 560 ms.
Number of charges	3	9
Weight traveling	2700 kg.	5750 kg.
Weight of piece in battery	2300 kg.	5250 kg.

These two guns are capable of plunging fire.

The 105mm gun weighs considerably less than the 155mm howitzer and is comparable to the 75mm gun as regards mobility. It weighs 2700 kg. as compared with 2100 kg. for the 75. Its range is somewhat longer than that of the 75 (12,700 meters against 11,000 meters) and it fires a projectile which weighs about three times as much. Therefore in war of movement the 105mm guns were often attached to divisions at the beginning of a battle in order to obtain contact with the enemy and they were also assigned to rear guards.

Of the four types of artillery weapons in the French division and corps only the 75 was constructed in accordance with French specifications. The 105mm gun and the 155mm howitzer are copied from Russian weapons. Their carriages as well as that of the 155mm gun, is likewise Russian.

These three types were put out by the Schneider factories which had manufactured the Russian artillery. From this we must conclude the following: *it is very important for the government to favor the building of foreign matériel in home factories*. French artillery would have been cruelly diminished if Schneider had not been making guns for Russia. Their plant had also been used to manufacture heavy mortars of 293mm caliber for Denmark.

Drawbacks of the flat trajectory of the 75s.—The 75mm gun (model 1897) has as much muzzle velocity as the other light field pieces which were constructed at that time. It exceeds the German

75mm gun (model 1896) by about 100 meters per second—535 ms. against 440 ms. The trajectory of the French weapon is much flatter than that of the German weapon, which makes it much more difficult to obtain suitable positions from which the crest can be cleared. On the other hand the French projectile has a fuze which is not streamlined, with the result that the projectile moves poorly through the air and quickly loses its initial velocity and consequently its remaining velocity after going 3000 meters is the same as that of the German projectile. The great initial velocity of the French 75 caused nothing but trouble. It may be interesting to explain why its designers wanted it. Back in 1890 when the specifications for a new field piece were being worked out, all of the artillery generals had forgotten the war of 1870. They didn't dream about massed fire and they had bad memories about fuzes which caused air bursts. They decided to turn to percussion fire in view of the fact that the German artillery had obtained an incontestable superiority with it. Now in percussion fire, as soon as the remaining velocity becomes very small and the angle of fall is very steep, the projectile sinks straight into the earth, bursts and is ineffective. In order to avoid this at medium ranges, the designers decided that a very high initial velocity was desirable. They even talked about 700 meters per second. Although they finally came down on their specifications as regards muzzle velocity, nevertheless the 75 has a very high muzzle velocity.

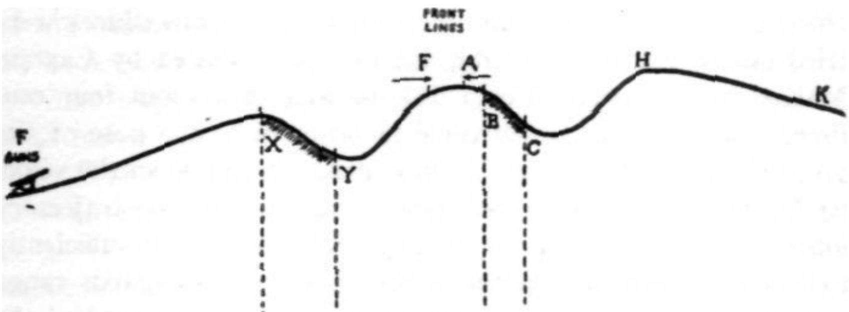
During the World War the flatness of the trajectory of the 75mm gun gave the following two kinds of trouble: first, difficulty as regards positions for the batteries; second, inability to reach targets which were well defiladed or to reach many slopes upon which the enemy was located.

On the defensive and in stabilized warfare one of the best methods of safeguarding the inviolability of a front is by dense barrages of explosives put in front of the line of resistance as soon as the Infantry which occupies the first line trenches is menaced by enemy attack.

Evidently the sectors assigned to the supporting batteries should be in continuous line along the whole front without the batteries belonging to one unitbeing called upon to shoot into the sector of another unit. This condition is necessitated by the fact that any Infantry unit must be able to call upon its supporting artillery for the protective barrages it requires. Thus excellent liaison is established between the two arms, and this liaison is not only neessary for barrages but it also serves during all the situations which occur in battle such as movements forward and to the rear.

Now when it happens that the terrain is broken or rugged in the vicinity of the line of resistance it is often necessary to emplace the artillery at some distance from its Infantry both as to depth and lateral displacement. It frequently occurs that batteries of other corps utilize areas left vacant by these batteries which have to go some distance to support their Infantry. Thus for example batteries A, B and C might have to be put in positions at some distance from the Infantry they are supporting and batteries D, E and F might utilize ground immediately behind that Infantry, but the sectors of the baterries are determined not by their position in line from right to left but by the position of the Infantry they are supporting. In the case above since batteries A, B and C are supporting their Infantry their fire would be in front of their Infantry and the fire of batteries D, E, and F would be in front of the Infantry they are supporting regardless of where battery positions are located. Naturally such siting of batteries causes a lot of trouble as far as interior communications, supply and discipline in the artillery are concerned. Such an arrangement would be intolerable in the case of an artillery duel. In stabilized sectors, however, it was possible to put up with it because communications and liaison are established slowly and the 75mm guns are rarely used for counterbattery. It hardly seems necessary to say that in war of movement such a mix-up of battery emplacements, with areas occupied by batteries of different battalions and even different regiments, would be out of the question. With light howitzers, whose trajectories are more adaptable to the forms of the ground, this kind of mix-up would not occur.

Frequently the angle of fall of the 75s was not steep enough to reach many slopes in northeastern France. On these slopes our Infantry could not be supported by its artillery. The Infantry must fight regardless of terrain and it is not right to require them to fall back or to advance to positions which can not be covered by the batteries supporting them. Thus on the ground shown in the illustration where the opposing Infantry troops are located at F and A, the slope BC can not be reached by the flat trajectory artillery of the F troops, and the enemy A can assemble his reserves on the ground BC without being molested by the F artillery. Now if the Fs fall back they can not be supported between Y and X. If the Fs advance they can not be supported between B and C. Yet the As with their curved trajectory weapons can reach this area. At times the 75s had to be put far back in order to be able to sweep zones with long range fire which they could not reach with shorter ranges. This expedient was particularly detestable because the farther back the artillery gets from the front the less it can reach into the depths of the enemy positions.



There were other objectionable features caused by the flatness of the trajectory of the 75s. In the autumn of 1916 at Mort-Homme at Verdun on the left bank of the Meuse the French commander ordered that the crest be taken from the Germans because it furnished them good observation. The attack went off perfectly but on the next day the Germans counter-attacked and were able to gain back the crest. The Infantry said that the artillery had not responded to their calls for a barrage. The artillery said that was not so. A German prisoner stated that he had seen the shells falling in the area referred to, but they were very scattered. Now just what did happen? Comparing the profile of the ground HK where the Germans counterattacked with the trajectory of the 75s at the range they were firing (4500 meters), it was found that the slope of the terrain and the angle of fall were just about the same. That explained the whole trouble. This parallelism caused a very small difference in the trajectories of the various rounds to make a tremendous difference in range to the points of fall. That is just why the German prisoner saw so few shells landing. The French barrage in this case did not form a solid wall of bursting shell. On the contrary it was very easy for the Germans to walk through it.

Therefore in order that division artillery may be readily emplaced so as to support its Infantry regardless of the profile of the terrain, division artillery must have curved trajectory weapons.

Measures taken to give the 75mm gun a curved trajectory.—Even before the war the difficulties caused by the field gun's flat trajectory and the resulting lack of ability to emplace the guns suitably in various kinds of terrain had become apparent to many officers. To get around this the following two procedures were tried out in France: the first, a nose disk invented by Captain Malandrin. It consisted of a little metallic disk about four centimeters in diameter which could be adjusted to the nose of the projectile just before firing. These disks slowed down the velocity by creating extra air resistance, thus making the trajectory more curved and increasing the angle of fall, but not sufficiently to do much good. Furthermore the dispersion as regards range was greatly increased. This mediocre device, however, had the bad effect of causing the light howitzer to be deemed unnecessary, although the wisest military authorities were calling for this type of weapon. Even Captain Malandrin himself declared that his disks were not a satisfactory substitute for the light howitzer for plunging fire. The second method was a fuze which would explode in the air for H. E. shell. Since a large proportion of projectiles of this type could be made to explode in a small zone perpendicular to the trajectory it was believed that if the shell were made to burst at the proper altitude, say thirty meters above the target, it could reach the enemy in trenches or located behind a steep obstacle. In order to do this the fire would have to be exceedingly precise, more so than practicable, and again this kind of fire was not very effective because a great amount of the effect was in the air and to the flanks. Nevertheless the introduction of the high explosive shell with time fuze was the chief argument that the artillery technicians used to prove that the 75mm gun was able to accomplish all division missions.

During the war it became evident that the two procedures outlined above were of little value. Therefore, we had to reduce the propelling charge and we thus obtained an initial velocity of 340 meters per second which gives a sufficiently curved trajectory. This arrangement was satisfactory as regards dispersion, but the range was considerably reduced. Reduced charges, of course, had the advantage of causing less wear to the guns than regular charges and permitted them to fire more rounds per minute than ordinarily. It should be pointed out, however, that even an initial velocity of 340 meters per second is too great for certain kinds of terrain. The initial velocity should be reduced to 250 meters per second in order to obtain proper angles of fall on many of the slopes where our targets were located.

It may be stated that the present organization of French division artillery is far from model. Our small caliber field piece with its flat trajectory does not give much more than an intermittent support to the Infantry when the fighting occurs over even slightly hilly country. The addition of the heavy 155mm howitzer does not solve the problem either. The latter weapon is not really designed to provide plunging fire; its efficient role is to destroy trenches and cover.

Foreign armies have very properly adopted a light howitzer which has approximately the same mobility as the light gun. Thus the two kinds of matériel are able to supplement one another. The Germans, before the war, had mixed regiments consisting of guns and howitzers and during the war they organized mixed battalions with two batteries of light guns and one battery of light howitzers. Today the question is *Shouldn't the light howitzer be the only division artillery weapon?* We will discuss this point in a later article at the time when we take up the problem of anti-aircraft and anti-tank weapons.

At this point it is well to go into the question of the desirability of increasing the range of division artillery. At present the maximum range is from ten to twelve kilometers; should we build for fourteen or fifteen kilometers? If so what kind of weapon should we have for this increased range? In order to discuss this point let us take up the matter of a more powerful 75mm gun.

A more powerful 75mm gun.—The tendency to increase range has always been manifest, but particularly so since aerial observation enables us to locate targets which can not be seen from ground O. P.'s. At the present time an effort is being made to obtain a maximum range of about fifteen kilometers for division artillery, that is to say for 75mm guns and 105mm howitzers. As regards corps artillery, an attempt is being made to increase their range to about twenty kilometers with the new types of 105 and 155mm guns. Several types of various calibers have been constructed in France which will provide the ranges given above. Schneider and Company has been making them for foreign armies.

With a given caliber, increased range is obtainable only as a result of sacrificing, in the first place, mobility, which is measured in terms of rate of travel on the road and across country; in the second place, the effectiveness of the projectile, which depends upon the amount of high explosive which it carries; and in the third place, the conservation of matériel, since the wear on the matériel is in direct relation to the muzzle velocity. These points can be brought out by referring to the following table for the ordinary and the more powerful types of 75 and 105mm guns.

75MM GUNS	*Ordinary type*	*New type*
Maximum range	11,500 meters	14,000 meters
Weight of the gun in draft	1,790 kgm.	2,110 kgm.
Weight of the gun in battery	1,320 kgm.	1,630 kgm.
Weight of bursting charge	1,725 gms.	430 gms.
Maximum muzzle velocity	570 meters	660 meters
105MM GUNS		
Maximum range	15,000 meters	19,000 meters
Weight of gun in draft	3,775 kgm.	5,425 kgm.
Weight of gun in battery	3,125 kgm.	4,950 kgm.
Weight of bursting charge	2,600 gms.	1,400 gms.
Maximum muzzle velocity	660 meters	840 meters

This table shows that for any given caliber there is a limiting maximum range which can not be surpassed without making great sacrifice as regards the mobility of the weapon in the traveling position, its ease of handling when in battle, effectiveness of its projectile and its muzzle velocity. The latest type of 75mm guns, and particularly the 105mm guns, have attained an unreasonably great range. They are super-weapons. Just a few years ago there was a saying that the greatest range in kilometers should be one and one-half times the caliber in centimeters; thus a range of 11,500 meters was about right for a 75mm gun and a range of 15,000 meters was appropriate for a 105mm gun.

One could get away from the lack of mobility on the road and in occupying positions with these powerful new weapons by giving them motor traction, or by making the battery more manoeuverable by mounting the guns on motors. Nevertheless nobody can get around the objections to having a projectile which does not carry much explosive, and a weapon which has an excessive muzzle velocity. The latter objection would, of course, mean that the weapons would wear out more quickly and heat up much sooner. As regards wear on the gun it is interesting to note that the ordinary 75 with a muzzle velocity of 535 meters per second is worn out after firing about 7,000 rounds. Some have fired 12,000, but they have been particularly well cared for. We do not know the rapidity of wear on the new more powerful 75, which has a muzzle velocity of 660 to 770 meters per second but we do know that with a 75 shooting with a muzzle velocity of 850 meters per second, as do some of the 105mm guns, the weapon would only be able to shoot about 600 rounds. Therefore, it is very important that every high-powered gun should be provided with reduced charges for medium ranges. Thus the new 75 should have two projectiles, as follows:

Range	*Weight of projectile*	*Weight of bursting charge*	*Muzzle velocity*
14,000	7,100 gr.	430 gr.	660
9,900	6,500 gr.	810 gr.	600

In order to avoid excessive wear it is necessary for these new pieces to be constructed so they can readily be relined. In order that the relining may be done without having to send the gun back to a factory it is necessary that the lined part have a little play between it and the tube. When fired the pressure of the gases of the propellants push out against the tube and the play is thus taken up. The operation of relining with this procedure only takes a few minutes. Therefore, it may be stated that each high-powered weapon should be constructed so it can be relined.

