No. 3

Major General Ernest Hinds .... *Frontispiece*

Major General Ernest Hinds **237**

Mechanization **238**
By Major Rene E. DeR. Hoyle, G. S. (F. A.)

The Drift of Artillery Projectiles **249**
By First Lieutenant William W. Ford, F. A.

Campaign Summary and Notes on Horse Artillery in Sinai and Palestine **255**
By Lieutenant E. L. Sibert, F. A.

A Standard Headquarters Truck **272**
By First Lieutenant Wilbur S. Nye, F. A.

Field Artillery: Past, Present, and Future **280**
By General Herr of the French Army.

Army Central Polo Committee Bulletin **309**

Foreign Military Journals—A Current Résumé **314**

Current Field Artillery Notes **330**
Field Artillery Ammunition Allowances and Quarterly Reports of Target Practice.
Points to be Noted in Preparing Firing Reports on Form 820-A.
Recent Developments in Wire Laying Equipment.
124th Field Artillery Memorial Armory.
Basic Principles for Mechanized Force.
Committee for Development of Mechanized Force.
Officers' Instruction as Motor Mechanics.
United States Olympic Equestrian Team to Complete Training at Rye, N. Y.
Field Artillery Board Notes.

The United States Field Artillery Association **349**

MAJOR GENERAL ERNEST HINDS

THE FIELD ARTILLERY JOURNAL

VOL. XVIII MAY-JUNE, 1928 NO. 3

MAJOR GENERAL ERNEST HINDS

ON APRIL 18, 1928, Major General Ernest Hinds was retired at his own request, after more than forty-four years service. Few officers have had a more illustrious career than has General Hinds, and few indeed are held in such personal esteem by those who have had the privilege of knowing or serving under him.

Born at Red Hill, Alabama, August 18, 1864, appointed to the Military Academy on July 1, 1883, and as a second lieutenant, Second Artillery, on June 12, 1887, his entire service until 1922, when as a Major General he commanded the Second Division, has, with the exception of various details, been with the Artillery, and since the separation, with the Field Artillery.

General Hind's war service includes the Santiago Campaign, when as a first lieutenant, he commanded Light Battery F, Second Artillery (now E, 3rd F. A.); Philippine campaigns at Las Pinas, Abulug and Aparri as a Major, 49th U. S. V. Infantry; the World War as commander of the First Corps Artillery, A. E. F., then of the Army Artillery, First Army, A. E. F., and finally Chief of Artillery, A. E. F., from May 24, 1918, to June 12, 1919.

General Hinds was an Honor Graduate, Artillery School, 1898, a graduate of the Field Officers' Course, School of Fire, 1911, completed the Field Officers' Course, General Service Schools, 1914, and is on the Initial General Staff Corps Eligible List. He was commandant of the Saumur (Field) Artillery School during 1917, and of the Field Artillery School from October, 1919 to July, 1923.

A four-year detail with the Adjutant General's Department ended in 1911. In 1913, he was detailed to the General Staff Corps and served over two years as chief of staff, Philippine Department. He commanded the Second Division from July, 1923 to January 10, 1925, when he assumed command of the Eighth Corps Area, holding this latter command until his retirement.

General Hinds was awarded the DISTINGUISHED SERVICE MEDAL—"For exceptionally meritorious and distinguished services as Chief of Artillery, First Army Corps; commanding General Army Artillery of the First American Army, and as Chief of Artillery, American Expeditionary Forces. He perfected and successfully directed the organization and training of the Artillery of the American Army in France."

MECHANIZATION

MAJOR RENE E. DeR. HOYLE, G.S. (F.A.)

ASTONISHING progress is now being made in the development of motor vehicles and other mechanical equipment in the United States, and the output is enormous. Our World supremacy in this field cannot fail to be a great military asset in time of war. We must, therefore, be prepared to take full advantage of this situation. The Ordnance Department, Quartermaster Department and other military agencies are keeping in close touch with producers throughout the country, and are, in addition, laboratories of experiment, development and production. When commercial products are found to satisfy military requirements, wholly or in part, they must be used; for it is only by such use that we can hope to keep the tremendous expense of war within reasonable bounds and shorten the time required to supply units on mobilization. This alone will not satisfy the military demand however as certain developments and production must be carried on by the military establishment, of those products which serve no commercial purpose. The latter not only require service tests but a reasonable reserve should be acquired and maintained to satisfy the demand of a general mobilization prior to the time quantity production begins.

One branch of this development I have called mechanization. At the mention of this term many officers are prone to shy. It is however no new term to military men. For example, Major General "Light Horse Harry" Lee (father of Robert E. Lee) in our Revolutionary days, when speaking of our uninformed and untaught soldiers said "*******they are to meet men of the same age and strength, mechanized by education and disciplined for battle." In this day and generation we have a different means of mechanizing our men. The General Staff of the War Department has had this matter under study for some time and has recently prepared plans for forming its first "Mechanized Force."

Before entering into a discussion of this subject, it appears desirable to define just what mechanization is considered to mean at present, and to distinguish mechanized units from others using various types of motor transportation, for unfortunately the term has been given various interpretations. In so doing it is realized that definitions are classed as painful reading matter, and tend to indicate that the subject treated is of a technical nature. In this article it is intended to touch only the high spots, in an endeavor to show where the latest developments in motor and mechanical equipment are leading us, and to describe the nature of the experimental work that is to be undertaken in the near future. This is a live issue with which we should all be familiar.

The following definition is believed satisfactory and sufficient for this discussion: Mechanization is the application of mechanics to the combat soldier on the battlefield with a view to increasing his mobility, his protection, and his striking power.

To distinguish mechanized from motorized or portée units, the following definitions should be borne in mind:

1. To Mechanize.—To equip the unit considered with the latest mechanical developments in weapons, armor protection, and self-propelled fighting vehicles suitable for rapid movement across country and on the battlefield. Such units will be without animals and animal transport.

Example.—"The Mechanized Force" (described herein) equipped with fast-moving tanks, light cross-country cars and cargo carriers, machine gun power carts, artillery with self-propelled mounts, etc.

2. To Motorize.—To equip the unit considered with motor transportation. Normally this unit will have slow moving elements suitable for cross-country work and fast moving elements suitable for road traffic. In certain cases animals belong to such units.

Examples.—Tractor-drawn Field Artillery and Motor Transport Units.

3. To Portée.—To equip, or supply, the unit considered with motor transport so that it will be able to cover rapidly long distances on roads suitable for commercial motor transportation, its slow-moving elements (tractors, horses, etc.) being carried in trucks, or on trailers behind trucks. In order to accomplish this, extra trucks and trailers may be made a part of the unit equipment of the organization, or motor transport companies may be used to render it temporarily portée. The decision will depend upon the type of unit in mind. A field artillery unit maintained with a normal function of being employed to effect strategic reinforcement should have the trucks, etc., required to portée, assigned organically. Other types should draw upon available motor pools.

Obviously an important advantage sought by mechanization is increased mobility, and in considering this phase it is necessary to distinguish between strategic mobility and tactical mobility. The former relates to long distance movements from one part of the theater of operations to another part, or to a different theater of operations. The latter relates to relatively short movements or maneuvers within a more restricted area.

When referring to speeds of our tractor-drawn artillery, it is usual to consider a speed which could be maintained for long distances and without undue strain on the tractor. This speed therefore represents the strategic mobility of tractor-drawn artillery. For short movements in the immediate presence of the enemy, and when maximum speed is of more importance than conserving the life of the tractor, a somewhat higher speed would be justified and would represent the maximum tactical mobility of these organizations.

Our portée artillery has, by utilizing trucks, great strategic mobility when on good roads, still retaining the tactical mobility of the tractor-drawn artillery when operating over varied terrain.

Similarly the division tanks are given great strategic mobility on roads by being carried in trucks, high tactical mobility being obtained by utilizing the trucks as far as possible, and then operating under their own power, when necessary at speeds which would greatly reduce their mileage life if maintained for considerable distances.

Many of the speeds mentioned later may seem revolutionary, but it should be borne in mind that these are speeds used for tactical purposes of relatively short duration. Their strategic mobility, when under their own power, would be at a materially lower speed—just how much less can be determined only as a result of further experience. Viewed from this angle the speeds mentioned are believed to be attainable.

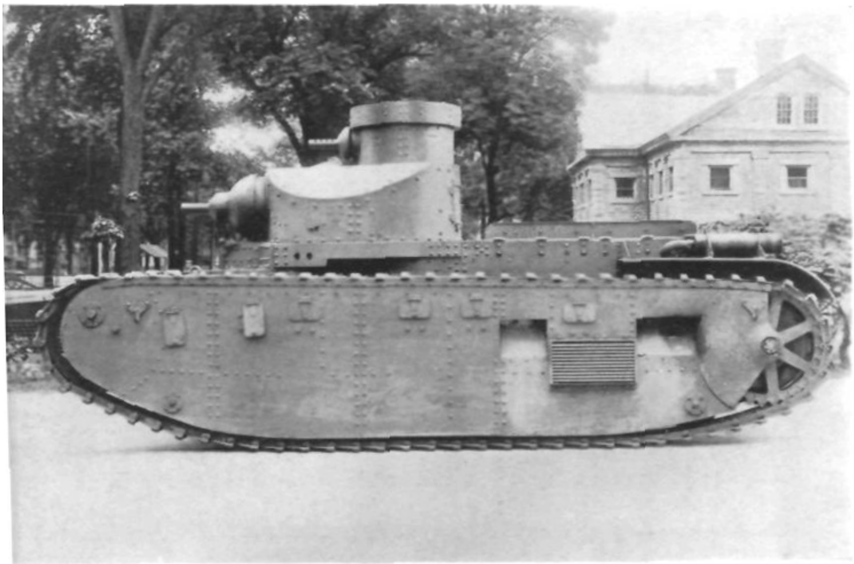
Before discussing the "Mechanized Force" to be experimented with during the summer of 1928, it is believed advisable to describe briefly the motor equipment under consideration, part of which will be available for this test. Some of this equipment has not as yet received a field trial, but its production is being rushed by the Ordnance Department in order that as much as possible of it may be on hand for this summer's maneuvers.

TANKS

Heavy Tank, Mark VIII. Weight 40 tons. Length approximately 34 feet. Width 9 feet. Speed 5.2 miles per hour. Crew 12 men. Armor .25 inch to .65 inch. Armament two 6-pounder guns and seven caliber .30 machine guns.

This tank is of the generally accepted type of British tank developed during the World War and adapted to our manufacturing standards. It is driven by a modified Liberty aircraft engine.

The principal advantages of this tank are its length, permitting it to cross trenches, and its thickness of armor. Its principal disadvantages are its size, weight, and lack of speed, making it an easy target and decreasing its mobility.



MEDIUM TANK, MARK VIII

LIGHT TANK, T1, 1927

LIGHT CROSS-COUNTRY CARGO CARRIER, T1

SIX-WHEEL CROSS-COUNTRY TRUCK (CHEVROLET)

It is felt that this is not a suitable weapon for the "Mechanized Force" under consideration. Greater speed and maneuverability is desired, and less target. The self-propelled artillery behind the tanks must keep close enough to supply the artillery fire required by this force.

Medium Tank.—Medium Tank T1. Weight 23 tons (1927). Length approximately 21 feet. Height 9½ feet. Width 8 feet. Speed 12 miles per hour. Crew 4 men. Armor ½ to 1 inch. Armament one 6-pounder and one caliber .30 machine gun in lower turret and one caliber .30 machine gun in upper turret. Each turret has a 360 degrees traverse independent of the other.

This tank was given a field test this year. It is mechanically good, has much greater speed than those manufactured during the World War and is believed to be a satisfactory fighting machine for the Tank Corps.

In considering the heaviest tank required by the "Mechanized Force," it is believed that a medium tank of from 12 to 15 tons will be sufficient, when artillery support is taken into account, rather than to depend upon the T1.

The Ordnance Department believes that it will be possible to manufacture a tank of 12 to 15 tons with equal or greater firepower and one that will have much greater speed and maneuverability. As this tank will lack ability to cross trenches, other means must be developed for that purpose.

Light Tank.—The new Light Tank T1 (1927). Weight 7 tons. Length 12 feet 8½ inches. Height approximately 7 feet. Width 5 feet 10 inches. Speed 18 miles per hour. Crew 2 men. Armor 375 inch. Armament one 37-mm. gun and one caliber .30 machine gun, in a 360 degree traverse turret.

This tank is the most interesting development yet undertaken. The experimental model, recently completed, exhibited remarkable mechanical performance and it is believed to be the ideal light tank for our "Mechanized Force." It has much greater speed than any tank yet developed, and has a cruising radius of eighty miles on the gas carried. Its engine is a commercial Cunningham. When we take into consideration the great number of light tanks that would be needed in wartime, it is most satisfying to know that a satisfactory type has been found that meets our specifications. Other advantages of this tank are: Its heavy armament as compared with weight and size, (other light tanks carry either a 37-mm. gun or a caliber .30 machine gun, but not both); its complete ventilation of the fighting compartment, insuring comfort to the crew; and its all-purpose chassis, permitting the use of several different types of bodies, as well as adaptability as a self-propelled gun mount or as a light fast tractor. The Ordnance Department deserves great credit for this development.

"Featherweight" Tank, or one-man tank. Its weight might best be about 1½ tons. Its height will be limited by the height of a man seated in it, as low as possible. Its speed should be 20 miles an hour or better. Its armament should be one machine gun.