As a matter of fact, the new 75 and 105mm guns whose specifications are given in the table on page 391 are so constructed.

Furthermore high-powered weapons heat very fast. This means that "cease firing" has to be given unless serious damage is done to the gun. Cooling is, of course, a slow process, and is hastened only slightly by swabbing out. Thus these high-powered weapons are only able to furnish intermittent fire and this means that they are not very suitable for supporting Infantry unless one is satisfied with a very slow rate of fire. The necessity for reduced charges is thus obvious, and reduced charges are, of course, desirable in that they give curved trajectories. What we have said above brings us now to the question of deciding about the future field piece.

Note: This is the first of two articles by General Culmann.

ANTIAIRCRAFT FIRING BY FIRST FIELD ARTILLERY BRIGADE

BY 1ST LIEUT. R. G. PRATHER, INF., D. O. L., A. D. C. TO BRIG. GEN. GOWEN

IN connection with experimental tests in artillery antiaircraft defense, firing at towed aerial targets with Browning machine guns and automatic rifles was recently conducted at Fort Hoyle, Maryland, by the First Field Artillery Brigade.

Two sections from the 6th Field Artillery, each consisting of one noncommissioned officer and 12 privates, were detailed for the work, one section to operate the machine guns and one the automatic rifles. None of the privates had ever fired a machine gun or automatic rifle prior to the preliminary training period. One noncommissioned officer had had some experience in machine gunnery, but had had no training in antiaircraft firing.

A total of 38½ hours was available for the preliminary training which was divided as follows:

5 hours—Mechanical training.
12 hours—Preparatory marksmanship exercises.
9 hours—1,000 inch range practice.
1½ hours—Preparatory antiaircraft exercises.
7 hours—Antiaircraft practice firing on 1,000 inch range.
4 hours—Firing at meteorological balloons.

With the exception of a few changes in the targets and scoring system, the preparatory antiaircraft exercises and 1,000 inch practice followed the provisions of Training Regulations 300-5 as nearly as local facilities permitted. Calibre .22 Rifles, M1922 M1, were used by the automatic rifle section during initial 1,000 inch practice. All subsequent firing and all training of the machine gun section were with .30 calibre ammunition.

None of the new type antiaircraft sights for machine guns were available, but during preliminary practice on the 1,000 inch range and firing at balloons an attempt was made to use the M1917 antiaircraft (front area) sight. It proved unsatisfactory and was discarded for the battle sight. Guns were fired as issued without installing a stronger driving spring. Three of the machine guns were fired from the high antiaircraft tripods, M1918. The fourth gun was mounted on the low machine gun tripod, M1918, with an antiaircraft adapter. Gunners were changed frequently so as to give each man of the section an opportunity to fire.

The regular peep sight was used for the automatic rifle firing, all of which was semi-automatic and done at the standing position over a sand-bag parapet.

The rubber meteorological balloons were inflated to about twenty inches diameter and released from a pit one hundred and fifty yards in front of the battery position. A brisk wind carried them across the line of fire. The number of hits made on balloons was very satisfactory, *one automatic rifleman bringing down four of them out of ten rounds fired*.

For the firing at towed aerial targets, ammunition was loaded with one tracer to three ball cartridges. The ball cartrides were U. S. C. C. 1917 and R. A. 1918. The tracer cartridges were F. A. 1925 and F. A. 1926. Approximately fifty per cent of the stoppages that occurred during firing were due to faulty ammunition, such as split cases, short rounds, defective primers and bent cases.

The direction of fire was generally south against a bright sky and the tracer visibility was rarely good and at times practically nil. The weather was mild. On two days, the ground wind varied from seventeen to twenty miles per hour and the wind at 600 feet altitude from thirty-eight to forty-eight miles per hour. The airplanes had so much difficulty towing targets in the high wind at one time that firing had to be suspended. Much delay was experienced throughout the week through the failure of the towed target release system to function satisfactorily.

The target employed was the B 9 A, 5 feet diameter, sleeve. It was towed at an average speed of between eighty and ninety miles per hour. Panel signals were used to indicate the various directions of flight and altitudes of target desired and when targets were to be dropped. Flying missions were performed by the Ninth Observation Group from Mitchel Field, New York.

Training Regulations 300-5 on antiaircraft combat state that trained automatic riflemen can average 6 shots in 12 seconds while firing at a plane travelling eighty-five miles per hour and approaching the firer. It is also stated that the limit of the effective rate of fire at aerial targets is 40 to 60 aimed shots per minute with the automatic. The automatic riflemen at Fort Hoyle averaged about 13 shots in 12 seconds, or 64.51 aimed shots per rifle per minute throughout the whole course. It was also noticed that the two best shots in the section were the most rapid firers.

The amount of target length lead required for aiming at the various ranges was always announced in fire orders, the table given on page 55 of Training Regulations 300-5 being used as a guide. Observation of this firing seemed to indicate that the number of leads given in that table is greater than necessary.

The results of the firing at towed targets are as tabulated below.

The number of hits was computed by dividing the number of holes found in the target by two, except in a few cases where it was evident that only one hole was made by a bullet entering the front of the target.

The time for firing shown in the seventh column is the actual amount of time allowed for firing the number of rounds indicated at each altitude and includes time lost through stoppages and time consumed while guns which had stoppages were completing their firing. The computation of the rounds fired per gun per minute and of the hit per gun per minute was based on the time shown and the results indicate the effects of stoppages and delays.

RESULTS OF ANTIAIRCRAFT FIRING AT TOWED TARGETS

MACHINE GUNS

Date	Altitude of target in feet	Horizontal range to target in yards	Direction of flight re: Battery front	Lead announced in Fire Order	No. of guns firing	Actual time for firing in seconds	No. of rounds fired	No. of holes in target	No. of hits	Rounds fired per gun per minute	Hits per gun per minute	Percentage of hits
Apr. 20	200	250	Parallel	1	1	7.	65	0	0	557	0.	0. %
Apr. 20	200	250	Parallel	1	2	22.	386	24	12	527	16.39	3.11%
Apr. 21	200		Perpend.	½	4	10.2	198	28	14	291	20.58	7.07%
Apr. 22	500	250	Parallel	*1	4	18.6	503	19	10	406	8.06	2.00%
Apr. 23	500		Perpend.	*1	4	9.4	189	18	9	308	14.67	4.76%
Apr. 24	800	250	Parallel	3	4	18.8	469	11	6	374	4.79	1.28%
Apr. 24	800		Perpend.	2	4	22.	340	28	14	232	9.55	4.12%
Apr. 24	1000	250	Parallel	3	4	14.	190	0	0	204	0.	0. %
Apr. 24	1000		Perpend.	3	4	14.	179	10	5	192	5.36	2.79%
Apr. 24	1200	250	Parallel	4	4	13.	270	0	0	312	0.	0. %
Apr. 24	1200	250	Perpend.	4	4	19.6	288	12	6	220	4.59	2.08%
Apr. 24	1400	250	Parallel	4	4	12.2	293	6	3	360	3.68	1.02%
Apr. 24	200	250	Parallel	1	4	12.	295	29	15	369	18.75	5.08%
Apr. 24	200		Perpend.	1	4	15.	358	66	35	358	35.00	9.78%
Apr. 24	1400		Perpend.	4	4	17.	308	1	1	272	.88	.32%
Total for all firing with machine guns..						3.75 Minutes	4331		130	315	9.45	3.00%

*Target moving against head wind of forty-five to forty-eight miles per hour.

RESULTS OF ANTI-AIRCRAFT FIRING AT TOWED TARGETS

AUTOMATIC RIFLES

Date	Altitude of target in feet	Horizontal range to target in yards	Direction of flight re: Battery front	Lead announced in Fire Order	No. of guns firing	Actual time for firing in seconds	No. of rounds fired	No. of holes in target	No. of hits	Rounds fired per gun per minute	Hits per gun per minute	Percentage of hits
Apr. 21	200	250	Parallel	1	2	22.2	60	11	8	81.0	10.80	13.33%
Apr. 21	200	250	Parallel	½	6	12.4	84	22	11	67.8	8.88	13.10%
Apr. 21	200		Perpend.	1	6	23.8	175	28	14	73.5	5.88	8.00%
Apr. 22	400	250	Parallel	1	6	17.4	106	19	10	61.0	5.75	9.43%
Apr. 22	400		Perpend.	1	6	19.8	159	14	7	80.3	3.54	4.40%
Apr. 22	500	250	Parallel	1	6	17.8	169	20	10	94.9	5.62	5.92%
Apr. 22	500		Perpend.	1	6	14.2	139	2	1	98.0	.71	.72%
Apr. 23	600	250	Parallel	*½	4	39.6	175	16	8	66.5	3.04	4.57%
Apr. 23	600		Perpend.	*½	5	24.8	114	33	17	55.2	8.22	14.90%
Apr. 24	700	250	Parallel	3	6	24.	142	6	3	59.1	1.25	2.11%
Apr. 24	700		Perpend.	2	6	26.2	143	19	10	54.6	3.81	7.00%
Apr. 24	800	250	Parallel	3	6	19.8	88	2	1	44.9	.51	1.14%
Apr. 24	800		Perpend.	2	6	22.2	113	8	4	50.9	1.80	3.54%
Apr. 24	1200		Perpend.	4	6	21.8	143	4	2	65.5	.92	1.40%
Total for all firing with automatic rifle……………						5.1 minutes	1810		106	64.51	3.78	5.86%

*Target moving against head wind of forty-five to forty-eight miles per hour.

CONSERVATION OF FORAGE

ALL Field Artillerymen should know that the Army horse and horse-drawn organizations are under constant fire from Congress and in some cases from the Army itself. Unfavorable cost comparisons are frequently made between animal-drawn and motorized units. Able and experienced officers are convinced that the horse and mule still constitute a vital factor in army mobility, yet it can be truthfully said that the very existence of horse-drawn organizations is threatened, largely due to the expense of their upkeep. The expense of their upkeep is unnecessarily high unless the greatest care and intelligence is exerted in cutting down forage expenses. Mounted officers themselves, perhaps unacquainted with the seriousness of the situation, who permit stable management to develop into wasteful routine in the hands of stable police not only are neglecting important duties, but are exposing our mounted organizations to serious criticism.

Waste of forage and the consequent loss of condition of the animals as well as unnecessary expenditure can be avoided by particular attention to the following factors:

Supervision.—The feeding and care of animals must not be a purely routine matter. Of course a certain amount of routine is necessary and desirable, but this routine must be carefully planned and executed. The feed of each animal should be prescribed individually by the battery commander or stable officer. In general there is a tendency toward over-feeding of grain and under-feeding of hay. Lack of sufficient water and salt is inexcusable.

Oats.—The galvanized iron feed box now in general use throughout the service may become a prolific source of waste. The size and shape of this box necessitate what is known as "deep feeding" with the result that many greedy horses, through a motion of their heads, throw out a large amount of the feed from the box. Furthermore these animals grab deep in the feed and gather more oats than they can possibly masticate. While attempting to masticate oats the animal carries his head out from the feed box and showers the oats all over the ground. Also many oats are taken into the horse's stomach before being properly masticated. Had this same feed been placed in a box of the proper proportions the horse would have been forced to gather his feed slowly and in small amounts and would have masticated it as he gathered it. In many cases managers can be notified so as to do away with the feed pan. The Field Artillery School has some stables in which the lower part of the manger is boarded up tight. The oats and hay together are placed in the mangers, effectively preventing the animal from eating his grain too rapidly. The mangers are made continuous and corners are avoided in order to facilitate cleaning. Crushed oats, it is claimed, save about 20% of this ingredient of the forage when this procedure is practicable. However, there are objections to crushing the oats. The paraphernalia necessary for crushing oats is not suitable for field service. Thus many animals which have become accustomed to crushed oats in garrison suddenly get their type of grain changed upon taking the field and the result of this may be injurious. Furthermore the handling of crushed oats within the organization and prior to its arrival thereat present many objections. It is much more difficult to supervise the distribution and checking of crushed oats than sacked uncrushed oats.

Storage.—Constant attention must be given to avoid wastage of all grain due to inroads of rats, mice, small birds and loose animals.

Bran.—Dry bran should be fed with each feeding of oats. In addition to its other qualities it is an excellent slow feeder.

Hay.—Perhaps the greatest wastage in hay comes about through the failure of stable police to shake out the hay properly before it is placed in the manger. If two or three compressed layers of hay are placed in the manger without being properly shaken out, the animal may, in his effort to break up the compressed hay, lift the whole compact out of the manger and drop it under his feet where it is out of reach and becomes soiled. In the field great wastage of hay may be caused by the whole or a large part of the hay ration being fed at one time instead of in small amounts and often. Of course there are many times in the field when it is impossible to feed the animals hay at frequent intervals due to their being in use most of the time. The purchase of low grade No. 2 hay is uneconomical although it is believed that a good grade of No. 2 hay is quite satisfactory. It is very doubtful if the additional expense would justify the purchase of No. 1 hay at all times. It behooves all officers to keep a close watch of the hay issued to their animals. Contractors soon become expert in striking close to the border line between low grade and satisfactory No. 2 hay.

Grazing.—Every advantage should be taken of local grazing facilities. The saving in forage as well as the improved health of the animal is important. On many reservations a great many tons of hay can be, and are, cut and baled each year. The cost of this hay to the government is always below the market price. Great care should be exercised in the selection of plots to be cut, otherwise many tons of inferior or useless hay are baled and issued to organizations.

Amount of Forage to Be Fed.—Through many months of the year a large number of the animals of the mounted organizations can be put on maintenance ration resulting in a large saving of forage, especially in grain.

Par. 3d (2) AR 30-480 permits variation of amounts of hay and grain and provides for the purchase of special classes of forage to meet special conditions "provided a saving can be effected thereby or the cost of the ration for the station concerned is not increased." This regulation permits the increase of the hay component in relation to the decrease of the grain component. W. D. Circular 14, April 11, 1927, goes deeply into the subject of feeding and should be stressed in each animal organization so that all officers may become acquainted with its provisions. The proper routine for feeding is described in *Field Artillery Field Manual,* Volume I. The proper training of Field Artillery officers along these lines is an important part of their professional education and an intelligent and loyal application of these regulations and principles is an indication of the discipline of the officers concerned. The resourcefulness, diligence and intelligence of battery officers and their superiors in regard to economic and efficient feeding of their animals are excellent indications of their personal qualifications.

AIR DENSITY IN FIRE CONTROL

BY CAPT. BERTRAM J. SHERRY, SIGNAL CORPS

[*The following should be of particular interest to Field Artillerymen in that it tells just how the data for the "meteorological message" are obtained and shows the degree of accuracy which may be expected. It is published here with the kind permission of the Signal Corps Bulletin.*—EDITOR.]

WHEN a projectile is fired from a gun, the distance and direction the projectile will travel after leaving the gun depends, among other things, on the weather. The atmospheric elements that influence the distance and direction a projectile will travel after leaving a gun are the wind and air density. If a projectile is fired in the same direction that the wind is blowing, it will travel a greater distance than if it is fired against the wind. If a projectile is fired at right angles to the direction the wind is blowing, the projectile will be deflected to one side of its normal path by the wind. It is therefore necessary to make corrections to the aim of guns for the wind speed and wind direction. These corrections are important when long-range or high-angle fire is concerned.

The distance a projectile will travel after being fired from a gun depends to some extent also on the density of the air. When the air density is greater than normal, a projectile shot from a gun will not travel as far as it will in normal air density. On the other hand, when the air density is less than normal the projectile will travel farther than it will in normal air density.

The behavior of a projectile shot from a gun is influenced not only by the wind and air density near the gun but also by the wind and air density along the path followed by the projectile from the gun to the target. As projectiles sometimes reach heights of several miles, it is necessary to consider the wind and air density at these altitudes if one wants to determine the wind and air density through which the projectile passes.

The measuring of wind speed and direction at various altitudes is done by observing the drift of pilot balloons with special theodolites, and the results are fairly satisfactory. The results of attempts to determine air densities at various altitudes above the ground under field conditions are not satisfactory. Since no satisfactory method has been devised for use under field conditions to determine the air densities at high altitudes, it is necessary to resort to a method that may be expected to give the best approximation of the true air densities at various levels above the ground.

In computing firing tables the Ordnance Department has assumed that the density of the air at the gun under normal conditions is 1,203.4 grams per cubic meter. This is approximately the average air density actually found at a height of 940 feet above sea level in the central part of the United States. The Ordnance Department has also assumed that the density decreases a definite amount with increase in altitude. In other words, definite values for air density have been assumed for various heights above the gun. The values used as standard by the Ordnance Department for air density at various heights above the gun do not agree with average values determined from actual observations, but the differences are not important, except possibly for very high levels. Air density, especially in the lower levels, is contantly changing. For instance, the average air density at 940 feet above sea level during the three winter months is approximately 5 per cent greater than the average yearly density, and the average air density during the three summer months at this height is approximately 5 per cent less than the average yearly density. On individual days in winter the air has been observed to be 8 per cent denser than normal, and on individual days in summer the air density has been observed to be 7 per cent less than the normal yearly density.

If one wants to take advantage of all aids in fire control, he must consider air density. The amount of error due to neglect of air density is generally not large, but in unusual cases of long-range fire the variation of air density may cause a projectile to miss the target by one-quarter of a mile if no correction is made for this variation. It is therefore necessary to make an effort to correct for such errors.

Air density is not measured directly, but is computed by the use of the following formula:

$$D=\frac{b-0.378e}{459+t}\times 21218$$

Where D is air density in grams per cubic meter.
b is station barometer reading in inches.
e is vapor pressure in inches of mercury.
t is temperature on Fahrenheit scale.

In order to determine air density, it is necessary, therefore, to measure the air temperature, the air pressure, and the vapor pressure at the place where it is desired to determine the air density. In fire control it is desired to know the air density along the path followed by the projectile from the gun to the target. As it is impracticable to get this information directly, the air temperature, air pressure, and vapor pressure are determined for certain levels, and the values at these levels are taken as the values of these elements at the same levels on the trajectory of the projectile. An airplane is used in making measurements of the atmospheric elements at levels above the ground. The airplane carries a meteorological observer, who reads the various meteorological instruments at the desired levels above the ground. The data are brought back to the meteorological station and the air density computed for the desired levels.

The making of observations with an airplane under field conditions upon which to base computations of air density is not a satisfactory method, because—

(a) In an airplane it is difficult to determine true free air conditions that are not affected by the presence of the airplane and its engine.

(b) Considerable time elapses between the times observations are made and the necessary computations are completed, because under present conditions the airplane must bring the data to the ground before the computations can be started, and in the meantime the weather is likely to change.

(c) The airplane seldom succeeds in reaching altitudes above 15,000 feet, and then only with considerable time elapsing before the data are available for the artillery.

(d) Airplanes are not always available, or, if available, fog or other adverse conditions may prevent or interfere with their operation.

Efforts have been made, therefore, to find a simpler and quicker method of determining air density for artillery that will be more suitable for field use. The United States Weather Bureau has made many thousands of observations of air density at various altitudes with the aid of kites and balloons. The results of these observations are available. Based on these results, tables were prepared in the office of the Chief Signal Officer, showing the average rate of change in air density with increase in altitude for all air densities ordinarily observed at the surface of the earth. For instance, when the air density at a gun 940 feet above sea level is found to be 105 per cent of the Ordnance Department normal density, these tables show that the density will be approximately 103 per cent of the Ordnance Department normal density at an altitude of 3,370 feet and 100 per cent of normal at 15,400 feet above the gun. On the other hand, if the density is 95 per cent of normal at the gun, it will be approximately 97 per cent of normal at an altitude of 7,000 feet and 98 per cent of normal at 21,000 feet above the gun.

A study of the results of a large number of observations of air density made with kites and sounding balloons indicates that the following statements are generally true:

(a) When the air density is normal at the earth's surface, it is approximately normal at all altitudes up to and probably above 50,000 feet.

(b) At an altitude of 26,250 feet above sea level the air density remains approximately constant.

(c) When the air density is above normal at the surface, it is usually above normal at all altitudes up to 26,250 feet and below normal above 26,250 feet.

(d) The greatest variations in air density usually occur at the surface of the earth, and when the air density is above or below normal at the surface the departure from normal becomes less and less with increase in altitude, becoming normal at about 26,250 feet above sea level.

If the statements above are accepted as generally true, it is evident that one may determine the approximate air density at any particular height if he knows the air density at the surface of the earth. Since, no matter what the air density at the surface may be, the air density at an altitude of 26,250 feet above sea level remains approximately constant, it follows that the rate of change of air density with increase in altitude depends on what the density happens to be at the surface of the earth.

After giving the matter very careful consideration, it is believed that more satisfactory results will be obtained if, in determining air density for the use of artillery under field conditions, the actual observations are limited to a determination of air density at the surface of the earth. Instead of trying to make observations at high altitudes, it is believed that more satisfactory results will be attained if the density at any particular height is assumed to be the average of all densities that have been actually observed at the height when the air density at the surface was the same as in the case under consideration. No pretense is made that this method will produce highly accurate results. It is believed, however, that results obtained in the manner outlined will compare favorably with respect to accuracy with results obtained by sending an observer aloft in an airplane under field conditions to make observations of air density. Furthermore, the method outlined may be used when airplanes are not available or can not operate.

The artillery is not equipped to use true air-density data; that is, it is of no advantage to the artilleryman to know that the air density at his gun is 98 per cent of normal. What he wants to know is the "ballistic density" for the maximum ordinate that the projectile he proposes to fire will reach in traveling from his particular gun to the target. The "ballistic density" may be defined as a single computed air density that will have the same effect on the behavior of a projectile as all the various air densities through which the projectile passes in traveling from the gun to the target. Separate ballistic air densities are computed for maximum ordinates of 600 feet, 1,500 feet, 3,000 feet, and so on up, at varying intervals, to 30,000 feet.

Ballistic air densities are computed for each maximum ordinate by multiplying the air densities at designated levels by weighting factors; the sum of the products thus obtained is the ballistic density for the particular maximum ordinate. The method described below is believed to be the most satisfactory for use in computing ballistic density for the artillery.

(a) The air density at the ground is computed from data obtained by observing the actual air temperature, air pressure, and vapor pressure.

(b) The average value of the air density that has been observed at each of the designated levels when the particular density prevailed at the surface is determined from tables.

(c) These average densities for designated levels are then multiplied by the proper weighting factors, and the sum of the products is the ballistic density for the particular maximum ordinate under consideration.

(d) A separate computation is required to determine the ballistic density for each maximum ordinate.

An example of the processes involved is given below. Suppose it is desired to compute the ballistic density for a maximum ordinate of 4,500 feet for use with a gun at sea level. The barometer reading is 29.60 inches, the temperature is 84°, and the vapor pressure is 0.926 inch:

(a) Using the formula given above, the air density is found to be 1,143.0 grams per cubic meter. This density is 95 per cent of the standard density for artillery.

(b) From the tables of averages it is found that when the air density at sea level is 95 per cent of normal the average air density found at 300 feet above sea level is 95.2 per cent; at 1,050 feet, 95.6 per cent; at 2,250 feet, 96.3 per cent; and at 3,750 feet, 97.1 per cent.

(c) The ballistic density is then determined by multiplying these densities by appropriate weighting factors as illustrated below.

Altitude above sea level	Air density	Weighting factors	Density X weighting factors
	Per cent		
3,750 feet	97.1	0.323	31.4
2,250 feet	96.3	.314	30.2
1,050 feet	95.6	.212	20.3
300 feet	95.2	.151	14.4
Ballistic density for maximum ordinate of 4.500 feet			96.3

The density at an altitude of 300 feet is used to represent the average air density of the first zone between sea level and 600 feet above sea level; the air density at 1,050 feet is used to represent the average air density of the second zone between 600 feet and 1,500 feet above sea level; the densities at 2,250 feet and 3,750 feet above sea level represent the densities in the third and fourth zones, respectively.

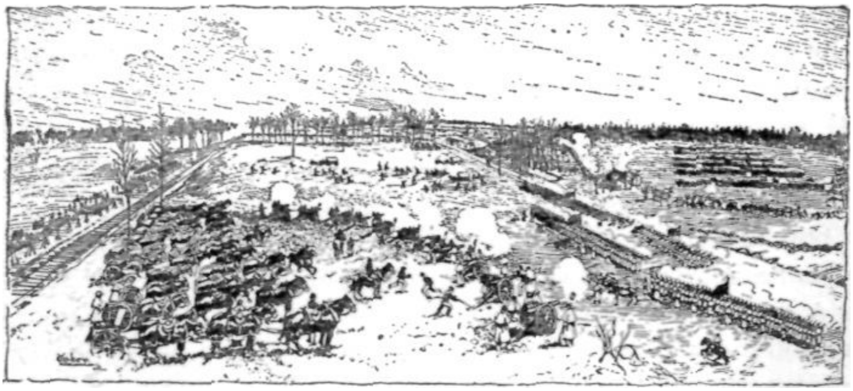
The method outlined above is based on the assumption that with a given air density at the surface of the earth the air density at any level above the surface will be the average of the values that were found at that level by actual observations when the given density was observed at the surface. Since the density at any altitude above the surface is assumed to depend on the density at the surface, it is possible to compute in advance the ballistic densities for all standard maximum ordinates for all densities likely to be observed at the surface. These ballistic densities, computed in the office of the Chief Signal Officer and arranged in tables, make it unnecessary for the computations to be done in the field. All that is necessary to do in the field is to determine the density at the ground, and, using this surface density as the argument, find the ballistic density from the tables for any particular maximum ordinate desired.

Since guns are not always located at the same level above the sea, tables have been prepared for use with guns located at sea level, at 1,000 feet above sea level, and also at 2,000 feet above sea level. For guns located at any altitude higher than 2,000 feet above sea level it will be necessary for the present to use the values in the table for an altitude of 2,000 feet. For guns located at levels between sea level and 1,000 feet above sea level or between 1,000 and 2,000 feet above sea level the ballistic density values should be interpolated from the two appropriate tables. The meteorological station will send out by radio the ballistic air density in per cent of the Ordnance Department normal for all standard maximum ordinates.

The meteorological station should be located at approximately the average altitude of the artillery units served. Differences of a few hundred feet between the altitude of the artillery and the meteorological station will not introduce large errors; but if there is a difference of more than 500 feet in altitude between the meteorological station and the artillery, special provision should be made at the meteorological station to correct the density for this difference in elevation.

In the computation of ballistic density and ballistic wind for use with antiaircraft guns, it is necessary to use different weighting factors from those used in the computation of ballistic densities and ballisitic wind for terrestrial artillery. The meteorological station, therefore, broadcasts two sets of meteorological data for artillery, one set of data for the use of terrestrial artillery and another set of data for the use of the antiaircraft artillery.

As a test of the accuracy of the method described, densities computed by this method were compared with ballistic densities computed with data obtained by sending recording instruments aloft by means of sounding balloons. More than 200 ballistic densities were computed by both methods. In 67 per cent of the cases ballistic densities computed by the two methods differed by not more than 1 per cent, in 24 per cent of the cases the ballistic densities differed by between 1 and 2 per cent, and in 9 per cent of the cases the ballistic densities differed by between 2 and 4 per cent. The larger discrepancies occurred during a period when the country was overspread by unusually cold, dense air.