We have no such animal as yet. However, the British have been working on some such vehicle and it behooves us to get busy. Armored motorcycles and side-cars have also been tried out in other countries. The motorcycle has possibilities. We are doing nothing at present to develop them.

The "Mechanized Force" needs a self-propelled, armor-protected vehicle to follow the tanks, carrying one infantryman, a machine gun and plenty of ammunition. It must be the smallest possible target and fast-moving. Its machine gun must be so mounted that it can be slipped off and set up in a shell hole if conditions require it. When moving it should be controlled by foot pedals so that both hands will be free to operate the machine gun. Such a machine gun unit is necessary to hold ground taken by the "Mechanized Force" until the relieving infantry arrives.

CARGO CARRIERS—(CROSS-COUNTRY)

Light Cross-Country Cargo Carrier T1. This vehicle needs no description here, being built on the same chassis as the Light Tank T1, described above, and having the same fine qualities of speed, maneuverability, etc.

An illustration shows the chassis with the tank superstructure replaced by a cargo body with a capacity of from 2 to 3 tons. This chassis can be used for many purposes, *i.e.*, for an ammunition carrier for artillery ammunition up to three tons; as a reel cart for artillery or signal corps units; to carry engineer equipment and tools; as a self-propelled mount for a 75-mm. gun; as a light high-speed tractor; or for carrying men. Its possibilities are great and only funds are necessary to develop them. This vehicle has greater ability to cross soft ground than any wheeled vehicle, as the ability to do so is primarily a function of unit ground pressure, (gear reduction, clearance, etc., being considered the same).

The 6-Wheel Cross Country Truck. (Chevrolet.) This is a standard Chevrolet one-ton truck equipped with oversize balloon tires, and an extra driven axle which greatly reduces ground pressure.

It is a light truck and should be able to get over very bad ground. A few men can extricate a truck of this kind without much effort.

Heavy trucks of over 1½ tons will ordinarily be used to carry supplies to "truck heads" on highways. From such points it is hoped that light trucks of the latest design will be able to operate overland. The advantage of a wheeled vehicle, like the one above described, as compared with a track machine, is its mobility on roads and good ground, and its greater mileage life and simpler maintenance problem.

The Ordnance Department is working on the development of many different types of cross-country cargo carriers, two of the best designs having been described. It is hoped to be able to determine the relative values of these vehicles at the maneuvers this summer.

SELF-PROPELLED ARTILLERY

Self-propelled artillery is considered absolutely necessary to a mechanized force. To build a tank sufficiently large for carrying light and medium artillery guns and howitzers calls for the "Land Battleship," slow-moving and a most vulnerable target. It has no place in our "Mechanized Force." Self-propelled artillery can be fast-moving and present a small target and must be close at hand to support the advance of the light and medium tanks. None of the three self-propelled materiels mentioned below have progressed very far towards standardization. Especially in the case of the two experimental 75-mm. vehicles (Mark VI and VII), tests have indicated that these particular experimental models fall far short of having the qualities desired. However, later developments along this line should give us an accompanying gun of great value.

Mark VII Self-Propelled Mount (Division) with 75 mm. gun M. 1916. The general specifications of this mount are as follows:

Weight 10,600 pounds. Speed, normal, 9.5 miles per hour; maximum, 15 miles per hour. Engine, Cadillac 8-V. Length, overall, 135.25 inches. Width 63 inches. Height 71 inches. Fuel tank capacity 21 gallons, (45 miles). Gun elevation—5 degrees to 45 degrees. Traverse at maximum elevation 490 miles.

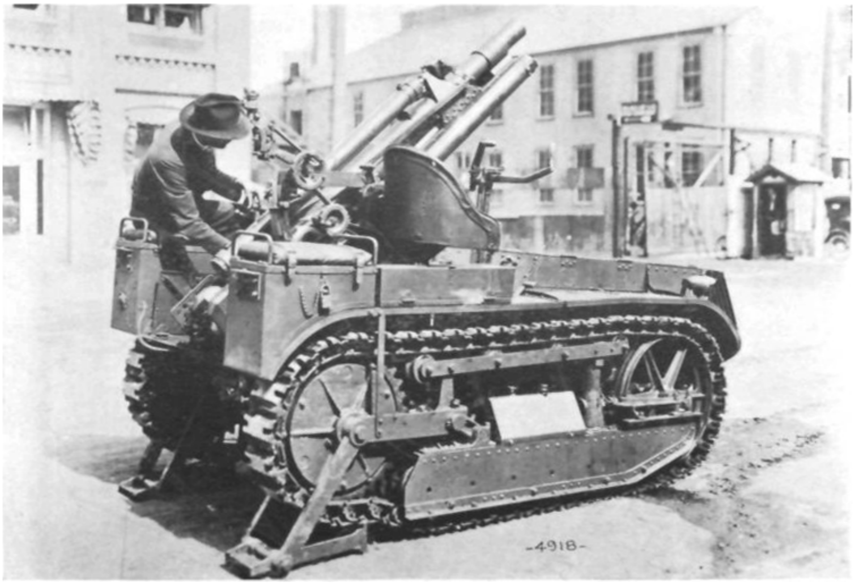
There has been no recent development or manufacture of this type of mount, and in considering its ability, it must be borne in mind that this chassis was built in 1919, and the engine is not that desired at the present time. It has other mechanical drawbacks which I will not mention, as they can all be overcome if funds are made available for this development. This should be remembered by those who are apt to condemn this type of vehicle. Unfortunately no more recent designs can be made available for this summer's maneuvers. It is confidently believed that the Ordnance Department is in a position to develop a fast moving mount of this type, with low relief and armor protection, that will have as its motive power a commercial engine of latest design and which will be satisfactory to the service. After this year's experiments are completed we can look forward to having funds provided for this very necessary development.

Corps Self-Propelled Mount. One of these Corps mounts was built in 1923. It mounts interchangeably the 4.7-inch gun or the 155-mm. howitzer M. 1921. Its weight is about eleven tons and its speed about twelve miles per hour. The self-propelled mount, 155-mm. howitzer might well be included in our Mechanized Force.

Army Self-Propelled Mount. Two of these mounts were built in 1921. They mount interchangeably the 155-mm. gun or the 8 inch howitzer M. 1920. Their weight is about twenty-two tons and their speed about ten miles per hour. This is probably too heavy a vehicle to keep up with the Mechanized Force. It might well be used as a reinforcing weapon.

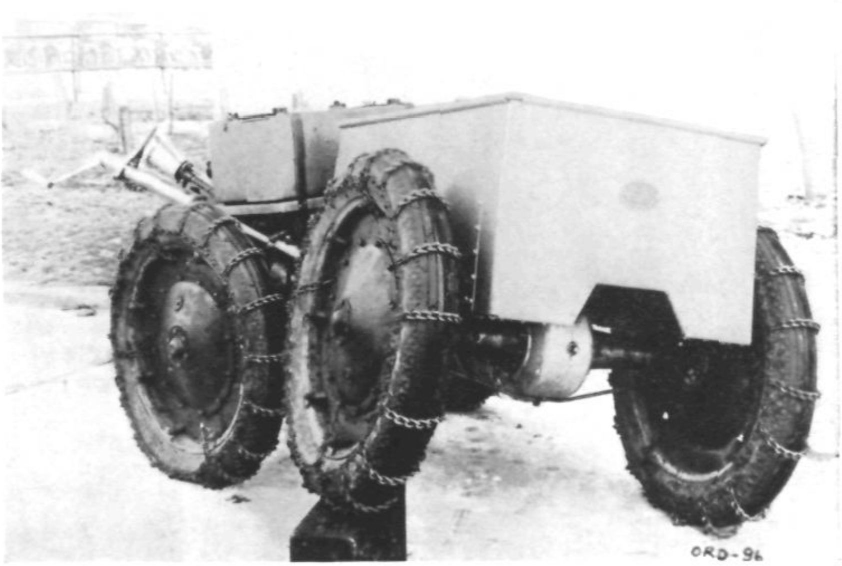
Before leaving self-propelled mounts it is well to remember that only limited experimentation has been carried out to date. Such weapons can be rapidly emplaced. For example:—Brakes are set, a pin is pulled which permits lowering struts in rear of the gun carriage and you are ready to fire. In addition to the uses for which these weapons were built, they are wonderful reserve weapons. As an accompanying gun for infantry, even with an ammunition carrier in attendance, it will furnish a much smaller and less vulnerable target than guns and caissons drawn by 6-horse teams. Some protection can also be given the gun crews. There will be fewer men required and undoubtedly less casualties.

With the completion of some of the more urgent development work on Field Artillery projects, or the availability of additional funds for this purpose, it may be expected that further development of the self-propelled mounts will be undertaken. As against obvious advantages of this type of mount, it has the disadvantage of lack of interchangeability of motive power. If the tractor element becomes a casuality the gun loses its mobility; the tractor element can not take cover, or draw ammunition while the gun is in action. A most serious objection from the procurement standpoint is that it is a strictly military vehicle and therefore cannot be obtained in quantity at short notice. As the number which would be available during the first months of a major emergency would be practically limited to those purchased during time of peace, they would appear to be

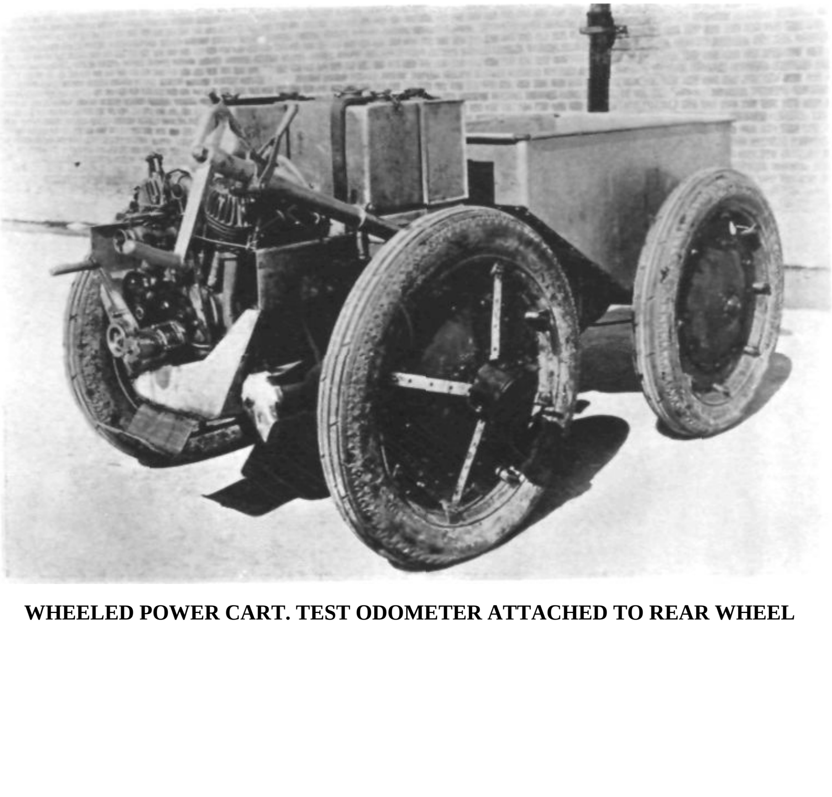


SELF-PROPELLED MOUNT, MARK VII, 1919, WITH 75-MM. GUN, MODEL 1916

SELF-PROPELLED MOUNT, 1922, WITH 4.7-INCH GUN, MODEL 1921



WHEELED POWER CART. CAPACITY 450 POUNDS



WHEELED POWER CART. TEST ODOMETER ATTACHED TO REAR WHEEL

precluded as initial divisional matériel. This latter objection is less applicable to a special mechanized force, than to division artillery, due to the smaller numbers required by the former.

Should the Nation's output of mechanical equipment for airplanes, heavy tractors, trucks, etc., be sufficient to justify the use of special vehicles for the Field Artillery, it would not be unreasonable to anticipate division guns and ammunition carriers, able to travel at an emergency speed of from 15 to 25 miles per hour, and corps and army guns from 10 to 15 miles per hour.

WHEELED POWER CARTS

The Infantry have an item in this year's Budget (F.Y. 1929) for $140,000 to cover the manufacture of experimental equipment for mechanizing one regiment of Infantry. The desired equipment has been based upon tests of various types of cross-country vehicles by the Ordnance Department and the Infantry Board. It includes, among other items, fourteen Power Carts. In addition the following cross-country vehicles will be purchased or manufactured by the Ordnance Department, for an infantry regiment: 20 cross-country cars, 14 2½-ton tractors, 10 cargo carts, and 17 cross-country trucks.

Track-laying types of the power cart with a drastic weight limitation of 600 pounds were found unsatisfactory and a four-wheel drive, balloon-tired type seemed most desirable. Air-cooled motorcycle engines have been tried out with but indifferent success. If enough power is not developed by such an engine, a light four cylinder automobile engine can be used. Articulation between the front and rear axles permits wheels to follow the inequalities of the ground, giving excellent traction. Steering is done by varying the angle between the two axles. Such a vehicle, it is hoped, will satisfactorily carry machine guns and ammunition at the rate of the infantry advance. Its main disadvantage is that its useful load is only 450 pounds, which does not permit mounting on the carriage the armor desired. The so-called "featherweight," or one man, tank has distinct advantages over the above vehicle, and undoubtedly development will proceed along this line.

With the foregoing ideas on "Mechanized Forces" and recent mechanical developments in mind, we are ready to proceed to the consideration of the possible tactical and strategical use of mechanized troops, their organization, and the program to be put into effect in order to test and develop their possibilities.