FOREIGN MILITARY JOURNALS: A CURRENT RESUME

England—Journal of the Royal Artillery, April, 1931

Major A. F. Becke, late R. F. A., in **"The Coming of the Creeping Barrage,"** presents the results of his careful study of World War documents on the employment of barrages. His step-by-step account of the development of the creeping barrage is greatly enhanced by numerous instances of successful and unsuccessful employment of barrages during the World War. The whole study is intensely interesting as will be shown by the following extracts:

On the 25th of August, 1346, the day before the Battle of Crecy, Edward the IIIrd's archers loosed off a protective barrage of arrows to cover the successful crossing of the Somme ford at Blanchetache (near Saigneville)

In the Great War it may be stated that the documents do not altogether support the oft-repeated story of the introduction of the creeping barrage; but, as might be expected, they show that the innovation was of gradual growth and that it was being tried in more corps than one at the same time. It is well known that normally a change would spring from the fighting troops gradually, and generally it would be adopted, then in due course G. H. Q. would hear of it and in a circular memorandum give it an official blessing. Thus it happened in the case of the creeping barrage.

In the Battle of Neuve Chapelle, 10th of March, 1915, the first definite attack mounted by the British after the stabilization of siege warfare conditions, several milestones can be noticed. In this battle the artillery time-table was introduced, and the three phases given in the time-table were called: "the preliminary bombardment," "the assault of the enemy's first line of trenches," and "the assault of the Village of Neuve Chapelle." Also we do find the word "barrage" used in the true sense of the word—a barrier, or dam, to prevent the arrival of reinforcements.

Before the battle of Neuve Chapelle the Royal Flying Corps photographed the German trenches that were opposite to the front of attack, and these trenches were then carefully plotted onto large scale maps, which proved of the greatest assistance both to the artillery and to the infantry during the progress of the attack, an innovation that was tremendously developed during the War, playing a particularly important part in mapping forward areas, enemy trench systems, battery positions, etc.

In the assault of the German position at Neuve Chapelle the guns covering the British made two main lifts, from trench line to trench line, and then beyond the final objective all 13-pdr, and 18-pdr. batteries were ordered to "establish a belt of fire round the front of the position," in other words to put down a curtain, or protective barrage. Thus Neuve Chapelle saw considerable evolution in the tactics of artillery.

In the Battle of Festubert, 15th-27th May, 1915, corps artillery command was for the first time exercised in the field and this led to the appointment of Corps Chiefs of Artillery. In this same battle the opposing trenches on the front selected for attack at dawn were between 80 and 200 yards apart, and, to cover the assault, the final phase of the artillery preparation was a H. E. bombardment by 18-pdrs. Under cover of this fire the assaulting infantry climbed out of their trenches and lay down in No Man's Land to wait for the moment of assault. Despite the dim light and the proximity of the opposing lines, no casualties from our own fire were reported, and in places the initial assault was successful. Possibly this episode was recalled when the introduction of something akin to a creeping barrage was being considered.

Before the opening of the Battle of Loos (25th September-13th October, 1915) there was a prolonged, systematic bombardment, lasting four days, but neither the number of guns nor the quantity of ammunition available were sufficient to make it really formidable. At Loos, too, "the hour of zero" appears in First Army Operation Order, No. 95, and is possibly the first use of this term. But for the purpose of this study the most interesting feature of the battle was that just before the actual assault an 18-pdr, barrage was fired by the 15th Divisional Artillery, searching forward 50 yards at a time, the guns firing a certain number of rounds at each move. But though it was not an attack barrage closely followed by the infantry, yet it may have occurred to somebody that if only the assaulting infantry had kept close up behind this barrage as it swept slowly forward, then the attacking troops would probably have been saved from incurring such heavy losses.

The lack of success that attended the earlier attacks supported in this manner was sometimes due to the fact that at that time the infantry had not been sufficiently trained to get close up to the barrage, and on other occasions the barrage advanced at too fast a pace for the infantry to keep pace with it. Occasionally the last-named condition was due to the infantry misjudging the pace at which it would advance and asking for the lifts to take place too quickly, and then attempting to advance on the objective some time after the barrage had lifted off it, and the guns were serenely firing perhaps a thousand yards beyond the line where their fire was needed. In addition the Battle of Loos sounded the death-knell of the Group system, by emphasizing that a Corps Commander must control all the guns in his own area.

The next big battle, or series of battles, The Somme, which raged between the last July and the 18th of November, 1916, definitely saw the introduction of the creeping barrage, which was the most practical way of dealing with the enemy's plan of placing riflemen and putting machine guns in shell-holes outside his knocked-about trenches. Whether this innovation originally came from the French Army and was adopted by the British Fourth Army is still rather a matter of doubt, and some doubt also exists about the date of the introduction of the first creeping barrage in the German Army.

In 1916 the only attack made by the Germans on the Western, Front was at Verdun (21st February-31st August) and in the orders for the original attack on Verdun there is no mention of any barrage, but only of a bombardment, and in the text the only word used is an "artillery curtain" (Vorhang) and this, presumably, protective barrage had already been employed by the British at Neuve Chapelle.

But the Germans do claim that just before the opening of the Battle of the Narotsch Lake (18th March-30th April) the "Fire roller" (Feuerwalze) was successfully used by the 86th Division for the recapture of a hill near the Lake. It is also claimed that in a later stage of the fighting at Verdun a "rolling barrage" was used in May in the attack of Thiaumont by the Jager Brigade of the Alpine Corps. On the other hand, in Colonel Bruchmuller's book, "Die Artillerie biem Angriff im Stellungskrieg," several artillery orders are given as specimens, and on the Eastern Front, even as late as November, 1916, these orders only speak of lifts of 100 metres.

As for the French, no trace has so far been found in our documents of any proof that we are indebted to our Allies for this particular form of barrage, nor is it at all certain that a creeping barrage (barrage mobile) was being used by the French in the Somme battle.

At the time of the Battle of the Somme in France there were with the British Expeditionary Force 3,304 field guns and howitzers and 714 heavy guns and howitzers, as well as 114 AA guns; and on the 30,000 yards of the Somme battlefront from Maricourt in the south to beyond Gommecourt in the north the British employed 1,434 field guns and howitzers and 527 heavy guns and howitzers, a total of 1,961 pieces, giving an average of 1 field piece to every 20.9 yards, and 1 heavy piece to every 56.9 yards, or 1 piece to every 15.3 yards. This is a very different proportion to the artillery available at Loos, although the front of attack on the 1st July was fully twice as wide as it was on the 25th September, 1915; and if on the 29th June zero had not been postponed for forty-eight hours, and the preliminary bombardment had not been extended for this reason for two extra days there would probably have been ample ammunition for every task.

To begin with at a Fourth Army conference, held on the 16th April, in dealing with Artillery co-operation in the offensive, which was then under consideration, and with the experience of Loos fresh in his mind, the Army Commander stated: ". . . . The lifts of the artillery time-tables must conform to the advance of the infantry. The infantry must be given plenty of time. The guns must 'arrose' each objective just before the infantry assault it. Timing is a matter of most careful consideration. . . . ."

In a later conference held on the 17th May the Army Commander emphasized that on former occasions the lifts had always been too quick and not enough time had been allowed for the artillery to cover the advance of the infantry. But neither allusion to the artillery lifts lays stress on the barrage creeping forward by short lifts, and neither does much more than give vent to the pious hope that the barrage shall not run away from the infantry.

It was also made clear that experience had shown that the only safe method of artillery support during an advance was a fixed time-table of lifts to which both arms must conform; and the *Notes* stated that it was better for the infantry to have to wait in front of an objective until the artillery lifted off it, than it was for the artillery fire to be too far ahead of the infantry.

There is in a diary a description of what occurred on the 1st July: ". . . . The general plan for the bombardment was an intense bombardment of the front line system for 65 minutes, followed by successive lifts from trench to trench. Then concentration of fire on certain trench systems and strong points, and finally a general barrage along the divisional front preceding the advance of the infantry by increments of range of 50 yards every one and one-half minutes. The above plan was considered most adapted to the general configuration of the ground. The bombardment was carried out in accordance with the pre-arranged time-table, and the general timing of lifts appeared satisfactory . . . as a whole the lifts appear to have suited the time of the infantry assault . . ." In passing it may be mentioned that the attack of the XIII Corps was by far the most successful of all those that were delivered by the British on the 1st July. * * *

In the 7th Division of the XV Corps in Operation Order No. 11, issued by the B. G., R. A., at 7 P. M. on the 18th June, 1916, there occurs the following paragraph which states very clearly the procedure that this divisional artillery was to follow in the attack on the 1st July. It ran as follows: ". . . 3 . . . (b) During the advance of the infantry a barrage of artillery fire will be formed in front of the infantry according to the timings shown on the tracings issued to those concerned. The lines shown on the tracings indicate the nearest points on which guns will fire up to the hour indicated. At the times shown heavy guns will lift their fire direct to the next barrage line. The divisional artillery will move their fire progressively at the rate of 50 yards a minute.

Should the infantry arrive at any point before the time fixed for the barrage to lift, they will wait under the best cover available and be prepared to assault directly the lift takes place. . . ."

"The assault will be carried out steadily behind the artillery barrage. At the hour named for the barrage to lift the leading line will be as close to the hostile position as possible, and on the barrage lifting will at once move forward steadily, keeping touch, and only halt and lie down when next compelled to do so by awaiting the lift of the artillery barrage." As a result of his experiences on the 1st July, the Brigadier of the 20th Brigade was convinced that it was essential the objective should be entered immediately the barrage lifted off it. The attack of the 7th Division on the list July was very successful. * * *

But there is a different story to tell of the attack of the 50th Infantry Brigade, attached on the 1st July of the 21st Division. It was specially detailed for the capture of Fricourt Village so as to connect the two front line divisions of the XV Corps. Both in the Brigade Operation Order No. 76 of the 22nd June and in the battalion orders of the 7/Yorkshire Regiment (Green Howards) issued on the 25th June, it is stated that after a thirty-minute preliminary bombardment the barrage would lift 500 yards back at zero, and fifteen minutes later the barrage would again lift 250 yards further back, and continue on this line until 1 hour and 45 minutes after zero. The attack delivered by the 50th Brigade on Fricourt Village was repulsed with heavy loss.

In the III Corps documents there is an elaborate map showing the eight major lifts of the artillery barrage that were to be put down on the III Corps front on the 1st July, but actually on this day the barrage on this Corps front seems to have been made to jump from one trench system to the next, and jumping in this way the barrage never touched the intermediate shell-holes which held riflemen and machine guns. Possibly the costly failures in front of La Boisselle and Ovillers may be partly traced to this procedure. * * *

In the 34th Divisional Operations Orders there is a further explanation: ". . . The speed at which this (Field Artillery) rake goes back to the next line will be calculated so that the shrapnel barrage moves back faster than the infantry can advance. . .

If there was any doubt before whether this rake was a creeping barrage in embryonic form, this explanation shows that the real idea underlying the employment of a creeping barrage is absent from "the rake" as employed by the 34th Division on the 1st July.

In the X Corps, in the attack of the Leipzig Salient, an interesting expedient was tried by the brigadier (Br.-General J. B. Jardine) commanding the right brigade (97th) of the 32nd Division. Recalling his experience of the successful combination in the attack of the Japanese artillery and infantry, in the battles of 1904-5, General Jardine insisted that the front lines of the attacking infantry of his brigade should creep out into No Man's Land before zero and lie down within 30 or 40 yards of the barrage that was then on the German front line, so that they could rush the German trench directly the barrage lifted off it. Acting in this way General Jardine's right battalion succeeded in forcing its way into the Leipzig Salient. Unfortunately there seems to have been no idea of any further advance close behind the barrage; indeed the map in the R. A. June Diary, which shows ten distinct lifts, makes it quite clear that the lifts were from trench to trench, and in no sense was it a creeping barrage. Consequently, with the original penetration that had been achieved at zero, the advance of the 97th Infantry Brigade came to a standstill. Later on the Brigadier heard that the advance of his infantry had been checked in the Leipzig Salient but that the barrage was carrying on and lifting according to plan, so General Jardine gave immediate orders that two batteries should be taken out of the barrage and switched onto the defense of those men who were still maintaining a precarious hold on their gains in the Salient. This timely artillery co-operation undoubtedly went far towards assisting the hard-pressed infantry to hold what they had gained at the first onrush. * * *

In the 31st Division, attacking on the left of the Corps front, in the Divisional Instructions for the assault, issued on the 26th June, and repeated in the Divisional Artillery Instructions, the batteries are ordered in one case to "creep forward by 100 yards every two minutes" so that all through this Corps the creeping arrangement was well recognized. Yet on the 1st July the attack of the VIII Corps was a tragic failure. Possibly this was partly accounted for by the fact that although zero was at 7:30 A. M. yet the Corps heavy artillery lifted at 7:20 A. M. off the German front line to the reserve trenches and at 7:25 A. M. they were joined by the howitzers which had been firing on the support trenches whilst the 15-in. and 12-in. howitzers pounded Beaumont Hamel and Serre. If any further warning was needed by the Germans that the assault was coming the Hawthorn Redoubt Mine (40,000 lbs.) on the right of the Corps front and in front of Beaumont Hamel, was fired at 7:20 A. M. Thus the up-to-date artillery arrangements of the Corps Offensive Scheme were nullified. * * *

Thus we see that the change sprang from the line in the normal way, and it was gradually adopted by the attacking divisions, so all that remained to be done was for G. H. Q. to give the innovation its official blessing, and this was duly given on the 16th in a circular memorandum as follows:

"One of the outstanding artillery lessons of the recent fighting has been the great assistance afforded by a well-directed field artillery barrage maintained close in front of the advancing infantry. It is beyond dispute that on several occasions where the field artillery has made a considerable "lift," that is to say has outstripped the infantry advance, the enemy has been able to man his parapets with rifles and machine guns. It is therefore of first importance that in all cases infantry should be instructed to advance right under the field artillery barrage, which should not uncover the first objective until the infantry are close up to it (even within 50 or 60 yards). . . An infantry brigadier, whose command has met with conspicuous success, ascribes it largely to the fact that his men have insisted in advancing close under the field artillery fire . . . and he has stated that on more than one occasion his men were thus enabled to gain an enemy's trench almost without loss, and in time to meet the defenders hand-to-hand as they emerged from their dug-outs and before they could mount their machine guns."

After the attack on the 19th August against Guillemonte and Delville and High Woods, an artillery officer walked over the ground after the attack on the 15th September, in which a creeping barrage was fired from Pozieres to Courcelette at the rate of

100 yards in 3 minutes, and he said: "There was no doubt that a barrage at this rate fired by shrapnel was effective. The machine gunners were killed in their shell holes, and the shell cases covered the ground in a regular pattern." After more than a year of experiment and gradual evolution the creeping barrage had come to stay, and from now onwards constant use developed its application.

Guns and Tanks, by Major C. A. L. Brownlow, D.S.O., R.A., p.s.c., is an exceedingly clever discussion of artillery support for tanks and well worth reading in its entirety. Space however permits us only to give the following extracts:

The "Infantry fire fight" the "building up of the firing line," so dear a maxim in 1913, did not pan out as expected in the test of 1914. The infantry turned to the artillery for help, but experience was to prove that, only when guns were available in quantities sufficient to blast a passage by an expenditure of ammunition expressed in astronomical figures, did the attack regain its ascendency and the infantry its forward momentum to victory: but it took years to produce such artillery material. The plans of attack were artillery plans. Infantry commanders thought first in terms of artillery and infantry followed the shell. But was there no alternative to the ponderous gunners? There was. A new voice was being heard in the councils of war, a new weapon or instrument of battle had appeared, the Tank.

* * * * *

In the opening stages of the Great War while the defending artillery obtained good targets, the attacking artillery was confronted with the problem of South Africa, an invisible enemy. The fire power of the defense led to a stalemate; the infantry looked to the artillery and the artillery was not able to provide until years had passed and its strength had multiplied manifold. Nevertheless, in the later stages of the war the tank challenged the gun in friendly rivalry as the infantryman's support. The infantryman welcomed the new comer but still stuck to his old friend. All three in combination gained victory.

The post war reduction of the army naturally included the reduction of the artillery, but (and here is the vital point) in its reduced circumstances the artillery could not find the *proportion* of guns to infantry for the ammunition which experience had shown was necessary to blast the foot-soldier onto his objective. In the attack infantry by itself will fail; infantry and artillery (in the strength we have today) will fail; infantry, plus artillery, plus tanks alone will succeed. Therefore the cooperation of artillery with tanks is of vital importance.

Let us consider in more detail the phases of the attack. Economy in tanks being necessary, the first forward operation of an attack—the pushing in of outposts, the squeezing of the concertina until the enemy is pushed up against the rock of his defense—will be carried out without tanks. The second phase will be the breaking of the crusts of the defense and here tanks will be used. In essence, the tank attack will take the place of the shell barrage and will free the artillery for other tasks. There is an excellent theory that the tank blow must come from a flank, but when several divisions are in line the theory is difficult to apply in practice. In war the simple is the best and, in this phase of the battle, the tank attack will be on the method of the barrage, the straight line parallel to the front going straight ahead. The artillery commander will find himself with a wider field for the application of his fire. How can he best apply it? To ascertain this we must ask what is the object? It is to place the infantry on the objective. The machine gun and the enemy infantry is the greatest obstacle, and the tank the best means of overcoming it. Therefore, the first object of the artillery is to assist the tank. To what dangers is the tank exposed? To direct fire from anti-tank weapons and guns sited for this purpose; to indirect fire on forming up places and to direct fire from battery positions should the tanks run into them; to counter attack by enemy tanks. The task of the artillery will, therefore, be:

(1) To engage anti-tank weapons and guns by bombarding the likely places where such guns will be concealed; by smoke screens; by allotting certain guns to the task of engaging A. T. guns when they open fire. * * *

(2) Counter battery work—Counter battery assumes great importance. If it is effective the tanks will be greatly assisted.

As the proportion of medium batteries is now so weak, it may be necessary to allot field batteries for this task.

* * * * *

Some artillery support for the reserve tank stroke is necessary. How is it to be obtained?

In two ways: first, by ensuring that when the attack is delivered, counter-battery work on the whole front is increased to maximum intensity. By previous arrangement a single code message could effect this.

Second, by definitely allocating to the reserve tank group a reserve of artillery which would be under the command of the tank commander. The strength of this artillery would depend on the artillery available and the strength of the armoured fighting units. The principle of this allotment is the important point.

* * * * *

In discussing *Artillery with an Independent Armoured Force*, Major Brownlow says: "The use of an independent armoured force is still a matter of argument and experiment, but it is clear that such a force may be employed in war. The question of what artillery, if any, is to form part of such a force must be considered. The first question is, does it require any artillery? The supply and maintenance of an armoured force operating "in the blue" at a distance from railhead is a difficult problem to solve. To add unnecessary artillery means a useless clogging of the chains of supply. Artillery must be cut out if it does not justify its existence. Imagine such a force without artillery. It will encounter perhaps another armoured force, perhaps a force of all arms. The enemy have artillery." * * * "The action of our force is offensive (possibly with the object of destroying some vital centre, or of causing strategic delay to a part of the enemy forces); to have a long hitting weapon with a powerful shell would be of the greatest value. Further, a long range weapon directed from the air can give useful assistance to tanks in the attack as the battery need not move. It is the opinion of the writer that some 60 pounders should form part of an independent armoured force.

Next is the question of field guns. Without their support in the attack the enemy anti-tank weapons will have unrestricted play. Would not the tank commander feel on his reconnaissance that he would like that place hotted up or that area screened by smoke. Further, the ultimate object of the armoured force is to destroy something, men or material. The shell is a destructive agent and against material has far more destructive power than any tank can produce. It can also destroy at great distances. We only realize obvious facts when we are deprived of the means of obtaining them. Our fingers are wanted only when they are cut off. We think then that some field artillery is required in the order of battle of our armoured formation."

France—Revue Militaire Francaise, February and March

"Strategic Success, Tactical Success," by Colonel Loiseau, is a comparison of the theories advanced by various German Chiefs of Staff.

General von Schlieffen was the author of the initial plan of war in 1914, a plan calling for a war on two fronts: France and Russia. It was evident that one of these adversaries had to be crushed completely and rapidly before the other could be defeated. Several prominent members of the German staff suggested Russia as the first point of attack, but von Schlieffen decided that the political and military situation required that France be defeated first.

Various considerations led him to this decision. At the very beginning of hostilities, Germany would encounter a mobilized French army ready to accept a decisive engagement. In the East, that part of the Russian army which would be mobilized could, without seriously affecting the general situation, refuse to fight a decisive battle and retreat into the vast spaces of Russia.

Von Schlieffen was willing to risk the danger of a Russian advance in the East and the sacrifice of at least one German province in order to devote all German strength to a rapid victory over France. On the other hand, an initial offensive against Russia and a defensive on the Western front would lead to a long war.

"Unity, rapidity, and power were the characteristics of the action which von Schlieffen planned to pursue with obstinacy to gain strategical success in the war on two fronts."

Taking command of the German armies in 1915, Falkenhayn found a difficult situation. In the West, the hope of obtaining a rapid decision, which had been the fundamental principle of the German high command, was destroyed. In the East, Hindenburg had defeated the Russians at Tannenberg and at the Mazurian lakes; but the Austrian forces had been driven back and badly crippled.

Although a rapid decision was impossible, Falkenhayn still hoped to win strategic success. In considering the two fronts, he felt that it was useless to attack in the East until the Western front was completely consolidated. He could not hope for a complete success in the East at that time on account of the season and for other reasons. He, therefore, decided to follow von Schlieffen's plan by concentrating his forces in the West, thus giving a bare minimum of forces to the Eastern commander. Ludendorf had proposed a more daring plan in the East calling for sufficient force to turn the Russian right flank. Falkenhayn admitted the cleverness of this plan, but did not feel that he could spare the man power. He finally prescribed that Hindenburg join with the Austrian army for a frontal attack action.

"Falkenhayn strategy lacked breadth; it was not guided by a continuity necessary to reach a distant objective. Moreover, his strategy was too prudent. Calculating the possibilities in a mathematically precise manner, he failed to consider other favorable factors. He did not have that 'divine spark' of the true strategist."

Early in 1918, the Allied forces had reached their lowest ebb: Russia and Roumania were beaten, Italy weakened, and the Americans were unable to intervene before summer. The French and English had only 170 divisions. The German forces were progressively strengthened by additions from the Russian and Italian fronts. Ludendorf's fundamental idea was to defeat the enemy in the West with all available forces before the arrival of the Americans.

The plan was excellently conceived, but Ludendorf did not have the means to execute it. Had he possessed greater forces he would have launched a diverting attack at Verdun, or some other point far removed from the main attack against the British sector, in order to occupy allied reserves. However, he hoped to repeat his success in the East by a rapid break-through and to reach a decision before the enemy reserves had time to intervene.

"This was Ludendorf's fundamental error. Experience has proved that an adversary, not exhausted in morale or matériel, who retains his liberty of action, can always make use of his reserves in time to make a rupture of the line impossible."

*   *   *   *   *

"The 9th Division in 1918," by General Gemelin and Commandant Petibon begins in the February number. Included in this detailed account of the several engagements of the French division is a description of the employment of various arms at the battle of Noyon in March.

The authors note the value of infantry fire, not only during an attack but also before the attack as a preparation fire, and as a means of breaking up enemy attack preparations.

From an artillery point of view; Early in the engagement the Germans used only light artillery. The 150's and heavier guns rejoined the division later as they had not been able to keep up with the rapid advance.

The German artillery engaged in very little counter battery work. It directed its fire on the infantry front lines by means of concentration on chosen points of attack, followed by rolling barrages during the assault.

The French artillery was usually held as a unit by the Division Commander. Having a very limited supply of artillery, the allotment of groups to support various infantry units would have led to such dispersion as to render the artillery fire ineffective. It was found advisable to concentrate a large part of the artillery fire on that part of the front which at the moment was considered in greatest danger. This concentration of artillery was possible due to the circular form of the sector which facilitated the shift to successive objectives and simplified the problem of communications.

TYPE PROBLEMS

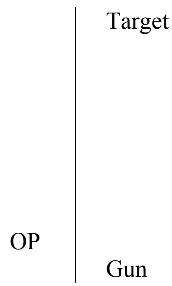
Precision Lateral (Large T)

(See Par. 86, TR 430-85, 1930 Edition)

Target Description: Enemy gun. Mission: To destroy. Materiel: French 75mm Model 1897. Visibility: Excellent. Wind: None. Initial data obtained: Deflection: Aiming Circle. Range: Estimated. Observer on the left. r = 3, R = 4, T = 600, d = 60/3 = 20, s = 60/4 = 15, c = 5, Fork = 5, c/s = 1/3, c/d = 1/4.

Initial commands:

No. 1, adjust
Compass 1660
Shell Mark I
Fuze short
No. 1, 1 rd.
Quadrant



Commands	Elev.	Rd. No.	Dev.	Sensing Rn.	Sensing Def.	Remarks
	130	1	40 R.	?	?	
	140	2	10 L.	?	?	c/d = 10/50 = 1/5.
	138	3	Line	+	+	
Lt. 120	98	4	35 R.	?	?	
	105	5	5 L.	–	–	
	(104)		On the line.			
Rt. 60	121	6	Line	–	–	
Rt. 30	130	7	Line	+	+	
Lt. 15	125	8	2 R.	+	(+)	Forced deflection.
Lt. 8, 3 rds.	123	9	2 R.	–	?	
		10	2 L.	+	?	
		11	Line	+	+	
Lt. 4	123	12	Target	Correct	Correct	
		13	5 R.	–	?	
		14	3 R.	–	?	3 shorts, 2 overs. 1/12 × 5 = .4.
6 rds.	123.4		Cease firing, End of problem.			

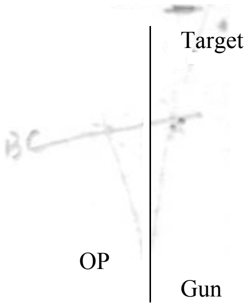
Summary: Errors in initial data: Deflection: 57 mils. Range: 132 yds. Time from identification of target to announcement of 1st range: 2 minutes and 10 seconds. Average sensing and command: 18.4 seconds. Total time of problem: 9 minutes, 5 seconds. Ammunition expended: 14 rounds. Classification: Satisfactory. General comments. This was an excellent problem and was correctly handled throughout.

Precision Lateral Problem (Large T)

Target Description: Concrete O. P. Mission: To Destroy. Materiel: French 75mm gun Model 1897. Visibility: Very good. Wind: From right to left. Initial data obtained: Deflection and range estimated. Observer on the left. T = 800 mils, R = 4.0, r = 5.3, s = 20, d = 15, c = 6, c/d = .4, c/s = .3.

Initial commands:

Compass 4870
Shell Mark, I, Fuze Short
No. 1, Adjust
No. 1, 1 round
Quadrant 160



Commands	Elev.	Rd. No.	Dev. from O. P.	Sensing Rn.	Sensing Def.	Remarks
No. 1, 1 rd.	160	1	30 Right	?	?	
	172	2	6 Left	+	+	c/d = 1/3. On line at 170
Lt. 120	134	3	12 Right	–	–	On line 138
Rt. 60	154	4	Line	–	–	
Rt. 30	162	5	Line	+	+	
Lt. 15	158	6	3 Right	+	+	Fork = 6
Lt.8, 3 rds.	156	7	Line	+	+	
		8	5 Left	+	?	
		9	Line	+	+	
Lt. 4, 2 rds.	153	10	3 Right	+	?	4 over and 2 short at 154.5 (The short at 154 is counted as a short at 153) $154.5 - \frac{2}{12}(6) = 153.5$
		11	5 Left	–	?	
3 rds.	153.5	C.F.				

Summary: Errors in initial data: Deflection 57 mils, range about 100 yards or 2%. Time: None taken. Seemed to go along well. No unnecessary delays. Ammunition expended 11 rounds. Classification: Satisfactory. General comments: Well handled.