I visualize a mechanized force as a tactical unit, complete in itself. It is an additional offensive weapon of opportunity, to be put in the hands of higher commanders. Its organization will in no way affect the present organization of divisions, corps or armies. Nothing in this article is intended to convey the idea that we are attempting to mechanize the Army of the United States. Undoubtedly, as further improvements take place in motor transport, particularly in truck transport, or if funds were available for the purchase of modern trucks, we would find more motor transport trains, and possibly other motorized units in our army replacing animal-drawn units, but this is not mechanization.

Having set up one "Mechanized Force," experimented with it, and determined its possibilities, it will be necessary, at some future date, to re-study the missions of the Regular Army in order to determine whether we want one, or more than one such unit in our peace organization. In our war planning we will be called upon to determine what number of mechanized forces should be attached to corps, armies and General Headquarters. The corps would probably be the smallest unit to which a mechanized force should normally be attached.

A "Mechanized Force" would normally be held in reserve, and when called upon in battle should be able to exert great offensive power. Having carried out its mission of breaking through strong opposition, it should be promptly relieved by troops suitable for holding ground, and again revert to a reserve status.

The Chief of Staff has already approved plans for the training, organization and operation of our first "Mechanized Force" at Camp Meade, Maryland, during the coming summer. This force will include the following units:

One battalion, 34th Infantry,
2nd Platoon, 4th Tank Company,
One battalion, 6th Field Artillery, (less one battery)
One battery, 61st Coast Artillery, (A.A.)
One company, 1st Engineers (Combat),
1st Signal Company,
Elements of the 1st Ammunition Train,
Medical Detachment,
One platoon, 1st Gas Regiment.

The following units, or elements of same, will be made available for use with the above experimental force:

One armored car platoon,
Elements of the 16th Tank Battalion (light),
Elements of the 17th Tank Battalion (heavy),
One platoon, Chemical Warfare troops,
Provisional platoon, 1st Armored Car Troop.

With this experimental force it is hoped to determine the correct organization and equipment for a mechanized force or unit and its tactical and strategic possibilities.

Too much must not be expected of this force, for although it will be partially equipped with motor and mechanical elements of the latest design, but few of these will be available for test next summer, and the great majority of the vehicles used will not be those desired. The cross-country possibilities of recently developed machines can, however, be thoroughly tested and upon completion of the test we should know what to manufacture, develop and purchase for a future mechanized force.

The Chiefs of Supply Branches are intensifying their studies and rushing development of motor vehicles and weapons for this year's use with the Mechanized Force. Both the Chief of Ordnance and the Quartermaster General will invite civilian manufacturers of motor vehicles to submit their latest models for test.

The necessity for developing a mechanized force in the Regular Army as an experimental laboratory is now conceded by all. When developed, this force will be primarily a self-contained offensive weapon. The following are believed to be some of the missions that should be well handled by a mechanized force in war:

a. As a strategic advance guard of a large force. (Corps or Army.)
b. As a mobile flank guard.
c. To seize and hold key positions for a short time.
d. To attack enemy's flank or break up his communications in rear areas.
e. To penetrate the enemy's line when strong resistence is met.
f. As a counter-attack weapon.
g. As a rear guard of a large force.

Its organization and strength must be worked out. It must be strong in tanks, both light and medium. For example: it is not difficult to picture, first, reconnaissance of the enemy by air, armored cars and light cross-country vehicles. This would be followed by the shock troops, the light tanks, a battalion attack on a relatively wide front, in three waves, closely supported by the fire of self-propelled artillery and hidden by smoke. Then a company of heavy tanks, followed in turn by the mechanized machine guns, say a battalion prepared to mop up as it goes forward and eventually to hold the ground gained by the tank advance. Due to the speed of advance and difficulty of observation, the self-propelled artillery will have to support closely the tanks, which are particularly vulnerable to hostile artillery fire. The artillery might well consist of a battalion of 75-mm. guns, self-propelled and a battery of 105-mm. howitzers, on similar mounts. The 4.7-inch guns and tractor-drawn or portée artillery could also be used as reinforcement depending upon the situation. A small headquarters, engineers to assist the advance, signal troops to keep up communications, antiaircraft defense, and Chemical Warfare troops, complete the picture.

In comparison to its fire power, such a force will be comparatively small in man power. The above force would probably vary between two and three thousand men. Its speed of operation, its mobility and its armor protection should result in great saving of life as compared with a similar attack by infantry.

We are keeping abreast of the times. We have established our laboratory of development and training, for we feel that mechanized forces will play an important part in the next great war.

In closing it is well to remember that the Field Artillery will continue in an important rôle, regardless of the extent of mechanization in the Army of the United States. Whether they are horsed, motor-drawn, mechanized or portée—*"Keep 'Em Rolling"!!!*

THE DRIFT OF ARTILLERY PROJECTILES

BY FIRST LIEUTENANT WILLIAM W. FORD, F. A.

Introduction. The object of this article is to present briefly and in non-technical language an explanation of the more important phenomena attending the drift of artillery projectiles. The derivation of formulæ by means of which drift may be calculated will not be attempted, as this involves mathematics of an exceedingly difficult nature. Likewise, the solution of problems in the use of these formulæ is omitted. It is felt by the writer that what the artillery officer is most concerned with is merely an understanding of the physical forces operating to produce drift. To an exposition of these forces the present effort is addressed.

Before proceeding to a discussion of the causes of drift there are two erroneous impressions, commonly held, which should be corrected. One is that the modern cylindrical projectile is constrained *by its rotation* to maintain its axis tangent to the trajectory throughout flight. In the first place the axis does not actually remain tangent, but only approximately so. Numerous experiments conducted by firing through cardboard screens have proved this conclusively. Indeed it is estimated that, with certain guns, the *yaw** of the projectile just after the summit reaches the value 60°† where the projectile has been fired at 70° elevation. In the second place the tendency of the projectile to keep its axis even approximately tangent to the trajectory is due, not to rotation merely, but to the combined effects of rotation, air resistance and gravity. Reflection will show that a spinning projectile fired *in vacuo* would land on its base, with its axis inclined upward from the horizontal at an angle equal to the angle of departure. In other words the projectile, by virtue of its spin‡, is a powerful gyroscope, and as such tends to keep its axis of rotation parallel to its original direction (line of departure). Only when the projectile is acted upon by air resistance, which tends to upset its equilibrium, does it turn its point downward into the trajectory.

The second fallacious idea, widely held, is that the drift of a projectile occurs through the operation of the same forces that cause a baseball or tennis ball to curve. The same forces are present in both cases, to be sure, but their effect would be, in the

* The *yaw* is the angle at any moment between the axis of the projectile and the tangent to the trajectory.

† "The Aerodynamics of a Spinning Shell," by Fowler, Gallop, Lock and Richmond. (British.)

‡ A high explosive shell fired with normal charge from the 75-mm. Gun, Model 1897 (French) has a rate of rotation of approximately 17,000 r.p.m.

case of the projectile, to cause a drift to the left when the rotation is right-handed, and vice versa. We know, of course, that the drift is actually to the right when the rotation is right-handed, so we must conclude that the forces which cause a baseball to curve, though present in the flight of the projectile, are not strong enough to overcome other forces operating to produce drift in the opposite direction. This will be discussed further under "Magnus effect."

We are now ready to consider in detail the causes of drift. These are three in number, known as the gyroscopic, Magnus and Poisson effects. They will be treated in the order of their respective magnitudes, and as briefly as possible.

Gyroscopic effect. Consider the spinning cylinder of Figure I. XX′is the axis of rotation. YY′ and ZZ′ are other axes perpendicular to XX′ and to each other. The rotation is clockwise as viewed by the reader. The fundamental principle of the gyroscope is that it tends to maintain its axis of rotation XX′ parallel to itself no matter what movement of translation may take place. But apply any external force which has a component tending to rotate the axis XX′ in any direction whatsoever and curious things occur. Thus, if a force R is applied at X′, tending to rotate XX′ vertically about axis ZZ′ toward coincidence with YY′, the gyroscope resists this effort and if it possesses sufficient energy of spin no appreciable rotation of axis XX′ about axis ZZ′ will take place. Instead axis XX′ will rotate *about axis YY*′ so as to move X′ toward Z′. The general rule for predicting the effect of any effort to rotate the axis XX′ is as follows: The spin axis (XX′) tends to place itself parallel to the axis (ZZ′) about which the applied external force (R) is seeking to produce rotation, and in such manner that the direction of spin will be the same as the direction of rotation which the applied force seeks to produce (*i.e.*, X′ moves toward Z′ rather than toward Z). The parentheses above show a particular application of the general rule.

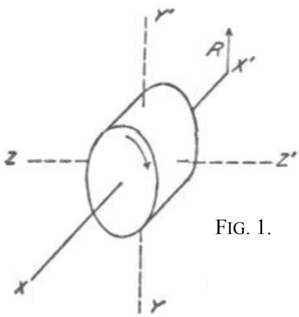


FIG. 1.

Now apply this principle to a projectile in flight. When the projectile first issues from the piece its axis of rotation is, let us say*, substantially tangent to the trajectory. Since the resistance of the air acts along this tangent there is no tendency to overturn the projectile about an axis perpendicular to the axis of rotation. As the projectile begins to drop from the line of departure its axis, being a stable axis of rotation, tends to remain parallel to itself

* See page 253, "Some further considerations."

during flight. But the tangent to the trajectory changes its inclination continuously and thereby becomes inclined to the axis of rotation. Since the resistance of the air acts always in the direction of the tangent it becomes inclined to the axis of rotation of the projectile. In modern projectiles the resultant of this air resistance intersects the axis of the projectile *in front of* the center of mass.† Thus, in Figure 2, where G represents the center of mass and R the resultant of the resistance of the air, R acts with a lever-arm *l* to overturn the projectile about a shorter axis through G, perpendicular to the plane of fire. But the projectile, due to gyroscopic action, resists this rotation, and instead turns its point slowly to the right‡ about an axis perpendicular to both the spin axis and the shorter axis mentioned above. An oblique air pressure on the left side is now experienced and the projectile is forced to the right, out of the plane of fire. Furthermore, as soon as the projectile begins to move in a sidelong manner the air resistance is met on the lower left side, and the gyroscopic effect now causes the point to turn still further to the right, and downward.

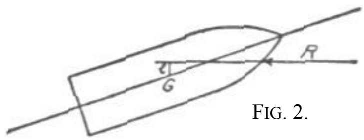


FIG. 2.

Magnus effect. This is, as was stated earlier, the principle which causes a baseball to curve, and it is also felt in the flight of a projectile, though it is not nearly so powerful as the gyroscopic effect discussed above. Gustav Magnus, professor of physics at the University of Berlin from 1834 to 1869, made extensive investigations of this principle, and from him it takes its name. He discovered that when a current of air is directed against a revolving cylinder it exerts a force tending to move the cylinder at right angles to the direction of the air current. The now famous rotorship of Anton Flettner operates by utilizing the Magnus effect, which briefly explained, is as follows: Consider, in Figure 3, that A is an end view of a cylinder being revolved in calm air by an outside source of power. The movement of the particles of air about A, due to friction, is suggested by the faint lines in the Figure. Next, consider in Figure 4 a similar cylinder at rest, but having a current of air directed against it. The lines of travel of the air particles are here again represented by the faint lines. Now, finally, in Figure 5 we have a combination of the conditions of Figures 3 and 4. In this case it is found that more particles of air will pass to the left of the revolving cylinder than to the right. In other words, most of the particles of air are deflected to that side of the cylinder

† "Ordnance and Gunnery," Bruff.

‡ It is assumed throughout this paper that the spin is right-handed.

where they are traveling in the same direction as the skin of the cylinder. Consequently the rate of flow past the left side is much higher than the rate past the right, the result being that the air on the left becomes rarefied, causing a partial vacuum, while that on the right becomes condensed, with a corresponding increase of pressure. This difference of atmospheric pressure is sufficiently large to be readily measurable with a barometer. The combination of partial vacuum on one side and increased pressure on

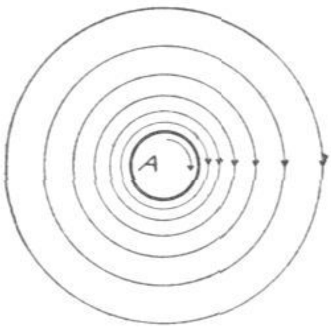


FIG. 3.

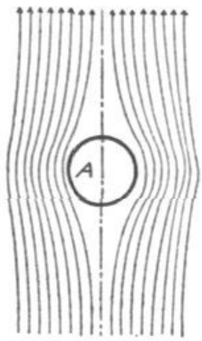


FIG. 4.

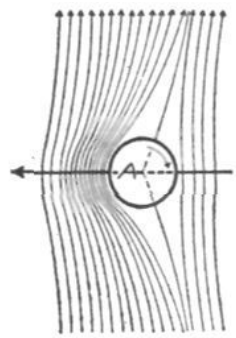


FIG. 5.

the other tend to force the cylinder bodily in the direction of the heavy arrow. Attention should be called to two curious circumstances involved in this reaction. First, the partial vacuum on the one side is several times as powerful as the increased pressure on the other. Second, the total force exerted on the cylinder in the direction of the heavy arrow is several times as great as would be the force exerted on an ordinary sail of same cross-sectional area as the cylinder A by a wind of the same velocity.

Now if we regard A, in Figure 5, as a baseball thrown from the top of the page toward the bottom with a twist as indicated, the heavy arrow will represent the resulting deflection. Thus, an "in-curve" will be produced.