Precision Lateral Problem (Large T)

Target Description: Stalled enemy tank. Mission: To destroy. Materiel: French 75mm gun Model 1897. Visibility: Excellent. Wind: Right to Left. Initial data obtained. Deflection: Map. Range: Map. Observer on the right. r = 3.6, R = 3, T = 500, c = 4, d = 13, S = 18 (from tables) c/d = 1/3, c/s = 1/4, fork = 4.

Target

Initial commands:
- No. 1, adjust
- Base Deflection Right 50
- Shell Mk. I.
- Fuze short
- No. 1, 1 rd.
- Quadrant

Gun OP

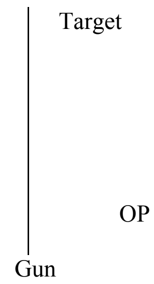
Commands	Elev.	Rd. No.	Sensing Dev.	Sensing Rn	Sensing Def.	Remarks
	94	1	6 R	?	–	On terrain
	(92)		On the line			
Left 16	96	2	1 L	+	(+)	Forced def.
Right 8, 3 rds.	94		Cease firing			92 was not fired, therefore no short sensing.
1 rd.	92	3	Line	–	–	
Left 4, 3 rds.	94	4	3 L	–	?	
		5	4 R	+	?	
		6	Line	–	–	
Left 2	94	7	3 L	–	?	
		8	Line	–	–	
		9	6 R	+	?	
						4 shorts 2 overs 2/12 × 4 = .7
Left 1, 6 rds.	94.7		Cease firing End of Problem.			

Summary: Error in initial data: Deflection 15 mils. Range 15 yds. Time from identification of target to announcement of 1st range 3 minutes. Average sensing and command 20.5 seconds. Total time of problem 7 minutes. Ammunition expended 9 rounds. Classification: Satisfactory. General Comments: The officer firing figured his 1st round on the line at 92, but having taken a deflection sensing it was unnecessary to shoot it. After the second round he had a 16-mil deflection bracket but he could not go to effect until obtaining a one fork range bracket. Otherwise the problem was correctly handled.

Precision Lateral Problem (Large T)

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

Target Description: Base Point. Mission: To register. Materiel: French 75mm gun Model 1897. Visibility: Good. Wind: Negligible. Initial data: Estimated. Observer on the right. T= 400, R = 5.0, r = 4.0, s = 8, d = 10, c = 7, c/s = .9, c/d = .7.



Initial commands:
- Compass 1280
- Shell Mk. I.
- Fuze long.
- No. 2, 1 round
- Quadrant 200

Commands	Elev.	Rd. No.	Dev. from O.P.	Sensing Rn.	Sensing Def.	Remarks
No. 1, 1 rd.	200	1	100 Right	?	?	100 × .7 = 70
	130	2	3 Left	?	?	3 × .7 = 2
	132	3	Line	–	–	
Lt. 60	186	4	10 Left	?	?	60 × .9 = 54
	193	5	3 Right	–	–	3 × .7 = 2
—						On line at 191
Lt. 60	250	6	Line	+	+	60 mil. def. bracket
						59 mil. rn. bracket
Rt. 30	220	7	Line	+	+	
Rt. 15	205	8	6 Left	?	?	6 × .7 = 4
	209	9	Line	–	–	
Lt. 8, 3 rds.	214(215)	10	5 Right	+	?	(by rule) F = 12
		11	7 Right	+	?	
		12	Line	+	+	
Rt. 4, 2 rds.	208	13	2 Right	+	?	
		14	Line	–	–	
Lt. 2, 3 rds.	209	C.F.				2/12 of 12 = 2
						211 – 2 = 209

Summary: Errors in initial data: Deflection 81 mils, range 200 yards or 4%. Time: None taken. General impression fair. Ammunition expended 14 rounds. Classification: Satisfactory. General comments: It should have been apparent that the deflection was in error on the first round. "Left 80 (100 × 4/5), 200" would have been a better second command.

THE FAST MOVING TARGET

DEVELOPED BY THE FIELD ARTILLERY BOARD

THE target as at present constructed, and tested at speeds of forty-five miles per hour over rough broken ground with changes in direction at equal speeds, consists of a galvanized roofing body with a bow (head) made of boiler plate.

Appreciating that the weight of the towing cable and the friction engendered by the towing cable operated, perhaps more than any other element, to cut down speed, various types and sizes of cable and wire were used for towing purposes. In the towing of the fast-moving target the best results were obtained by using the commercial No. 12 gauge galvanized iron wire.

The wire actually used was manufactured by the Youngstown Steel and Tube Co. It was No. 12 gauge, galvanized smooth fence wire, about 3,300 feet per bundle of 100 pounds.

For attaching the wire to the target, a bridle three feet long was formed, with the running ends passing through holes in the side of the head and attached to the cross brace. Towing with a single wire attached to the nose of the target proved to be unsatisfactory. Towing with the bridle attachment gave stability to the target, assisted in clearing obstacles and improved the action of the target on turns.

One of the chief objections to using a cable was the difficulty encountered in handling the cable after a run. The cable had a tendency to coil, when not under tension, and the result of releasing it was a helpless tangle. This difficulty was not encountered in using the No. 12 gauge wire.

Using the light target described above and the No. 12 gauge wire, no difficulties were encountered in using a Ford touring car as a prime mover. During the firing tests, a 3/4-ton GMC truck was used to place the target in position for the run, and a Ford touring car did the towing. In attaining high speeds on an unimproved road, the advantages inherent in a light prime mover are at once apparent.

During the Board's tests of the 3-inch AA gun M3, with the Sperry director, and the T3 and T2 mounts with the Vickers director, the services of the 1st Observation Battalion were used to record and plot the relative positions of the target and bursts. During the early stages of these tests a six foot flag of target cloth flown in a horizontal plane was used; this proved to be entirely satisfactory for the Board's purposes. In the later stages of these tests, a cylindrical sleeve was flown from the target standard, in order that hits could be counted. The sleeve used was a cylinder of light target cloth open at both ends and 2 feet 6 inches in diameter. The mounting of the sleeve standard at the rear of the target was found to be advantageous in keeping the target on its course in cross winds, and, by tending to lift the head, assisting it to negotiate rough ground. In addition, it was found that when turns were being made the pull of the sleeve warped the body and caused the target to ride on its inside heel, increasing stability.

Various schemes were examined for obtaining a change in direction. The scheme herein described proved to be the most satisfactory of those tested, answering the requirements of simplicity, ruggedness, and cheapness. In general, the apparatus consists of a wooden platform, pegged to the ground, with a bicycle wheel mounted so as to revolve in a horizontal plane on the upper surface of the platform, the bicycle wheel being countersunk in the platform to prevent the tow line from riding under the wheel. The tow line runs in the rim of the wheel. The tow line is released from the wheel by means of a polo ball threaded on the tow line slightly in advance of the target. To release the wire from the wheel, two blocks are attached to the upper surface of the platform, as hereinafter described, upon which the polo ball rides in its advance, causing the wire to be released from the wheel.

The wheel, used in the test, is an old bicycle wheel with a steel (clincher) rim. The ball bearings of the wheel are adjusted and locked. One end of the axle of the wheel (the bottom end when in position) is screwed into a piece of 3/4-inch shafting 8 inches long and locked therein; when the wheel is placed in position this shaft fits into the upper portion of the center spike and bottoms in it. The other end of the axle (the upper end when in position) is covered by a metal cone laced to the spokes; this cone is for the purpose of preventing fouling when the wire is tripped. The wheel, when placed in position, is so adjusted, by the depth to which the spike is driven, that the lower edge of the rim is below the upper surface of the platform.

The two tripping blocks are made of pieces of 2-inch by 4-inch lumber shaped as shown in the figures 2 and 3 and fastened rigidly to the upper surface of the platform.

Block A is undercut on the side nearest Block B so that the wire will run under this lip and be prevented from jumping off the top of the wheel rim. To prevent the wire from jumping out from under this lip, a wooden peg is driven into the hole D.

The tripping mechanism on the wire consists of a polo ball threaded on the wire in advance of the target.

The release of the wire from the wheel can be explained by the illustration. When a target is towed the polo ball strikes the groove C and breaks the wooden peg which was driven in the hole D. The ball then strikes the vertical face of Block A and is directed up onto Block B, thereby leading the wire out from between the blocks and lifting it from the rim of the wheel. When the wire is released from the wheel, the ball, and the wire to which it is attached, pass over the wheel and the target turns short of the platform a distance depending on the speed of the target and the relative position of the ball and target.

The tripping ball should be strung on the wire at such distance ahead of the target as to allow the tow wire to straighten and turn the target prior to the arrival of the target at the turning platform. The desirable position of the ball with relation to the target (distance from the target) will vary depending on the speed at the turn, the effect of the wind (head or tail wind), character of ground over which the target is traveling and the amount of the turn to be accomplished.

For a right angle turn, target moving at 20 miles per hour, a lead of fifteen yards proved satisfactory; moving at a speed of 40 miles per hour the lead was double, i. e., 30 yards.

The roads at Fort Bragg available for fast-moving targets are rutted sand roads, on the best parts of which it is possible to attain speeds of about 30 miles per hour with a light car. For the purposes of developing and testing the fast-moving target and for future tests of firing against moving ground targets, considerable clearing was done, and clay was hauled onto one of the roads and scraped. In all, about a mile and a quarter of road was thus improved. When completed, the road approximated a one-way average unimproved road in a clay soil country. No effort was made to improve the road over which the target was to run.

Considerable clearing was done to extend the field of view for future test purposes. For the purposes of immediate test, a field of view was secured for the director, permitting a visible run of a mile and a quarter, and a like field of view for the gun, the latter field of view being desirable for safety purposes, when using the director.

During the test of the 3-inch AA gun, Sperry director, straight runs were made using a metal sled type of target towed by a F. W. D. truck using a ½-inch cable. The maximum speed obtained during these runs approximated 25 miles per hour.

In the early tests of the 75mm gun mount, T3, Vickers director, the toboggan type of target was used, towed by a Ford touring car using No. 12 gauge wire. Speeds exceeding forty-five miles an hour were obtained without damage to the target or wire. In none of these runs did the target upset nor was the target damaged excepting by fire.

The apparatus herein described was used in making runs with a turn. A platform for a right and one for a left turn were constructed; a universal platform is simple of construction, but precautions should be taken to avoid fouling the wire on portions of the platform or blocks after the tripping has been accomplished.

The orienting of the turning apparatus is of importance. When placing the Block A in position on the platform, the line of the inner edge of its undercut portion, where it meets the face of the platform, should be tangent to the rim of the wheel; the hole D should be offset from this line to permit the width of the wire and about a half-inch play of the wire. On the surface of the platform a line should be drawn from D parallel to the inner edge of the undercut portion of Block A, that is, a line parallel to the tangent to the rim previously described. The hole E lies on such a line. In orienting the platform the hole E is used in conjunction with the hole D to orient the platform and the line between these points should be in prolongation of the direction from which the tow wire approaches the turning platform.

Successful turns were made at speeds up to 45 miles per hour. In no instances was the apparatus damaged, the target upset or the tow wire damaged.

Several zig zag runs were made over ground covered with stumps and shell holes. To guide the wire around obstacles, pieces of lath, each about 12 inches long, were driven lightly into the ground to guide the tow wire. These laths guided the wire at the critical points and were broken off by the ball or the target.

Fig. 5 illustrates the action of the target being towed at a speed of 40 miles per hour over a hole. The earth from the hole was thrown on the approach side of the hole in the form of a ramp. Laths were used to assure of the target passing over the hole. The result of this and similar tests was that the target cleared the hole and settled without shock some sixty feet beyond the hole.

FIGURE 1—LATEST MODEL FAST MOVING TARGET

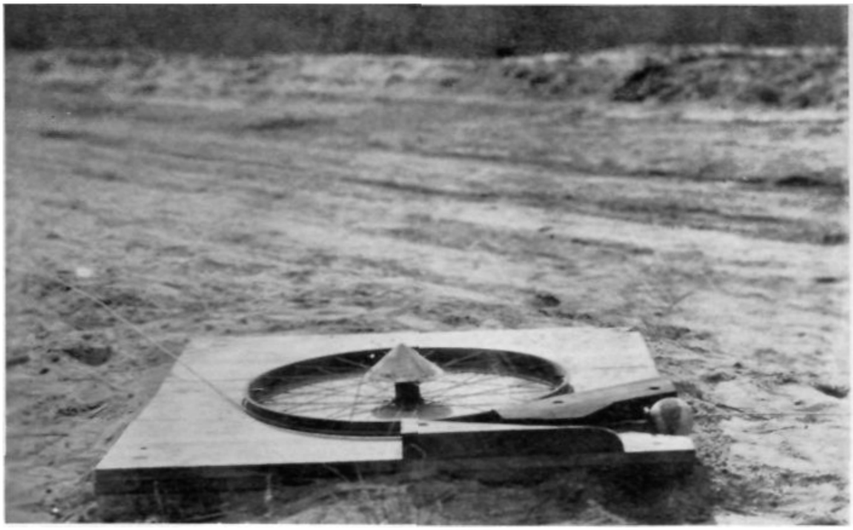


FIGURE 2—CHANGE OF DIRECTION DEVICE POLO BALL ABOUT TO TRIP AND THROW WIRE OFF WHEEL

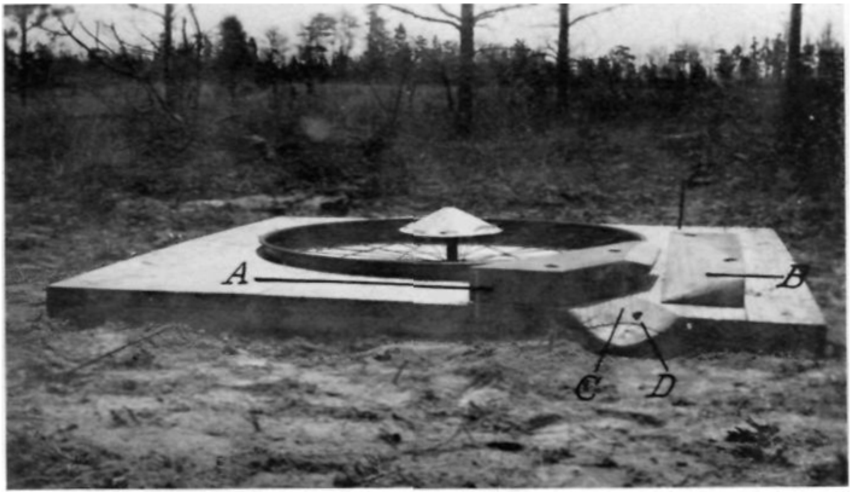


FIGURE 3—AFTER WIRE HAS BEEN THROWN OFF WHEEL

FIGURE 4—TARGET MOVING AT 20 M. P. H. FOR A LEFT HAND TURN

FIGURE 5—TARGET MOVING AT 40 M. P. H. OVER HOLES AND BUMPS

SUMMER WEATHER IS NOT SO BAD AFTER ALL!