In the case of the projectile we may regard A, Figure 5, as a rear view of a projectile fired with a right-hand twist. When the projectile begins to drop from the line of departure it meets on its under side an air current which has a component perpendicular to the axis of rotation. The consequent deflection due to Magnus effect is to the left. That the drift is actually to the right is explainable by the fact that the gyroscopic effect is much more powerful than the Magnus effect, and the latter is overcome.

Poisson effect. When the projectile begins to drop from the line of departure a cushion of air accumulates on its under side, over which it tends to "roll" to the right. This, the Poisson effect,

† "Drift." by H. P. Hitchcock. Aberdeen Proving Ground.

is said to be negligible.† It should be noted, however, that the Poisson effect augments the gyroscopic effect, and even helps to cause that part of the gyroscopic effect which keeps the point of the projectile turning downward. For obviously the friction of the cushion of air against the projectile is greatest at the ogive, causing the point to move to the right faster than the base. Here is, then, a force tending to disturb the equilibrium of the axis of rotation by urging the point of the projectile to the right. When this force is felt the projectile immediately begins to turn its point downward into the trajectory, in accordance with the principles discussed under "Gyroscopic effect."

Some further considerations. 1. In the preceding paragraphs it has been assumed that the projectile emerges from the bore in a state of "steady motion," with its axis exactly tangent to the trajectory. In reality the expanding eddies of gases from the powder charge follow the projectile during the first few yards of flight and impart to it oscillations comparable to the wobbling of a top which has lost momentum. This wobbling of the projectile is normally damped out rapidly by the frictional drag of air resistance and does not affect the drift to any great extent. While the oscillations continue, however, they cause the projectile to expose a varying surface to the onrush of air, which action produces the hissing sound frequently heard as a round is fired. This sound is often erroneously attributed to a rupture of the rotating band, but whereas a rupture of the rotating band causes the projectile to become unstable, and therefore erratic, the wobbling which causes a similar hissing produces no very harmful results. Many officers have undoubtedly had the experience of predicting an erratic range for a round which made an unusually loud hissing noise, only to find to their surprise that the round was not sensibly erratic. The explanation lies in the fact that the noise in question, in nearly all such cases, is due merely to the oscillations described above, and the projectiles concerned are found at their points of impact with their rotating bands uninjured.*

2. It has been determined practically that for a given gun the drift varies approximately as the maximum ordinate, or as the square of the time of flight.

3. The drift also varies approximately as the velocity of rotation, *i.e.*, with the final pitch of the rifling.

4. The greater the spin the greater the stability of the projectile. However, the projectile must not be *too stable*, for in such case it will have difficulty in keeping its axis even approximately tangent to

* Vol. II, "Technical Supplement to the School of the Battery Commander," Saumur, 1918.

the trajectory. The more powerful a gyroscope the greater its resistance to disturbing forces, and the projectile *depends* upon the disturbing forces met with in flight to keep its point turning downward continually into the trajectory.

5. Without *drift* the projectile could not keep its axis even approximately tangent to the trajectory. For the forces producing drift are the disturbing forces which cause the projectile, through gyroscopic action, to turn its point downward.

CAMPAIGN SUMMARY AND NOTES ON HORSE ARTILLERY IN SINAI AND PALESTINE

BY LIEUTENANT E. L. SIBERT. F.A.

To GATHER such meager facts as I have included below, it has been necessary to comb through a mass of matter on the campaigns in Palestine and Sinai. To Lieutenant Colonel The Hon. R. M. Preston, I am indebted for nearly the only direct opinions on employment of horse artillery that I have been able to find. He is an artilleryman himself, which explains his having included a number of valuable remarks on this subject in his very interesting book, "The Desert Mounted Corps." Practically all the other writers saw in these campaigns only the remarkable use of cavalry in modern warfare.

Some of the most frank and detailed accounts of the mounted work are contained in Vol. VII of the "Official History of Australia in the World War," and Vol. III of "Official History, New Zealand's Effort in the Great War." The horse artillery supporting the Australian and New Zealand troops, however, were not of Anzac origin, but were English and Scotch territorial batteries. Though they are mentioned most cordially and their efficiency very favorably commented upon, there are no detailed accounts of their work.

The United States Cavalry School History of the Palestine Campaign, naturally deals solely with the cavalry. "Allenby of Armageddon" though more or less the biography of a cavalryman, gives little space to his handling cavalry in the Palestine campaign and none to artillery. The only histories of horse artillery units in this campaign were found to be of limited edition, out of print and unobtainable.

Lawrence's really remarkable book, "Revolt in the Desert," though full of interesting side lights, contributes little to our narrow subject.

In order to keep the reader oriented and to help him keep events in their proper chronological order, I will include first a short outline of the campaign.

We will then proceed to examine the campaign in detail for points of interest to the artilleryman, taking up those particular actions that furnish interesting examples of horse artillery support.

General Murray took command of Eastern Egypt in January,

1916. He believed that the defense of Egypt should be undertaken on the southern border of Palestine, instead of at the canal.

In preparation for an advance he caused to be started a railway to Katia, and British troops occupied or patrolled the area thirty miles east of the canal. In July, 1916, the Turks made an attack in force on Katia and were repulsed. Most of the rest of the year was devoted to raids, reconnaissance and pushing forward the work on the railroad.

In December, 1916, the British again advanced practically unopposed. The Turks made a stand at Magdhaba and Rafa, both of which places, including many prisoners, were taken by British mounted troops. The British lines were now stabilized until the railroad and pipe lines could be extended to Rafa.

The Turks meanwhile took up a strong defensive line from Gaza to Beersheba. Late in March, 1917, the British with all arms made their first attack on Gaza; which was unsuccessful and costly. On April 17-19th the second attempt to carry this place was made. The attack again failed with even more severe losses to the British. Stabilized warfare conditions now set in. Morale was low and interest and support from home showed a marked falling off.

Many military authorities in England believed, in accordance with the first principle of war—that England could best help win the war by using nothing but the defensive at any threatened subsidiary points such as the Suez or Mesopotamia, and using every other available man, gun and penny on the western front in France to take the offensive against the enemy main force. This viewpoint had been more firmly established by the costly and sad Gallipoli failure.

Lloyd George, however, considered the Turkish Army as actually the left wing of the Central Powers' front, and believed that a victory against it would be as fruitful as a victory against the powerful right wing in Flanders. Accordingly he looked for a strong successful leader to send to Palestine.

After a careful search his choice fell upon General E. H. H. Allenby, who had gone to France with the first regular troops in 1914. He had had an excellent record in the Boer War as a cavalry leader, and also had a guiding hand in cavalry training in the period just prior to the World War. In the first B.E.F. he commanded the cavalry division, and within a short time was given command of the newly formed cavalry corps. He later successfully commanded the Fifth Corps and soon thereafter the Third Army in Picardy. His leadership in the Somme Offensive in October, 1915, and again in the spring of 1917 earned him universal praise.

Lloyd George's selection of General Allenby to command in Palestine therefore naturally met with favor. The new commander's plan to reënforce the Palestine front, however, was only carried through after a considerable fight with the London military powers.

Allenby's arrival in Palestine marked the beginning of a decidedly new era. More troops, better equipment, airplanes, and heavy guns arrived. Morale went up and intensive training, reorganization and preparation set in.

The new general found the enemy holding an organized position from the sea northwest of Gaza to Beersheba, about thirty miles to the southeast, the country to the east of the latter place being extremely rough, trackless and waterless. To all intents and purposes, therefore, this thirty-mile line was considered to rest on two impassable obstacles, the sea on the west, and the rough arid highlands of central Syria on the southeast. Beersheba itself contained practically the only water within miles to the east, west or south, of that place.

The opposing British lines were extended for about twenty miles, from the sea at Gaza to Gamli, roughly parallel to the Turkish lines.

Allenby's plan was simple. With a demonstration at Gaza, his main blow was delivered at Beersheba, enveloping the enemy's left and rolling his line up toward Gaza.

The attack began on October 31, 1917. By dark the mounted troops had galloped into Beersheba and the Turkish left was in full retreat. The next move was another demonstration at Gaza to immobilize the reserves there and prevent any reënforcement of the central position at Sheria. This attack on Gaza was made on November 2d and not only prevented the withdrawal of reserves, but gained many strong points and actually attracted most of the available reserves from the rest of the line.

On November 6th the Sheria-Hareira position was stormed and taken and the entire Turkish line gave way. The pursuit was immediately taken up, during which many stiff rear guard actions developed.

The country fought over was practically waterless. Roads did not exist and the going was exceedingly hard.

From November 7th to November 11th the advance on the part of the British was made by the Desert Mounted Corps east of the Ramleh-Gaza railroad and by two infantry divisions in the country west of it to the sea. The other infantry divisions gave up their transportation to enable these two to go ahead.

On November 11th the enemy took position on the Nahr Sukereir, but were soon driven out by the capture of the Tel El

Murre and Burkah. The advance now inclined to the east. The Katrah-El Mughar line was overrun and the British forces pushed on towards Ramleh and Ludd. These two towns and Jaffa being soon taken, there ensued a pause to await the progress of railroad construction and reconstruction.

Hence on November 16th General Allenby's army held the line Jaffa-Ludd-Ramleh-Junction Station, with a division of mounted troops north of Beersheba on the Hebron Road. In seventeen days the army had advanced over sixty miles and had captured over 9000 prisoners, and large quantities of matériel and stores!

Allenby now stabilized his left in defensive positions and reached to the east. His plan was to cut the Nablus road north of Jerusalem and thereby isolate that city. At this stage the Turks began to recuperate from their first panic, and were in addition, strongly reënforced with some of the best Turkish troops from other fronts. The difficult terrain, mud and cold (the winter rains having set in), added to the coming of these reënforcements, caused the British many costly delays and rebuffs.

In addition to cutting Jerusalem off on the north, a British division was to come up on the Hebron road and get across the Jericho road east of the Holy City. These advances finally succeeded but not until the Turks had withdrawn from Jerusalem.

That city surrendered on December 9, 1917. The total of prisoners taken since October 31st was brought up to 12,000 and of captured guns, up to 100.

The British lines now ran from just north of Jaffa to just north of Jerusalem and then bent back to the south. These lines were consolidated, the troops resupplied, communications improved and everything in general tightened up for one more effort.

This came on December 20th when for three days a battle raged on the left which resulted in an advance of several miles, far enough to make Jaffa safe to use as a base for unloading ships.

Again on the 27th for five days, attack and counter-attack immediately north of Jerusalem again resulted in a gain of enough miles to make Jerusalem safe from immediate threat.

The next move came on February 19th when one infantry and one cavalry division struck to the east down through the well-known wilderness of Christ's temptation, to Jericho and the northern inlet of the Dead Sea (*i.e.*, where the Jordan runs into the Dead Sea).

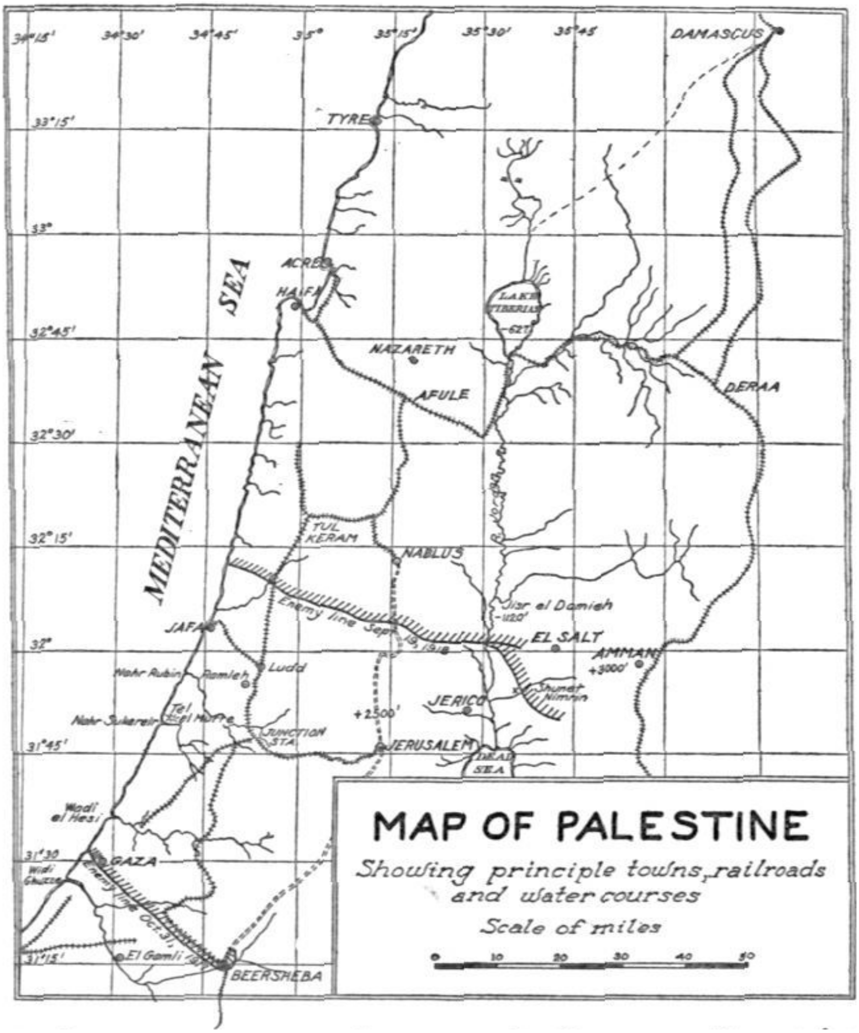
The country was the roughest yet met with and the weather most inclement. The 60th Division and the Anzac Mounted Division, however, fought their way through and captured Jericho on February 21st, and on the evening of the same day held the Jordan from the Dead Sea up to near the El Ghoraniyeh bridge.

Again early in March, the 60th Division pushed north along the

Jordan until the Turks evacuated their bridgehead covering the aforementioned bridge.

These operations thus securely established the British right.

It must be remembered at this point that the Arab tribes in Arabia had under Feisal, declared their independence, and inspired by Lawrence, were



carrying on a desultory guerrilla warfare against the Turks in the Hedjaz.

The Turkish communications to this front lay temptingly open, across the Jordan and up on the highlands of Moab, from the new British right.

At Amman, the Hedjaz railroad ran over a viaduct and through a tunnel. Quite naturally a raid against this place was conceived and launched. Amman is thirty miles east of Jericho. The first five miles is flat, but in the next twelve the ground rises 3500 feet, and is extremely rough and crossed by only one real road.

The raiding force consisted of an infantry division and a cavalry division. Starting March 21st the forcing of the Jordan took nearly two days, thereby vitiating most of the surprise element. The raiders doggedly advanced into the mountains and fought their way toward Amman, against minor enemy resistance for three days and nights. All wheeled transportation had to be left behind and the command suffered severely from the rain and cold.

By March 29th the advance was at a standstill just east and south of Amman, though some demolition of the railway had been effected.

On the night of the 30th after a day of final effort, orders were given to withdraw. Turkish reënforcements had arrived both at Amman and north of the route back to the river crossing, near Es Salt. By evening of April 2nd after many delaying actions the command was back west of the Jordan.

The next operation of any importance was the Es Salt Raid, the plan being to work to the rear of the Turkish position at Shunet Nimrin and capture Es Salt, thus severing the communications of the Turkish forces immediately east of the Jordan. Two cavalry divisions and one infantry division reënforced with Indian brigades composed the raiding force.

The Shunet Nimrin position was attacked and masked according to schedule while the mounted troops, leaving the 4th Australian Light Horse Brigade and three horse batteries to keep its line of retreat clear, pushed on to Es Salt and captured it. Expected Arab coöperation failed to materialize.

The enemy, however, quickly reënforced this end of his line from the west and elsewhere and made the British withdrawal not only necessary but very difficult. The aforementioned 4th Australian Light Horse Brigade lost two of its batteries and nearly lost itself; while the retreat of the Australian Mounted Division from Es Salt was made under very stiff pressure.

May 4th saw the restoration of the original positions on both sides, after five days of fighting.

Nothing of any magnitude or importance occurred in the Jordan valley until the Turks attacked on July 14th and were counterattacked and ejected from the British lines near Musallabeh and Abu Tellul.

The next act came in September, 1918, when Allenby massed most of his cavalry under cover on the coast; left a small but active force in the Jordan valley, and attacked on the coast for a "break through." The break through was achieved and according to plan, three divisions of cavalry trotted through the gap near the sea and drove on to the north.

By noon of the 19th of September, seven hours after the attack started, the cavalry was eighteen miles to the north, and were soon through the passes to the northeast into the Plain of Esdraelon. The 4th Cavalry Division reached Beisan the evening of the 20th, having covered eighty miles in thirty-four hours; the 19th Lancers securing the bridge over the Jordan at Jisr Mejamie, ten miles further north. On the 22nd the New Zealand Mounted Rifle Brigade seized the bridge at Jisr el Damieh.

Thus within less than four days all the routes of withdrawal for the Turkish armies east of the Jordan had been closed. By September 24th the last remnants of the VII and VIII Turkish armies had been rounded up, the infantry driving the panic-stricken Turks into the cavalry's arms.

In the interim, the cavalry had captured Acre and Haifa. The net result of the operation was the clearing of the whole of Palestine west of the Jordan and the capture of 40,000 prisoners.

On September 23rd Es Salt, east of the Jordan, was taken, and Amman on the 25th, the enemy Fourth Army retreating to the north along the Hedjaz railroad in a demoralized condition. The II Turkish Army at the same time started its retreat toward Amman from the Hedjaz pursued by the Arab Army. On the 28th, this army surrendered to the British without a fight.

The Desert Mounted Corps was now ordered to Damascus with all speed as some 40,000 Turks and Germans were either in it or retreating toward it. The race to this place was made against some opposition. The British troops were in two columns, the Australian Mounted Division and the 5th Cavalry Division in one, the 4th Cavalry Division in the other.

The first-named column had actions at Benat Yakup, Kuneitra, Sasa and Katana, before it reached and closed the north and northwest exits from Damascus on September 29th. The other column after fights at Irbid and Er Rempte and after joining the Arabs, entered Damascus the morning of October 1, 1918. However, about 17,000 Turks, the last remaining in Palestine, had succeeded in escaping northwards in a disorganized mob.

Thus ended Turkey's rôle as a combatant in the World War.

So much for the general narrative of the campaign. Now to examine particulars.

A British or Australian Mounted Division consisted at first of four brigades (about 2100 men each) plus a brigade of three horse artillery batteries of four guns each (13 pounders). Later the divisions were reduced to three cavalry brigades each. In addition there was a Field Squadron (Engineers), Signal Squadron and Medical, Veterinary and Supply units and trains.

At the end of the campaign it was a matter of more or less general agreement that the British Cavalry Division was under-gunned, both as to weight of metal and numbers; and the cry went up for the light howitzer (*i.e.*, the 105-mm. or similar weight).

What was deemed ideal was a battalion (brigade) of light guns and a battery of light howitzers in each division. This plan, however, contemplated six guns per battery. This would leave our cavalry divisions, by comparison, woefully under-gunned.

The British had from the first until well on into the campaign, one battery of 13 pounders assigned to each brigade.

The disadvantages of such a scheme is only too evident, and was thoroughly condemned by the artillery and remedied later. Brigades in reserve often kept their batteries with them, and fire direction in support of the action viewed as a whole was, of course, unusual.

Seldom in accounts of the campaign could be found incidents where the horse artillery was so left behind by fast marches as not to be on hand for the fight. September 19th and 20th, 1918, the Notts Battery accompanied the 3d Australian Light Horse Brigade fifty-one miles in twenty-five hours and then ten more miles in seventy minutes. Many times they could not keep up or follow at all because of the lack of roads, as on the trans-Jordan raids, but no wheeled vehicle of any description could do the trick. Hence we may assume that the weight of their guns, the 13 pounders (about 2000 pounds), was not excessive. Even during the early part of the Sinai campaign when the batteries were armed with the 18 pounder, no failure to keep up was noted, and the 18 pounder is a heavier gun than the French 75 mm.

On the other hand, time and again we note that the 13 pounders could not do the requisite damage or were outranged, and heavier metal was prayed for by those most interested. Naturally the problem is one in which mobility is the limiting factor. It would seem, however, that our 75 mm. is probably as good a gun for the purpose as any now in use, falling, as it does, between the 13 pounder and the 18 pounder.

The 105-mm. howitzers need only be sent along when the nature of the mission would indicate that they could catch up in time to have an influence on the action. Horse-drawn 105-mm. howitzers have the mobility, certainly, of any division train, so we may assume that their inclusion would be normal and the cases when they could not be used, abnormal.

While on the subject of matériel it is worthy of note that the pack horses carrying light wire reels were used early in the Sinai campaign and presumably throughout the later campaign. The arrangement was very similar to our modified pack artillery reel now in use at the Field Artillery School.

Another unusual feature was the use of so-called "ped-rails" on the wheeled matériel of the firing batteries. These were improvised wooden caterpillar treads kept in place much as chains on automobile tires are. Their use was restricted to the sandy desert. Pictures of batteries in action show sand bags used in place of trail logs when in position in sandy country. Carrying prepared trail logs was undoubtedly frowned upon because of the extra weight they would impose.

When it became necessary to move heavier guns through the sand, men preceded the guns and dug shallow tracks for each wheel to follow. These tracks were filled with brush cut nearby.

Again, for even the light guns moving through rough places where the going was particularly hard, the guns and caissons of the firing batteries were double teamed, it being necessary to immobilize the rest of the battery (and combat train) to make this possible.

Naturally under such conditions we hear of the batteries running out of ammunition, as at Rafa when the Inverness Battery supporting the New Zealand Mounted Rifles Brigade had to be sent to the rear. In this particular case, however, the small arms ammunition on the firing line gave out as well, so that the New Zealanders, forced to do something, charged home with the bayonet and took the enemy's Central Redoubt, thus turning the tide of battle at a most critical point.

By the very nature of cavalry and its use, we are taught not to expect sustained actions, so that the exhaustion of even the ammunition carried in each section may be regarded as unlikely. If the action lasts long enough to do this, surely the combat trains will have had an opportunity to close up.

Now to inquire into the use and care of animals.

One writer, Colonel Powles, states, in speaking of the Sinai campaign: "In this campaign our men became true horse masters; and it can be safely said, that in no campaign of which history has cognizance, has the horse been so well understood in all his needs, and so well fed and tended."

The hot dry climate apparently suited the horse, which is not strange considering the fact that practically all of their horses, as are ours, were of Oriental extraction. At first, the British, as do the French, erected shelters whenever possible to protect their horses from the sun. When this no longer was possible, practically no bad effect was noticed. Later in the Jordan valley under conditions which were almost unbearable for men, the horses maintained their condition wonderfully. There, the heat, dust and flies were appalling. (It is to be remembered that the Dead Sea is 1200 feet below sea level.)

In between these two periods of heat, for periods as long as six weeks the troops encountered rain, mud and piercing cold (comparable to the average rainy "Norther" experienced in Oklahoma, Texas and Northern Mexico) and in the winter of 1918 the horses often found themselves standing in six inches of snow.

Colonel Preston states in his "Desert Mounted Corps" that the opening of the cavalry operations, presumably September, 1917, found the animals in an unsatisfactory state of health; that whatever their outward appearance may have been, their internal condition was by no means good. Two years of indifferent forage and the large quantities of sand consumed with their food had more or less permanently injured their digestive organs. Though sand colic had ceased to trouble the command, the effect was still present as proven by most of the postmortems.

He further states that about ninety per cent, of the draft horses had strained their hearts to some extent during the terrible work in the Sinai desert. This is somewhat offset by the statement of the Brigade Major of the New Zealand Mounted Rifles Brigade that their horses started the Beersheba operation in the very pink of condition.

Colonel Preston maintains that the experience of the campaign proved that horses cannot be too "big" in condition at the commencement of operations provided they are kept adequately exercised. "The really fat round horses finished both series of operations in better condition than those who looked harder and more muscular, but not so fat, at the beginning. This was especially the case in the first series, during which the shortage of water was so acute. This seems to be in keeping with the usual British theory of throwing all the grain possible into their hunters during the conditioning period. It would seem that the explanation of the fat horses finishing in better shape, is that they were the natural "good keepers" of the command. That is, they were fat when others were thin, under presumably identical conditions of feed and exercise even prior to the campaign.

Remarks on forage are of indifferent interest to us, particularly as regards to kinds of grain, as they were local varieties hardly likely to be encountered by our service. The daily grain ration consisted of ten pounds of whatever grain was available. Such things as barley or gram were the staple issue for long periods. For "long" feed they used ten pounds of chopped barley straw, when obtainable. Later during more active operations the ration was nine and one-half pounds of grain (barley or gram) and nothing else. This was only about two-thirds of the normal garrison ration. Gram, or maize, caused the horses to scour badly, "thus increasing the weakness engendered by hard work and starvation." After the advance from the Gaza-Beersheba line, limited grazing was possible.

The subject of watering in these campaigns is particularly interesting.

It should be appropriate to include at this point, some official correspondence on this matter.

"G.O.C., DESERT MOUNTED CORPS:

I shall be glad if you will be so good as to let me have the following details as regards the animals of any of the units under your command during the period 1/11/17 to 31/12/17:

1. The longest period they were continuously without water.
2. The work performed during this period.
3. Whether they fed well when they were thirsty.
4. The average number of times they were watered daily during the period specified or during any intermediate period.
5. The smallest amount of grain and fodder they received at any time and for what period.
6. The average amount of grain and fodder they received during the whole or any intermediate period.
7. The maximum amount of grain and fodder they received at any time and for what period.
8. To what extent were units able to supplement their forage locally, by grazing or otherwise.
9. When was there any noticeable change in their condition and vigor as a result of work and privation.

(Signed) G. R. BUTLER, *Brig. General,*
Director of Veterinary Services, E.E.F."

G. H. Q.,
1st Echelon,
31/1/1918.

"HEADQUARTERS,
DESERT MOUNTED CORPS.

With reference to your . . . herewith report in detail as asked for:

1. (*a*) One cable wagon team from D.H.Q. was without water for a period of 84 hours.
   (*b*) Several regiments in the two Australian Brigades were without water for a period of 60 hours.
   (*c*) The N.Z.M.R. Brigade was without water for 72 hours.

2. By (*a*) above, almost continuous work, cable laying, which entailed heavy work partly over rough country.

By (*b*) above, fast travelling and reconnaissance, averaging about 20 miles each day.

By (*c*) above, first two days reconnaissance, averaging about 20 miles per day, remainder of period practically no movement.

3. Yes, up to 36 hours; after that, in most cases, they refused to eat.

4. During the period of advance, once per day, *i.e.*, to 15/11/17, after that twice daily.

5. Four lbs. grain and no bulk fodder for 24 hours.

6. An average of 9 lbs. grain with average 4 lbs. Tibbin requisitioned from inhabitants up to 17/12/17. From 17/12/17 to 31/12/17, 12 lbs. grain and average 4 lbs. haystuffs.