AN ARTILLERY GUARD AT VALLEY FORGE

POLO AT CORNELL

BY CAPTAIN J. A. STEWART, F. A. (D. O. L.) Polo Coach

POLO has been played at Cornell for some years, but it is only in the last two that it has become a student activity. As far back as 1921 the R. O. T. C. Unit had a regulation field on Upper Alumni Field and a student team was organized. These men played as a Cornell team, but had no official sanction and were more or less free lances. The project then met with considerable enthusiasm, but for unavoidable reasons no progress was made for its permanent establishment.

The game was not given up, however. Since 1921 there have always been at least two, and sometimes as many as four, enthusiastic players among the Regular Army officers stationed at the University and they have managed, in spite of the handicaps, not only to keep Polo alive and going, but have year by year gradually increased the interest of the student body. Every year there have been teams composed either entirely of Army Officers or a combination of officers and students, but due to lack of facilities all games, and there were many of them, were away and there was little chance for the University, itself, to become polo minded.

In 1927 four students (Richard H. Warden, of England; G. J. Olditch, from the Argentine; M. M. Fuerst and John Hertz, Jr., of Chicago) all polo players of some experience, got together and organized what they called the "Cayuga Heights Polo Club." This club was not officially connected with the University and they were not permitted, of course, to play under the name of "Cornell." They had no horses—no means or facilities for practicing—no backing—in short, nothing except the enthusiasm and desire to play, which they did all through the State of New York. Though they registered in the "Indoor Polo Association," their organization has, in the past couple of years, gradually broken up and there is only one of the original members now in college.

In 1928, an attempt was made to start Polo in the town of Ithaca, itself, but the effort was unsuccessful and almost financially disastrous. That same year Student Polo was discussed, but nothing was done until the summer of 1929, when plans were formulated by Captain Hugh Gaffey and Lieut. K. Hammond for a limited amount of Student Polo. The response, while not overwhelming, was satisfactory. Twenty-five men turned out. From this number, five of the best riders were selected and given almost constant practice and coaching. The remainder were limited to stick and ball work under supervision. The difficulties that these two officers had to overcome in the beginning were almost insurmountable. Many of the boys could not furnish their own equipment and it had to be obtained for them, yet there were no funds for this purpose and no means of raising any. Corps Area did help some, but even this source of supply was soon cut off. Riding, and, therefore, Polo, is possible only about a month and a half in the Fall and a month and a half in the Spring and there are no facilities for indoor work during the winter. They had no nucleus of players to start with—only a few fair ponies and the only playing field to be had was a small section of Upper Alumni less than 200 yards in length and about 100 yards in width. Somehow or another, they managed to get things going. Side boards and goal posts were constructed of anything that could be had. Captain Gaffey personally constructed a cage and a wooden horse, and between himself and Lt. Hammond, working in their off hours, nine ponies were added to the string.

So great was the progress made that before Christmas a student team was sent to Cincinnati to participate in the indoor tournament. To practice for this, these men drove fifty miles, over icy roads, to Syracuse three times a week and used the horses and indoor ring of the 104th F. A.

Encouraged by such a beginning, Polo in the Spring of 1930 was more thoroughly organized and made practically a student activity. It was not confined to the R. O. T. C., and in the beginning fifty turned out, each of whom was assessed fifty cents to purchase balls. From this number, sixteen were chosen for the first squad. They were divided into four teams, played three times a week among themselves and were assessed five dollars a term to cover the expense of balls and a small amount of necessary equipment. The second squad consisted of the remaining thirty-four men. They were assessed a dollar each and worked on the days that the first squad was not using the field. From this first squad a team of three (three because of the small field) were picked to play Ohio State at Cornell. This was the first intercollegiate game played and was lost by Cornell, 6-2.

In the summer of 1930, both Captain Gaffey and Lt. Hammond were relieved—their four years' tour of duty ending at the close of the college year—and for the first time in years no officer of Polo experience to amount to anything was among the replacements. However, so well were the foundations laid by these two officers that not only has the work been carried on by the players they developed, but has so increased as to necessitate almost a staff of managers and coaches to take care of it.

Immediately on the opening of the University in the Fall, a meeting was called of all men who were interested in Polo and Riding. The result of this meeting was the formation of what is now know as the "Cornell R. O. T. C. Polo and Riding Club." The object of this club was and is to solidify the work already begun and to promote Polo and Horsemanship at Cornell University. There are two classes of memberships. The Polo membership which is open to any student of proven riding ability in the University and the Riding membership which is open only to the students of the Advanced R. O. T. C. Courses. The Polo dues are $10.00, the Riding $3.00 per term. About one hundred students joined the club, forty-three of whom were out for Polo. The Polo group was organized into three squads. The first, consisting of ten men, worked on Mondays, Wednesdays and Fridays. The second, consisting of twelve men, reported on Tuesdays and Thursdays and the third, squad consisting of the remainder, were out every day at stick and ball practice. Four match games were played—two won and two lost. In one game with Ohio State, played at Columbus, Ohio, on November 1, 1930, the Cornell team was defeated by a score of 6 to 2. The team won two games played with the Cortland Polo Club and during the Thanksgiving holidays met defeat in an indoor game at Northfield, Vt., with Norwich.

To take care of this number of men approximately fifty horses from the Field Artillery stables were used. In fact, any horse, whether riding or draft, that would permit a ball to be hit from him was made into a polo pony. The small fund accruing from the dues made possible the purchasing of regulation side boards as well as some much needed equipment and at the end of the season additional ground for the playing field was secured. The field now is considerably larger though still far short of regulations. To get this ready for Spring, all members of the squad, after playing stopped, turned out every afternoon for a month, after studies and worked with picks, shovels, plow and harrow. During the winter months a few picked men have been working with the remounts with the result that the first string of ponies was increased by about six.

The Cornell R. O. T. C. Polo Club is now a member of the Indoor Polo Association and won the Class "D" N. Y. State Circuit Indoor Polo Championship. It was defeated in the last semi-final game for the National Championship at the Squadron "C" Armory in Brooklyn, on April 2d, by the strong Allenhurst team, by a score of 9 to ½. In winning its way to the State Championship the West Point Officers' Team was defeated 6 to 5½ and the Boulder Brook Club, of Scarsdale, N. Y., 9 to 8. In the first semi-final game the Cleveland Polo Club was defeated, 8 to 5½.

Our schedule of Spring games was disrupted on account of the inclement weather. On May 2d a game with Norwich University from Northfield, Vt., was played in Ithaca, which the Cornell team lost by a score of 6 to 5. It was a hard fought game. A game was scheduled with Ohio State University on May 8th, in Ithaca. The Ohio team arrived, but a terrific rainfall prevented it from being played. On May 30th the team went to Cortland, N. Y., and defeated the Cortland Polo Club by a score of 11 to 4. Cortland was given 3 goals at the beginning of the game. G. P. Cooke, Jr., was the greatest goal getter, having 5 goals to his credit.

On May 2nd a horse show was held in Ithaca and was attended by over 2,000 persons. This show was sponsored by the R. O. T. C. Polo and Riding Club and was the best show ever held in Ithaca. Entries were secured from Binghamton, Syracuse, Auburn, Rochester, Utica and other localities nearer Ithaca. The open and ladies' saddle class events would compare favorably with similar events at the annual Rochester or Madison Square

Garden. The gymkana events, particularly the musical chair, were greatly enjoyed by the spectators.

A feature of the show was a special exhibition ride by Troop "C" of the N. Y. State Police from Sidney, N. Y. The trick riding of these men was nothing short of marvelous and we hope to have them back next year, at which time we plan to have a show lasting for 2 afternoons. Major General Hansen E. Ely, U. S. A., was the guest of honor for the show and was accompanied by Colonel John J. Toffey, the 2nd Corps Area R. O. T. C. Officer.

The polo prospects for 1931-1932 are better than ever before. New material is being developed at the R. O. T. C. camp at Madison Barracks, while Cooke and Baldwin are keeping up their game by playing in the inter-island championship matches in Hawaii.

Everything has been done now that can be done. Polo can go this way for years, but further progress can be made only with outside help. There must be some facilities for indoor work during the winter months before any real advance can be made and the game made self-supporting.

Plans for such a building have been drawn and efforts to raise the money for its construction have been continuous for the past two years. $50,000 have been secured, but that amount is far short of the goal. The hall will cost $120,000. The possibilities of such an addition to the University are too numerous to mention here. Certainly there is no doubt but that with such help Cornell would become the fountain head of horsemanship and Polo for the State of New York.

EIGHT PERIOD GAMES FOR THE INTER-CIRCUIT

The Secretary of the United States Polo Association has sent out the following announcement to the delegates of the Association:

From the indicated wishes of a majority of the members clubs through their answer to a questionnaire sent out under date of February 3rd, it has been decided to play the Inter-Circuit tournament of 1931 on the following basis:

(a) Eight periods instead of six.

(b) The tournament to be played in two divisions.

The location and dates to be announced later.

POLO AT FORT SILL

In one of the biggest upsets in polo history at the Field Artillery School at Fort Sill the four bearing the colors of the 1st Field Artillery came into the semi-finals by virtue of a bye and then proceeded to ride over and around the vaunted outfits representing Oklahoma City and Wichita Falls, Texas, to win the championship of the annual invitation tournament.

Seven teams in all took part in the tourney, the others being the Academic Whites, the Academic Reds, the 18th Field Artillery, and the four from Anadarko, Okla. The former put the latter out of the running in the first game by a score of 11 to 10, and in the next game the Texans defeated the 18th, 11 to 5. The Sooners, from Oklahoma City, won from the Reds by a 6 to 4 tally, and in the first round of the consolations the 18th came back to defeat Anadarko for a place in the consolation finals.

In the initial semi-final game, Wichita Falls accounted for the Whites, 10 to 6, and on the next day the new champions nosed out Oklahoma City in a tight battle by 5 to 4. In the consolation finals the Reds won the sterling plates awarded in that event by taking the 18th Field Artillery by a 9 to 7 score, and then in the final game, Sunday, June 1, the Wichita Falls outfit was snowed under to a 7 to 3 tune.

At the close of the match Brig. Gen. Wm. M. Cruikshank, commandant of the Field Artillery School, presented individual cups to the winners. Lieut. Col. Rene E. deR. Hoyle, F. A., was the chairman of the polo committee this season, and 1st Lieut. Giles R. Carpenter functioned ably as secretary.

The Army teams were composed of the following:

1st Field Artillery—1st Lieut. E. A. Hopkins, 1st Lieut. G. E. Burritt, Capt. H. J. Gaffey, and 1st Lieut. D. S. Babcock.

Academic Whites—Lieut. Col. Rene R. E. deR. Hoyle, F. A.; Maj. Carlos Brewer, F. A.; Maj. C. A. Baehr, F. A., and Capt. P. E. Shea, F. A.

Academic Reds—Capt. C. E. Sargent, Capt. J. C. Adams, Maj. H. L. McBride, and 1st Lieut. Giles Carpenter.

18th Field Artillery—Capt. G. D. Wahl, 1st Lieut. J. W. Clyburn, 1st Lieut. P. R. M. Miller, and 1st Lieut. M. H. Lucas.

FIELD ARTILLERY NOTES

90mm Gun-Howitzer

The project for a 90mm gun-howitzer may be considered as only in the initial stage of development, and the ammunition part of the development contemplates two weights of projectile, 22 and 26 pounds, with a maximum range of not less than 14,000 yards.

The ordnance committee has recommended approval of the use of 105mm howitzer breech mechanism and ring T-1 and a tube outline similar to the exterior of 105mm howitzer T-1, as a basis for the 90mm gun T-1 for proving ground use. This gun will have the 32-groove type of rifling, .04-inch deep, 1 turn in 20. It also has been recommended that studies of the 105mm howitzer carriage and recoil mechanism T-1 be made to determine what changes are necessary to mount the 90mm gun T-1 satisfactorily for proving ground use, and that the 105mm howitzer and carriage T-1 No. 2 be selected for conversion into 90mm material, if practicable.

Armored Reconnaisance Cars

The Chief of Field Artillery has requested development of armored reconnaisance vehicles of two types, one to be based on the light passenger-car chassis, and the other on a chassis of the station-wagon type.

8-Inch Howitzer Firing Tests

Firings of the latest model 8-inch howitzer material T-2 at Aberdeen Proving Ground, Md., on June 8, were witnessed by Maj. Gen. Harry G. Bishop, Chief of Field Artillery, and other military officials. The carriage is built for either the 8-inch howitzer or the 155mm gun. The 8-inch howitzer T-2 embodies the latest ideas in artillery construction, and the carriage is equipped with dual balloon tires. There are eight such tires supporting the gun and its carriage and the bogie has two other balloon tires supporting the end of the trail, enabling the piece to travel 45 miles an hour on the road. It can go into position very quickly for firing, since all that is necessary is to remove the bogie from under the end of the trail and lower the carriage to the ground so that no weight will rest on the tires. This weapon was described at length in an illustrated article in the May-June FIELD ARTILLERY JOURNAL.