7. As shown in last period in paragraph 6.

8. An average of 4 lbs. haystuff per horse was obtained from the inhabitants throughout the whole period of operations. Grazing nil.

9. Decided falling off in condition and vigor after 36 hours without water. With good food and water horses picked up remarkably, though it is to be observed that all units report that issue of grain on five consecutive days caused serious trouble, the horses suffering from diarrhœa and laminitis and losing vigor. With reference to the cable wagon team which was without water for 84 hours, though much distressed at the end of that period, these horses quickly recovered. It is to be remembered that the horses of the Division commenced operations about 26/10/17, in excellent condition, which is largely responsible for the fact that evacuations on account of debility have been extremely small, both during operations and afterwards.

(Signed) E. W. C. CHAYTOR, *Major General.*
Commanding,
Australian and New Zealand Mounted Division."

12/2/18.

NOTE.—The horses of one Brigade had an indifferent watering only on morning of 6th, and watering next during the action on the 8th, no more water until during the night of 10-11th. They were greatly distressed on the 10th, but by the 13th were, with the good water and rest, fit for work again, though they lost considerably in condition.

Another report tells of one battery marching and fighting for nine consecutive days, watering only three times during this period.

The Royal Army Veterinary Corps, to get some interesting data, instituted a plan whereby a large number of horses of similar type and condition were divided into two groups, one to be watered twice a day and the other three times. "The result of these experiments was conclusively in favor of the two drinks a day. Not only did the horses on this régime improve in condition quicker than those which were watered three times, but it was proved by actual measurement that they drank more water in the day. By the time the force arrived at El Arish, watering twice a day was generally accepted as a standard." (Colonel Preston in "The Desert Mounted Corps.")

This is a startling contradiction of our teaching of "water as often as practicable."

Later when necessity forced the command to be watered in many cases only once a day, a certain loss of condition was noticeable, although this period (May to October, 1917) was a hard one in every way.

Colonel Preston goes even so far as to claim that if horses get water once a day and are given anything in the nature of bulky food (to supplement the grain ration, presumably) such as grazing, there is no reason why they should not be able to continue indefinitely.

During the Beersheba-Jerusalem operations the average watering per horse in the mounted troops was once in thirty-six hours.

In remarks on types of horses Colonel Preston urges that all horses in a horse battery (except officers' mounts) be of draft type, and that the draft type be light and well bred rather than heavy and coarse. This of course brings us to the inevitable impasse concerning the "ideal artillery horse." He states that nothing in the nature of a cart horse can live with cavalry in a march of forty miles.

The horses of the Mounted Corps had an excellent health record as regards disease, due of course to the excellence and efficiency of the British Veterinary Corps. Practically every account of the campaigns includes praise for the veterinary officer.

Leather muzzles are recommended by Colonel Preston to prevent hungry horses from eating picket ropes, wooden wheels or anything else they come in contact with. Steel wire picket lines and halter shanks are also recommended as they last forever, do not burn a horse that gets his foot over one of them, nor do they weigh more.

In the Australian Light Horse regiments neither manes nor tails were ever cut or pulled. The advantage and benefit of this in hot sunny fly-infested climates is evident. Such a practice, under such conditions, is strongly recommended.

TACTICAL EMPLOYMENT

The so-called normal cavalry offensive action is a quick affair. A development and holding of the enemy in a dismounted fire fight by the pivot of maneuver. Meanwhile the mass of maneuver rides to a "take off" position from which the main attack is launched, wholly mounted or partially so.

One writer describes one as follows: "The day's action brought into play the full attacking powers of the mounted arm against an enemy in position. There was the mounted advance to the first fire position by one regiment, and then its systematic capture of enemy trenches on foot as infantry with rifle and bayonet and Hotchkiss and machine guns, and its rapid reënforcing on horseback of the successive positions when captured.

With the other regiment there was the advance mounted under cover of artillery fire to successive fire positions; the rapid seizing of small tactical features at the gallop; the outflanking of the enemy position by aid of the mounted man's mobility; and finally there was the magnificent mounted charge by which the red knoll was captured."

This was the fight at Ayun Kara, November 14, 1917.

An interesting example of horse artillery in support of such an action is the attack on Tel el Saba (part of the Beersheba defenses).

"At eleven o'clock the Somerset Battery moved up and ranged on the hill (enemy entrenchments) at 1300 yards. Enemy machine guns were giving much trouble and were not located until the afternoon when Lieutenant Hatrick, Signal Officer of the Auckland Regiment, from a concealed position in the front line observed for the battery and directed fire by flag signal. A section of this battery was then moved around to the east of the hill to deal with machine guns in position on the high ground, etc."

Time and again we read of similar incidents. Direct laying was by no means unusual and it is remarkable what light losses such boldness entailed.

Again we find in the withdrawal from Sheikh Muaunis that "the evacuation was skillfully carried out with the help of the Somerset Battery firing from a position 1400 yards south of the village on the south side of the river. This battery remained in action until after the village was occupied by the enemy and the Commanding Officer of the Battery (Major Clowes), who was in the village observing, had to swim the river."

Another incident of artillery boldly used in a withdrawal, which terminated somewhat disastrously, was the fight of the 4th Australian

Light Horse Brigade to protect the line of communications with Es Salt. Here three batteries supporting one brigade were left in the foothills to guard the two routes leading from Es Salt to the Jordan, while the rest of the command raided Es Salt. A force of Turks estimated at about 5000, with some artillery and cavalry, crossed the Jordan higher up, and instead of going after the raiders, attacked the guard left on the line of communications.

To quote: "The brigade was now, however, in a very difficult position. Our troops had been forced back till they were facing due west, with their backs to the tangled maze of rocky hills, impassable for cavalry and guns. Some of the Turks were across their line of retreat to the south, though only in small numbers as yet. Others were working round the right flank of the brigade. All along the line our troops were hotly engaged at close quarters. To withdraw to a flank under such conditions was a very hazardous operation, but it appeared to offer the only chance of extricating the brigade from its desperate situation.

"Two regiments of the New Zealand Mounted Brigade, which had been coöperating in the attacks on the Shunet Nimrin positions from the south, had been dispatched to the assistance of the 4th Brigade, but they had fifteen miles of bad ground to cover, and could not possibly arrive in time to save the position. The most they could hope to do was to form a rallying point for the 4th Brigade to fall back upon.

"The 4th A.L.H. Regiment, on the right flank, held on till the enemy closed to within 200 yards, in a desperate effort to cover the retirement of our guns. 'A' Battery H.A.C. was in this sector of the line, the Notts Battery R.H.A. near the center, and 'B' Battery H.A.C. at the south end. The position of the two northernmost batteries was quite hopeless. Driven back to the verge of the impassable hills, they were in action in the open in the front line, and the only way of retreat feasible for wheeled vehicles was to the south, down the line of our troops, and in full view of the enemy at a few hundred yards distance.

"Nevertheless the two batteries fought steadily on, attempting the impossible task of retiring by sections to the left flank. Each time a Turkish attack broke and melted away before their fire, the enemy dead lay a little closer to our guns. Each time a short retirement was made, the heavy pressure of the enemy pushed the guns farther into the hills; and each time there were fewer men and horses to move them. At last they were forced into a position from which there was no way out, and here they made a final stand, fighting till all their ammunition was exhausted, and the Turks were within two or three hundred yards on three sides of them. Even then a last effort was made to find a way out, but the teams were mown down by machine-gun fire, and the guns had to be abandoned. The remaining men and horses scrambled up the hills to the east, and succeeded in reaching the Wadi el Retem. The Australian troopers accompanied them, fighting grimly and silently, as an old dog fox, run into by the hounds, turns on his pursuers, slashing right and left, and dies with his teeth locked in a hound.

"'B' Battery H.A.C., having a shorter distance to go, succeeded in retiring to the south, through the enemy, and came into action again near the Umm el Shert track, to cover the withdrawal of the rest of our troops. During its retirement a gun was overturned in the bottom of a deep wadi, and had to be abandoned. A party of men, under an officer, descended into the ravine, and made a fine effort to right the gun and get it away; but the Turks appeared on the banks above, and opened fire on them with machine guns, killing nearly all the horses, and the attempt had to be abandoned.

"The losses of the entire command were remarkably light (1 officer and 1 man killed, 7 officers and 44 men wounded, 48 men captured). Happily all the officers and men of the batteries escaped capture; they were at once supplied with new guns and were in action again in less than two days."

With three batteries in a division, Colonel Preston recommends putting one or even two with the advanced guard. Assuming that the advance guard provides the necessary security, it is hard to see why two batteries should not accompany it. Colonel Preston further recommends that the artillery battalion commander ride with the advance guard commander. This is of doubtful advisability in the opinion of the writer, as it has always been our policy to have the artillery commander with the division commander. This point, however, is one of interest. Certainly the battalion executive could ride with the advance guard commander and be empowered to make such decisions as the battalion commander himself would.

On the subject of escorts we find that the true rôle of artillery escorts is to provide information, not close protection, and that consequently patrols should search the country in all directions to give timely warning of an attack.

At Huj, the Turks had two battalions of infantry and several machine guns disposed about one field battery, one howitzer battery and one mountain battery. Taking advantage of a slight rise in the ground to one flank, ten troops (about 200 men) of British cavalry got within 800 yards before they were seen. "As the cavalry appeared, the Turks sprang to their guns and swung them around, firing point blank into the charging horsemen. The infantry . . . blazed away with their rifles till they were cut down . . .

Many saddles were emptied in that few yards, but the charge was irresistible. In a few minutes the enemy guns were silenced, their crews killed and the whole position in our hands." Most of the Turkish infantry escaped as the cavalry was too scattered and cut up to pursue. Poor security work on the part of the Turks.

The outstanding general conclusion that can be deduced from reading of these campaigns is the success of bold use of artillery. Defiladed routes or positions were acceptable when handy, but when conditions demanded, and it often did so, batteries galloped over the open and went into action just as they did in our Civil War. And strange to say most of them survived to fight another day. The charging forces that the guns are supporting, are the ones that get the attention of the enemy's artillery and small arms.

Some of the smaller actions recall vividly Kipling's "The Captain's Jacket," or General Forrest's remark at Brice Crossroads when he routed Sturgis who had double his strength. The fight was in the woods with only one road toward the enemy. His main force was driving ahead dismounted and his reserve had started to gallop down the road toward the Federal lines. He turned to the Commanding Officer of his only battery, and told him to gallop his battery in the charge, with the remark that "artillery was made to be captured." When the charge succeeded, this battery came into action and did great damage to the retreating enemy.

Give the artillery with cavalry an early warning of moves, a position well up in the marching column, and when the action is joined and the attack starts use it boldly. There is nothing halfhearted or reserved about a cavalry mounted charge, and if necessity demands, there should be the same spirit in its supporting artillery.

A STANDARD HEADQUARTERS TRUCK

BY FIRST LIEUTENANT WILBUR S. NYE, F.A.

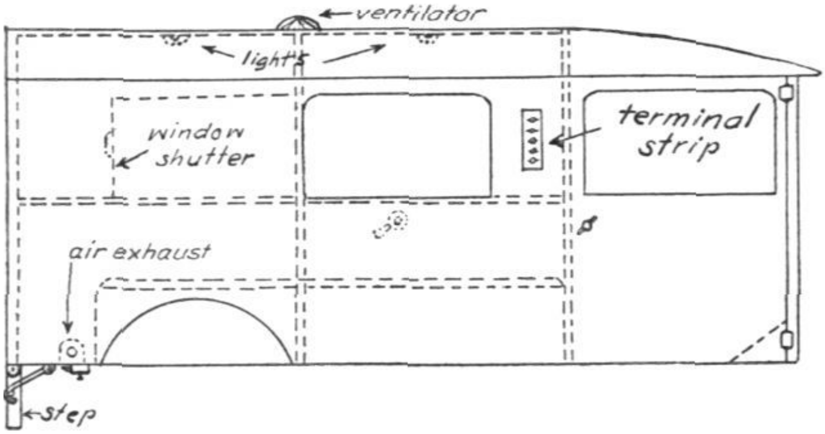
SEVERAL weeks ago Colonel C. H. Lanza, commanding the 17th Field Artillery, Fort Bragg, directed the writer to make a study of plans and specifications for the construction of an enclosed radio truck body to replace the canvas-covered G. M. C. now authorized. Nearly every officer who has served with a motorized headquarters unit of Field Artillery has attempted or desired to build a closed radio truck. Some organizations have also constructed or improvised "C. P." trucks or trailers. As a result of a careful study it was decided that a type of closed truck body could be devised which would serve any one or more of the following purposes:

1. Command post, or office for C. O.
2. Plans and training office.
3. Intelligence section.
4. Radio station.
5. Switchboard and telephone truck.
6. Light repair truck.
7. Ambulance.
8. Conveyance for personnel.
9. Store truck for rations, supplies, small arms, etc.
10. Plotting room.
11. Photographic dark room.
12. Mimeograph and hectograph shop.

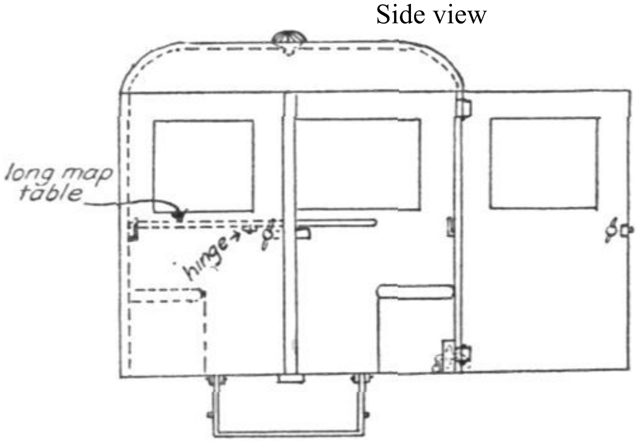
DESCRIPTION

In describing in detail this proposed headquarters truck body, I shall give what I consider a description of an ideal closed body, followed by a brief outline telling how to improvise such a vehicle.

The ideal body should be made of metal, with little or no wood or fiber used. The entire outer unit, including the driver's compartment, but less the floor, doors, and windows, should be pressed from a single sheet of steel, thus eliminating joints. This outer shell should be riveted to a channel-iron frame having sufficient members to provide the necessary strength in case of accidents, and also support for certain brackets which will be described later. An inside shell or lining of lighter weight metal should be provided, and the space between packed with kapok (South Sea Island floss). The purpose of this is to insulate the interior against cold, heat and sound. This method of construction, called "battleship construction" by an automobile manufacturer, is in accordance with the latest commercial procedure and is incorporated in the manufacture of certain large passenger airplanes, where the governing factors are light weight, strength and comfort for occupants. The all-steel feature provides strength, and can be made as light as a wood body unless it is desired to make the interior splinter proof, in which case light weight would have to be sacrificed, to



Side view



End view

some extent, in order to gain the added protection. The other gain from an all-steel body is in the simplicity of manufacture, providing a means of cheap mass production in time of war.

Two doors, installed at the rear, should be provided with standard handles, catches and theft-proof locks. In each of these doors and in the partition in rear of the driver's seat, there should be a window made of heavy celluloid or safety glass. It is probably desirable to have the front window slide in grooves. On each side of the body proper, near the front, there should be a fairly large window installed as in pleasure cars, capable of being raised or lowered by a crank. All glass, including the windshield, should be "safety glass," a material which is hard to break and will not throw splinters when fractured. On the inside of all windows there must be a shutter or slide of some opaque material for the purpose of shutting in light. These shutters can be placed in thick felt grooves, which can be soaked with water to exclude gas.

At the rear of the truck I recommend a metal step, which can be hinged and provided with braces and latches to hold it in position for use or secured up against the under side of the floor for traveling. Racks of strap iron along the side will carry medical corps litters, antenna mast sections, lance poles, etc.

On the inside there should be a folding seat or bench with cushions, installed along each wall, similar to those in the army ambulance. They must be built high enough from the floor to allow space for the reception underneath of radio storage batteries, instruments, map tubes, and similar articles. Brackets of angle iron should be bolted at various points along the wall at the proper height to provide supports and fasteners for litters, map tables, desks, benches, shelves, or cabinets, according to how each particular truck is going to be used. The supports for radio sets should have coiled springs and buffers as additional protection in transit.

The interior should be permanently wired for one or more dome lights and the space under the seats can be also wired for radio battery connections. Near the front of one side there should be a strip of bakelite set into the wall, with wing nut terminals for antenna and telephone wires; also an additional terminal for grounding the truck body as a precaution in case of electrical storms.

In the roof I would install a dome-shaped, ribbed ventilator, with a socket on the inside to which the canister of a gas mask can be attached. Near the floor there should be an orifice in the wall, with the outlet valve of a gas mask on the outside, and a small rotary pump actuated by a foot-pedal and gears on the inside. The purpose of this arrangement is as follows: during a gas attack the truck can be sealed and closed. At certain intervals, when the air inside becomes bad, the operation of the pump will exhaust the foul air, thus creating a sufficient vacuum or reduction of interior pressure to cause air from the outside to be sucked in through the ventilator at the top, being purified as it passes through the canister. The frequency with which the pump must be operated and the length of the time for which it must be run can be calculated from the cubic capacity of the truck and the number of occupants. If the truck is opened for entrance of an individual during an attack, it would be necessary for all occupants to have masks on until the interior has again been cleared of gas.

To reduce rumbles, rattles and squeaks the body can be insulated from the frame by rubber blocks or pads. Other refinements will no doubt occur to the designer should such a body actually be constructed.

It can be built to specification by any one of the various plants now engaged in the manufacture of all-steel bodies for passenger and commercial cars. However, it is considered desirable to adopt as far as possible automotive equipment already on the market. The many delivery van and cab bodies now being made and used by civilian concerns offer a wide range of choice both as to size and construction. Having selected a chassis as standard for the future, or considering the types already on hand, it would not be difficult to chose one or more metal bodies which, although not fulfilling all conditions of the ideal, could nevertheless with certain modifications or additions of fittings be readily adapted to our use.

To the officer who desires to build or improvise, for present use or experiment, a radio or C. P. truck, the following suggestions are offered:

With certain modifications, a salvaged ambulance body is fairly satisfactory. Remove the seats and mount them about three inches higher. This can be done in several ways; a good method is to make metal brackets of stout strap iron which can be bolted to the seats and to the supports, thus raising the seats while still allowing them to be hinged as before. The space underneath is now deep enough to accommodate storage batteries. Doors of wood or beaver board may be installed in the rear, but unless the body must also be used as an ambulance, I believe that it is better to close up the rear and cut a small door in the right front wall. The seat on that side will then either have to be removed or shortened. Wire the truck for lights, batteries and outside connections as described before, and install brackets or supports for the necessary tables or shelves.

If no ambulance body is available it will probably be necessary to build one complete from such materials as can be secured. In this case it will be best to copy some good commercial design, and if the frame is covered with wood, use a single ply of three-eighths-inch cypress or other light wood, ripped into four-inch strips and either tongue-and-grooved or ship-lapped. Curve the roof slightly, and stretch canvas over the strips on top, smeared with airplane "dope" to make it tight and smooth. The dimensions of the body will depend, of course, on the chassis available; make it as long as is safe, but not too high. A top-heavy truck is undesirable both from considerations of concealment and safety. The work inside is done sitting down, and it is unnecessary to provide head room for a man to stand erect. If any funds are available it may be possible to purchase an old or damaged body, frame, or fittings from an auto-wrecking firm or used-car dealer in a nearby city.

ADVANTAGES

In presenting an argument for this "standard headquarters truck," I shall enumerate all of its advantages as they have occurred to me, dwelling on each briefly, and endeavoring to avoid opinions not supported by general experience. The foregoing description may suggest uses other than those listed on the first page, and it can be seen that other arms could find a place for such a vehicle. Let it be issued to all units from gun batteries to division headquarters, with the ratio of issue to be determined by the number of light or medium canvas-covered vehicles which it would replace, and by the number of tentage-carrying trucks which it would eliminate.

The five major advantages to be gained from the proposed truck body are: uniformity, appearance, protection to personnel, protection to equipment, mobility and speed of operation. Taking up first the question of uniformity; we have at present a varied and odd asortment of vehicle bodies, most of which are open or canvas-covered. The steel closed body would replace or eliminate the following: G. M. C. three-quarter ton, G. M. C. canvas-covered ambulance, G. M. C. fiber board ambulance, White reconnaissance, White ton-and-a-half, Dodge light repair, Signal Corps radio truck, and at least one F. W. D. per battery. In the Field Artillery, the number of types of vehicles would be reduced to: passenger cars, cross-country cars, headquarters trucks and heavy cargo trucks. At present a great deal of the equipment vital to the needs of any headquarters is carried in cargo trucks, and the wire-laying device is pulled by a tractor. As a result, we have three columns for each unit, *i.e.*, a speed column, a truck column, and a tractor column. If the proposed headquarters truck is properly developed, and issued in sufficient quantity, each headquarters unit will have only a speed column.

The second advantage will be found in the improvement in appearance of army motor vehicles. It is obvious that a neat metal closed body would present a smarter appearance than that which is now displayed by our old cars and trucks as they pop and sputter around the posts and nearby towns, with their torn, faded and stained canvas covers flapping in the breeze. The day of the covered wagon is past, and any future vehicles which may be purchased should be as neat in appearance and as up-to-date in design as commercial cars.

Third, a closed truck would furnish better protection to personnel. It can be constructed to shut out the following: rain, wind, snow, cold, heat, dust, insects and gas. It will be light-proof and, to some extent, sound-proof. Canvas shelters protect us from none of the above annoyances. Nearly all officers, and some of the men at headquarters, could sleep on litters in these trucks. Being gasproof, sleeping men, wounded, or sick, would be safe without masks, whether the vehicle be stationary or moving. All details would have a protected, comfortable place to work, free from many of the present distractions caused by noise and weather; and in the tropics, especially, the annoyance caused by insects. Another reason why the closed truck will furnish superior protection is because it is easier to conceal or camouflage than tentage or canvas-covered vehicles. It can be painted any color, or covered semi-permanently with dirt, sand, grass, brush or any other material, either natural or artificial, depending upon the terrain. Being mobile and fairly light, it can be parked in gullies, under trees, or in brush. At night all details can carry on their work with good electric lights secure from aerial or terrestrial observation. This is not possible under canvas, and with issue lighting equipment, *i.e.*, candles and lanterns. It is absurd that in this age of electricity we still struggle along with such antiquated and inadequate methods of illumination.

Fourth, there is the advantage that all types of equipment would receive better care and protection. In garrison much of the equipment could be stored and locked in its appropriate vehicle, ready for use either for drill and maneuver, and in addition ready for mobilization orders. The same thing would apply in the field. The great reduction in the handling of equipment—loading and unloading—would naturally prolong the life of nearly every article, especially the more delicate pieces of signal property. Everything would be better protected from dust, dirt, and moisture. Each item would be close at hand for immediate use and at the same time in a position to be neatly displayed at inspections.

The last and greatest advantage is in the gain in speed and mobility. First, the speed in getting ready to take the field—already mentioned; second, mobility on the march. The organization equipped with these vehicles would be independent for at least twenty-four hours from a truck column. It can move at practically the same speed as the commander, and will arrive at the selected position as soon after his arrival as he may direct. Being lighter than trucks, the vehicles are more easily maneuvered around jams in traffic, and are capable of being driven over more difficult terrain. In case of complete disablement of any one car, a smaller amount of equipment is immobilized; furthermore it can be unloaded and transferred to other vehicles with no greater difficulty than with the present trucks. In fact, such changes can be more easily made, due to uniformity. Such a vehicle can be more readily moved or towed in case of a temporary break-down.

The headquarters vehicles will move into the selected position with a minimum amount of circulation on wheels, and with very little trampling of the ground by dismounted men, there being no tentage to pitch and conceal. Each vehicle will be quietly parked in its allotted place, under trees or in other concealment, and, with few exceptions, each detail will be ready for immediate operation. At present we expend no inconsiderable amount of time and energy in loading and unloading tents, poles, stakes, tools, tables, chairs, desks, maps, switchboards, telephones, radio sets, and other paraphernalia. All of this equipment must then be set up for operation. The attention of several officers and many men is distracted from other far more important tactical and technical duties. Most of this confusion will be eliminated by the use of the headquarters truck. Some of the details, notably the plans and training section, will even be able to function while enroute. The others will require little time to set up after a halt is made. The radio station will merely have to erect the antenna, this operation being simplified by having a bracket on the side of the truck to which the nearest mast can be fastened. If only one telephone truck is available the switchboard would have to be set on the ground temporarily while the vehicle goes out to lay wire. I estimate that such a truck could carry from four to six miles of wire on half-mile drums in addition to the switchboard and chest of telephones. If the wire is carried on a second vehicle (the ideal plan), more wire could be carried, and the switchboard truck would remain in position while the other truck goes out to lay the wire. The operator would merely have to place his terminal strip and cable on the ground. The message center chief, in his truck, could also begin to function at once.

Back at the rear echelon, the mechanics would have a dry, lighted workshop, with a small bench, spare parts and the necessary tools to carry on field repairs. At the ration and storage truck the cooks could unload a small field range and have a meal ready some time before this could have been accomplished had they been forced to wait for the arrival of a truck column. The present rolling kitchen may be too heavy to be towed behind a light headquarters truck unless a Coleman or similar ton-and-a-half chassis is adopted as standard, but that problem cannot be discussed in this article. In any case the officers and men will have rations for at least one day, carried in the speed column; which is an improvement over the present system. A speed column can usually move far enough and fast enough so that no halt need be made at noon for the purpose of cooking a meal. A better plan is to serve a cold lunch if the position is not reached in time for a mid-day meal. Furthermore, under the present arrangement, the rolling kitchen of a headquarters battery must go with the trucks, and the personnel of the speed and tractor columns are usually without food unless a long enough halt is made to close up the entire column. Such a plan sacrifices much of the speed gained by motorization.

The headquarters truck, however, can carry one or two days' rations, well protected from dirt and moisture, together with a small field range, and can tow a light water trailer. It is my belief, that the solution of the problem of water supply consists in having two or more water trailers of small capacity—say two hundred gallons—so that the column will scarcely ever be entirely without water, even in case of disablement or delay of some of the vehicles. Should it be impossible to keep the entire column together, each section can be provided with a water cart. These small carts are easily manhandled and are light enough to be towed by a headquarters truck.

In conclusion, it can be seen that on the march, occupying a position, changing a position, and in the work of the details, both by day and by night, the standard headquarters truck will add greatly to the feature of speed and mobility which the modern motor car has brought to military transportation.