The program of tests for this howitzer-gun T-2 material contemplates 200 miles of road test with the ordnance caterpillar "60" M-1 10-ton artillery tractor, M-1917, and 500 miles with truck draft, some of which has been performed, also maneuvering tests, and traction dynamometer tests.

An experimental lot of 155mm shell has been tested at Aberdeen in both the new howitzer and new gun, with ranges of 18,000 yards and 24,000 yards, respectively. Plans for the future provide for improvement of this projectile so as to make it more satisfactory for the howitzer fitted with the new fuze (T-2) and for use in the gun for all except the super ranges for which a special long-range shell will be developed.

While at Aberdeen, Gen. Bishop also witnessed the pulling of a French 75mm gun on a bogie across country and up steep grades by the tractor recently obtained from the Andre Citrogen-Kegress Company, of Paris, France. This tractor is intended particularly for light artillery; it is equipped with the Kegresse type of half track on the rear, and it was obtained to ascertain its suitability as a light tractor having both tactical and strategic mobility.

A modified 155mm howitzer T-1 is being tested by the Field Artillery Board at Fort Bragg, N. C. The piece weighs 14,300 pounds in the firing position, and it has a maximum range of 16,390 yards. As a result of changes made in the top carriage and wheel closures, the weapon is capable of attaining a speed of from 20 to 35 miles an hour on good roads. The tests at Fort Bragg include road and across country mobility trials, and firing.

Field Artillery Ammunition

Reports have been received at the ordnance office of proving ground tests of the T-3 75mm high-explosive shell for the 75mm gun and 75mm pack howitzer M-1. The shell was found to be satisfactory, and it has been released for manufacture for service tests.

With completion of current service tests of 1,000 rounds of the high-explosive shell ammunition for the 75mm pack howitzer, which includes a new type of combination super-quick and delay-point detonating-fuze (T-2), tests of similar rounds for the new 75mm gun (M-1), the new 105mm howitzer (M-2), the experimental 155mm howitzer (T-1) and the new 155mm gun-8-inch howitzer will follow. For the new 75mm gun (M-1), the new shell (T-3), fitted with the new fuze (T-2), has given a range of 15,000 yards. Additional proving ground firings are necessary, as some changes in the fuze have been made to increase the factor of safety against premature action.

A factory plan for 75mm shrapnel has been prepared and submitted by the Goslin-Birmingham Manufacturing Company, of Birmingham, Ala., through the district ordnance office at that place.

Delaware Ordnance Depot has completed experiments on the use of quick-drying lacquer on renovated 75mm shell. The lacquer is applied with a spray-gun to the shell as it revolves on a motor-driven turntable. All of the old paint is removed with acetone before the lacquer is applied. Only one coat is given the shell. The use of lacquer removes one of the principle choke points in the production of renovated shell at several plants, as the time required for the drying of the shell painted with oil paint retards the rate of production.

Sample lots of high-explosive shell ammunition with a modified French fuze (T-1), are being fired in the new 105mm howitzer (M-2) at Fort Sill, Okla., and Fort Bragg, N. C., with a view to adoption as a substitute standard for the weapon.

A favorable report has been received by the ordnance office of service tests of 240mm howitzer NH powder charges by the field artillery board at Fort Bragg, N. C. This is the first service test of NH powder in major-caliber weapons. The report, calling attention to the favorable results obtained, requests extension of general approval by the War Department of the use of this type of powder in all major-caliber weapons without the necessity of service tests for each weapon; this request was granted, so that the du Pont M-1 composition stands approved for use as a standard in the entire range of weapons from 37mm to 16-inch. Pyro powder is placed in the category of "substitute standard."

New Utah Brigadier General

Federal recognition has been extended to Brig. Gen. Wm. G.

Williams, the adjutant general of Utah, who has been commissioned brigadier general of the line by Gov. G. H. Dern and assigned to command the 65th Field Artillery Brigade, composed of the 145th and 222d Field Artillery, Utah National Guard, and the 143d Field Artillery, California National Guard. Headquarters 65th Field Artillery Brigade is just being organized.

Gen. Williams was born in Tredegar, Wales, July 17, 1872, and came to Utah at an early age. He enlisted in the Utah National Guard August 30, 1900.

Brig. Gen. Williams has been adjutant general of Utah with the rank of colonel for many years and will continue in that position, in addition to his duties as brigade commander.

Latest Automotive Vehicles in Aberdeen Try-Outs

Tanks, armored cars of latest design, and other automotive vehicles undergoing study by Ordnance experts were given extended field tests Tuesday, June 23, at the Aberdeen Proving Grounds, Maryland.

Vehicles used in the all-day demonstrations included the British made Vickers-Armstrong tank, the light tank type 1E3, the medium tank T-2, the Mack built A.A. Gun Prime Mover M1, a new G. M. C. 6 wheel-4 wheel drive 10 ton truck, the A. A. Machine Gun Mount T-2, the latest type armored car T-4, and a Citroen-Kegresse (French) light tractor.

Interest centered chiefly in the performances of the British tank, the new armored car, the G. M. C. truck and the diminutive French tractor drawing a regular 75mm gun. The demonstrations included road and cross country speeds, slope climbing ability, a drive through swamps and, for the tanks, an added test of adaptability for traversing shell crater areas and wooded terrain.

The new armored car, latest type developed from Ordnance specification, trim yet business like in appearance, sped over the concrete road at a speed in excess of 55 miles an hour. It weighs 8,500 pounds, is 15 feet in length and has a height over all of six feet eleven inches. It is powered with an eight cylinder, 135 horse power motor and has a speed range of 3 to 55 miles an hour. Armament consists of combined 30 and 50 caliber machine guns and one 30 caliber anti-aircraft gun. Its normal crew is four men.

The new G. M. C. truck, powered with a six-cylinder, 175 horse power motor, was used in the demonstration both as a cargo carrier and prime mover, carrying a load of eight tons and drawing an additional 15 ton load. The net weight of the truck is 18,000 pounds. It has a speed range of two to 40 miles an hour.

The Citroen-Kegresse light tractor used in the demonstration is one of the type used experimentally by the French Army as the motive power for their 75mm artillery. It weighs 4,130 pounds, is powered with a four cylinder 30 horsepower motor and has a rated speed of 1 to 25 miles an hour. It has a cargo rating of one ton with a normal drawing load of one 75 millimeter gun. Traction is furnished through a short rear drive track tread.

The demonstrations were arranged under the supervision of Colonel Edward M. Shinkle, commanding Aberdeen Proving Grounds, and directed by Major Robert Sears, Ordnance Department, of that post.

Per Capita Maintenance Cost—Officers' Reserve Corps

The following figures have been obtained by dividing total appropriations by the total strength:

Year	*Cost*
1924	$22.99
1925	36.89
1926	35.76
1927	36.63
1928	39.58
1929	53.46
1930	63.49

Average: $41.25

The increase in cost during past two years is due chiefly to the cessation of free issues of World War ammunition.—*99th Division Bulletin*.

Chief of Field Artillery Inspects Summer Training of Regular and R. O. T. C. Units

Major General Harry G. Bishop, Chief of Field Artillery, left Washington on June 21, 1931, for an inspection tour of various

Field Artillery posts, camps and R. O. T. C. units in the West, South and Pacific Coast, and will return to Washington about the middle of July. He will go first to Fort Leavenworth, Kansas, where the 3d Battalion of the 17th Field Artillery is stationed; thence to Fort Riley, Kansas, the home of the Cavalry School, where Battery "D," 18th Field Artillery, is located. General Bishop will then go to Colorado Agricultural College at Fort Collins, Colorado, for conference with Mr. Charles A. Lory, President of the college, and Major V. D. Vesely, Senior Field Artillery instructor. Fort Francis E. Warren, Wyoming, will next be visited. At this large army post the 76th Field Artillery, less four batteries, is stationed. The next stop will be at the University of Utah, Salt Lake City, Utah, where the Field Artillery R. O. T. C. unit is under the supervision of Major James A. Gillespie and Mr. George Thomas is President of the university. Oregon Agricultural College, at Corvallis, Oregon, will be the next stop. There General Bishop will confer with Major Freeman W. Bowley, senior Field Artillery instructor, and President William J. Kerr, of that college. General Bishop will then go to San Francisco to confer with the Commanding General and staff of the 9th Corps Area; after which he will proceed to Leland Stanford Junior University, Palo Alto, California, consulting with Lieut. Colonel Donald C. Cubbison, Senior Field Artillery, and Mr. Robert E. Swain, acting President of the university during the absence of its President, Secretary Wilbur, who is now serving as a cabinet officer in the Hoover Administration.

At the Presidio of Monterey, California, the Chief of Field Artillery will inspect the 2d Battalion of the 76th Field Artillery, after which he will go Fort Bliss, at El Paso, Texas, to inspect the 1st Battalion of the 82d Field Artillery, thence to Fort Sam Houston, Texas, for conference with the Commanding General and Staff of the Eighth Corps Area. Camp Stanley, Texas, will next be visited, and also the Agricultural and Mechanical College of Texas, at College Station, Texas, where Major John E. Sloan is Senior Field Artillery instructor, and T. O. Walton is President of the college; thence to Fort McClellan, Alabama, to investigate its possibilities for Field Artillery purposes.

In addition to inspecting the installations of the various R. O.

T. C. units mentioned above at their colleges, General Bishop will have an opportunity to visit the R. O. T. C. units in their summer camps and observe their field training.

Tablet to General Knox Unveiled in Boston

Dedication ceremonies in connection with the unveiling of a tablet to Major General Henry Knox, Chief of Artillery of the Continental Army and founder of the Military Academy at West Point, were held recently at the Old High Fort, Highland Park, Roxbury, Mass. On this precipitous eminence overlooking the city of Boston, a large gathering of people assembled for the ceremonies, notwithstanding the wind of near-gale proportions.

Joseph S. B. Knox, a lineal descendant of General Knox, unveiled the tablet. Brief addresses were made by Walter R. Meins, President of the Roxbury Historical Society; Colonel John B. Richards, President of the Massachusetts Society of Sons of the Revolution, and City Councilor Edward L. Englert. Judge Thomas H. Dowd, of the Boston Commission of Historical Sites, gave an historical address on General Knox and the Old High Fort.

In line were detachments from the United States Navy Color Guard, Grand Army of the Republic, National Indian War Veterans, United Spanish War Veterans, Veterans of Foreign Wars, American Legion, Gold Star Mothers, Kearsarge Association of Naval Veterans, Fusilier Veterans' Association, Massachusetts State Guard Veterans' Association, Loyal Order of Moose, Knights of Columbus, a battalion from Roxbury Memorial High School, High School of Commerce, Public Latin School and Boston Trade School, Boy Scouts and Girl Scouts. Major Charles T. Harding, U. S. R., was chairman of the parade committee.

The Old High Fort has been rehabilitated at a cost of $20,000. Concrete walks have been constructed and oak benches placed on the site. The original fort was destroyed in 1869. General Washington regarded it as one of the best situated and best constructed forts in America during his time.

Some Other Uses of Mustard

From time to time hopes are still entertained for some possible usefulness in medicine of "mustard gas," chemically known as dichlorethylsulphide. Thus British and German investigators report that the dermal application of dichlorethylsulphide will prevent the development of the experimental cancer. The prevention is said to be limited. Changes, it is asserted, result from an intracellular hydrolysis of the compound with liberation of hydrochloric acid; in other words, an intracellular acidosis and all that this connotes. The skin changes thus caused may be deep and resemble the burns from roentgen rays or radium. Accordingly, the protective action against pathologic growths of the skin, or destructive action on them, may have a definite objective basis. The compound might render the skin unfit soil for growth, but possibly only at the expense of considerable destruction of tissue.

When the concentration of the compound is greatly reduced, benefits of another kind are reported. Forster of the Pharmacologic Institute at Wurzburg has reported that dichlorethlysulphide in high dilution was the most efficient hair growth promoter of a considerable number of agents tried. Quantitative estimations of hair growth on shaved cats, treated locally with concentrations of 0.01 per cent of the compound in 50 per cent alcohol containing 2 per cent of glycerine, showed a production of hair. The hair grew not only more abundantly but also longer than in the untreated control areas.

Lest the results of this interesting research on hair tonics in felines arouse premature hopes in the bald and near bald, it should be mentioned that not all shaved and bald skins responded equally well. In fact, those of guinea pigs, rats, mice, rabbits and pigeons were decidedly unfit or unresponsive. Nor are all "war gases" necessarily effective, for the German cats in Forster's hands, frankly declined to respond to the much vaunted "war gas" of the Allies, chlorvinyldichlorrasine or "lewisite."

—*From the Journal of the American Medical Association*.

Radio Telephone Sets for the Field Artillery

Two radio telephone sets which are being developed by the Radio Corporation of America will soon be sent to the Field Artillery Board at Fort Bragg, N. C., for test. These sets are very compact and are easily carried on the operators' backs. The transmitter and the receiver together will probably weigh about eight pounds and the batteries about the same when sufficient charge for four hours' work is carried. The range of these sets is from two to four miles.

Loud Speakers for Firing Commands

In compliance with instructions from the Chief of Field Artillery, the Field Artillery Board, at Fort Bragg, N. C., is conducting a test of the Western Electric, type 2-A Public Address System Loud Speaker in order to determine its suitability for use in transmitting firing data. The loud speaker is installed at the battery position and when the commands are received over wire from the officer conducting fire at a distant observing point, they are broadcast directly to the gun crews. This arrangement does away with the necessity of telephone operators repeating the commands and the executive officer announcing them at the battery position. With the loud speaker there is no necessity for anybody to repeat the commands which are transmitted instantaneously to the firing battery by the voice of the officer observing and conducting the fire. The test is being carried out with a view to determine the practicability of using the loud speakers under field service conditions.

Come On, Mule

Come on, mule, I tell you. Doan vex me. Git on yo' footses, you long-mout', trifin', no 'count rat-tail, knock-knee, wall-eye, rabbit-ear, spavin'd, mangy chile of a jack-ass! Git up, mule, 'fore you make me forget my manners en call you what you is.—From Johnny Reb.