FIELD ARTILLERY: PAST, PRESENT, AND FUTURE

BY GENERAL HERR OF THE FRENCH ARMY

SEVENTH INSTALLMENT

[This treatise by General Frederick Georges Herr, published in French by Berger-Levault, Paris, is believed to be an outstanding book on the subject of field artillery. In the belief that heretofore there has not been an opportunity to read this in English, it is hoped that its publication in serial form, beginning in the May-June, 1927, JOURNAL, will be the means of acquainting more of our officers with this excellent work. During the World War, General Herr was successively the commander of an artillery brigade, an infantry division, an army corps and of an army detachment. He then became Inspector General of the French Artillery.—EDITOR.]

PART TWO

THE FIELD ARTILLERY NECESSARY FOR WAR

CHAPTER II

CHARACTERISTICS WHICH MATÉRIEL SHOULD HAVE

THE system of artillery which we have just briefly described has essential characteristics which are imperatively demanded by the requirements of modern war. These characteristics are as follows:

From the ballistical viewpoint: Long range and accuracy.

From the tactical viewpoint: Mobility, large field of fire, rapidity of fire, great destructive power.

In our previous discussion, we indicated to what degree each matériel should possess these various characteristics. It is now necessary to sum up the matter in a homogeneous synthesis.

I. BALLISTICAL CHARACTERISTICS

A. RANGE

Increase in range was throughout the war the principal consideration of all the belligerents' artilleries, every one of which always felt the threefold necessity:

> Of being able to strike the enemy's vitals, while itself remaining protected as much as possible from the enemy's blows.
>
> Of being able to always concentrate the fire of the maximum number of cannon on any desired region within the enemy's lines, and this no matter what distribution of matériels was forced by tactical requirements, by the necessity for defilade, or by difficulties as to terrain.
>
> Of being able to accompany its infantry's movement with fire, while reducing to a minimum changes of position which are always difficult, take a long time, and which create a critical period of interruption of fire and increased vulnerability.

We saw in Part I, what results along these lines were obtained by us and by our enemies between 1914 and 1918. The situation at the beginning and at the end of the war is summed up in Figure 1, which shows clearly that the German artillery was always ahead of the French artillery and that during the War it succeeded, by constant improvements, in increasing the range of the most frequently used matériels to a greater degree than did we.

We do not wish our artillery of the future to be handicapped by a similar inferiority and it was for this reason that in the preceding chapter we demanded for our matériels the maximum range which the progress of modern industry and of ballistics may permit.

The range of a projectile depends on its initial velocity and on how much of this velocity it retains in its movement through the atmosphere to its point of fall.

To increase the initial velocity of the projectile it is necessary on the one hand to increase powder pressure. This pressure also reacts on the walls of the bore of the cannon and on the base of the projectile and these walls and this base must be able to support the pressure without giving way. On the other hand slow burning powder must be used which requires, if all its power is to be utilized, that the bore of the cannon be lengthened.

Modern steels are continuously improving and allowable pressures are increasing. Furthermore, modern metallurgy is capable of providing sufficiently large and sound steel forgings for cannon tubes of great length.

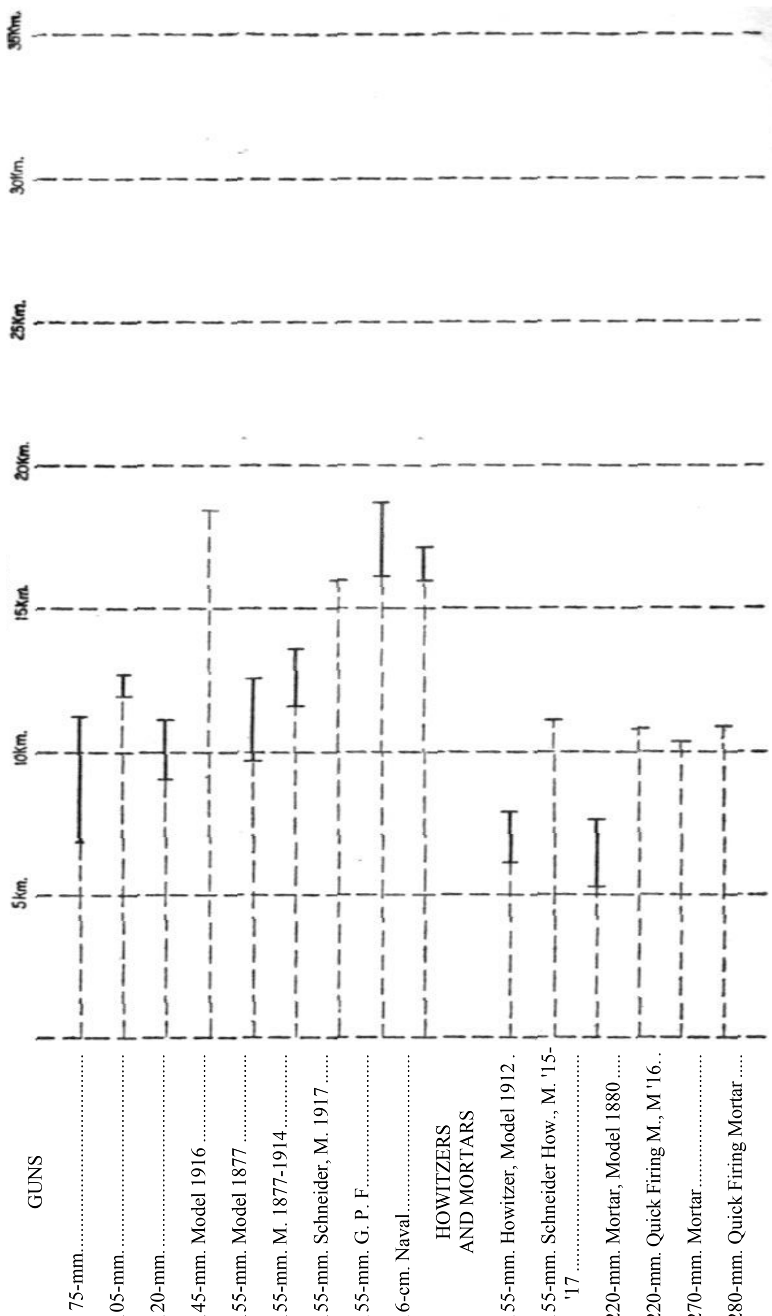
Here it is well to pause and clearly define the type of steel which should be used for the construction of artillery matériel. There are special steels and there are standard gun steels. The former are three or four times stronger than the latter and yet they are not the ones to be used. The experience of the last war showed that in war, the nation's industries must produce thousands of cannon and a formidable quantity of projectiles which will reach several hundred million. It is obvious that to obtain such production, special steels which are slow and difficult of production, and which only a few specialists know how to produce, should not be used. Ordinary steels which all the metallurgical establishments can furnish and which can easily be obtained from foreign sources should be used.* Since it is impracticable to upset manufacturing methods while passing from a peace to a war footing, it is necessary that in time of peace and war our artillery matériels, carriages, cannon and projectiles, be constructed with standard steels and not with special steels.

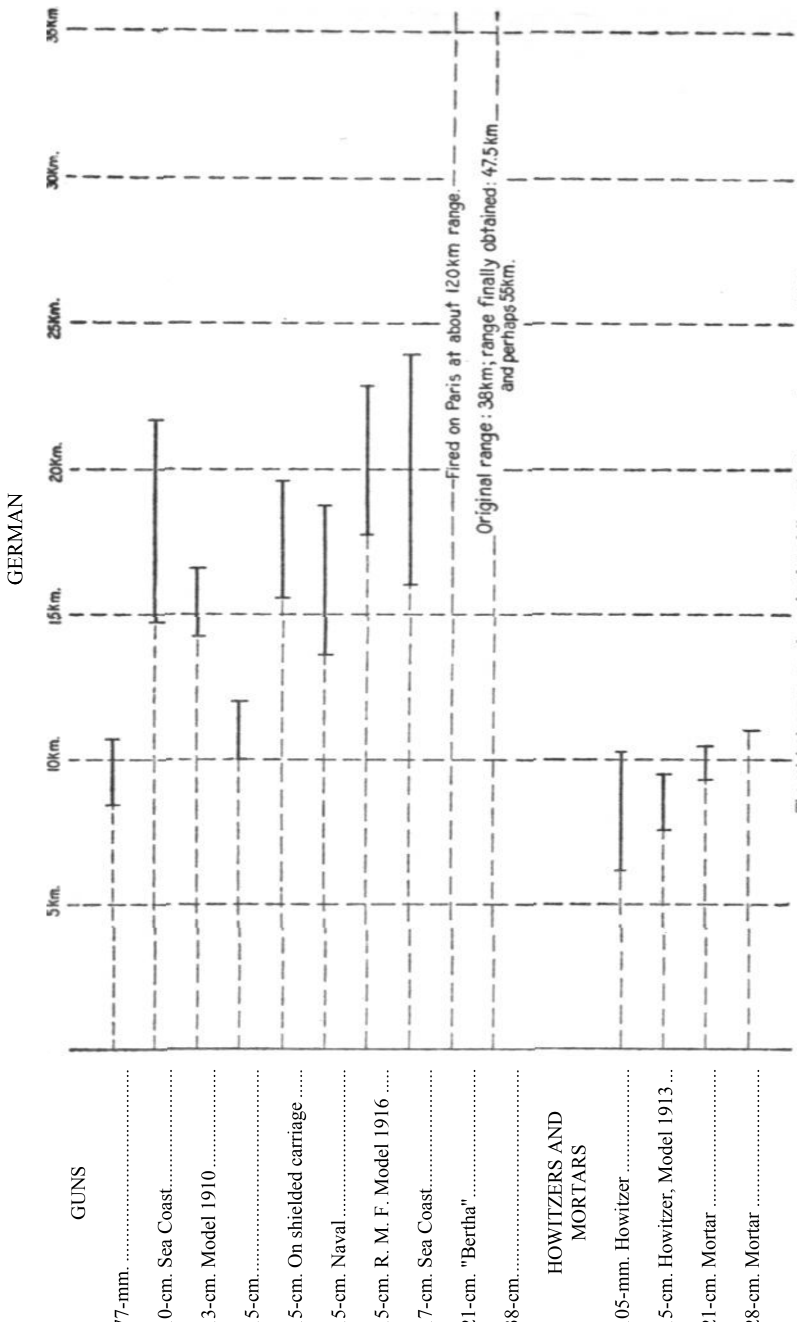
Relative to gun tubes, a manufacturing process recently developed by the Naval Artillery Engineer, Monsieur Malaval, known as autofrettage, permits of considerably increasing the elastic limit of the metal to a point almost equal to the point of yield, while maintaining an adequate factor of safety. Up till now pressures exceeding 3000 kg. per square centimeter have been inadmissable. Today cannon can be constructed to withstand 4000 kg, and doubtless in the future considerably greater pressures will be practicable. For this reason, requirements in range can be considerably extended and the most audacious views would be authorized if correspondingly resistant shell could be constructed.

* In 1917 our monthly requirements in gun steels had reached 500,000 tons. Domestic production furnished 180,000 tons and importations from England and America 200,000 tons, leaving a monthly deficit of 120,000 tons. From this the absolute impossibility of using special steels can be seen.

INCREASES, DURING THE WAR, IN THE RANGES OF THE MOST COMMONLY USED FRENCH AND GERMAN MATERIALS

FRENCH





The original ranges are shown by dotted lines, the increases in ranges by full lines

FIGURE 1

It must not be forgotten, however, that increased muzzle velocities cause still other complications. They require stronger powder charges to obtain the necessary high pressures. Firing with stronger powder charges at very high pressures causes the tube to heat very quickly. The most serious consequence of this, aside from the questions of accidents such as flarebacks and spontaneous combustion, is the rapid wear of the tube rifling. Experience shows, relative to similar cannon firing similar ammunition, that the large caliber cannon wears more quickly than the small caliber and that the wear is approximately proportional to the caliber. However, for a particular cannon firing stronger and stronger charges, the wear increases much more rapidly than the weight of the powder charge. In the case of large caliber cannon firing with very strong charges, the wear is extremely rapid.

Before 1914, there was not enough importance attached to this phenomenon of wear in the tube, because there was envisaged a campaign of only a few months during which it was thought that there would not be time to fire the number of rounds required to wear out the tubes. However, the long war completely changed the conditions and the question was still further aggravated by the intensity of the fires which had to be delivered. All cannon in service, but especially the rapid fire and high power guns, had considerable wear which presented, in all its acuteness, the problem of replacement with the attendant industrial and economic complications.*

Thus we found that cannon were unserviceable after a relatively small number of rounds: 8500 for the 75-mm. gun, 3500 for the 155-mm. G.P.F., 1200 for the 305-mm. Yet these cannon were fired at only moderate pressures, which did not exceed 2400 kg. per square centimeter for the 75-mm., 2200 kg. for the 155-mm. G.P.F., 3000 kg. for the 305-mm., and at the modest muzzle velocities of 525 meters per second for the 75, 755 meters for the G.P.F., 795 meters for the 305. We now foresee for the cannon of the future, service pressures mounting as high as 4000 kg. and muzzle velocities which may in some cases exceed 1000 meters per second.

No really efficacious means of reducing the wear of tubes is now known. The only thing that has given any result is the use of powders of low combustion temperatures, the heating of the tube being the principal cause of wear. Such powders have the additional advantage of being more flashless but on the other hand they give lower muzzle velocities for the same pressure, so that there is risk of turning in a vicious circle.

Wear of the tube must therefore be accepted as an inevitable evil and there must be sought a palliative in the process of *retubing,* which consists of providing the gun tube with a removable steel lining which is replaced when worn. The problem seems solved at this time. Tests recently made in France, in America, and in Germany have shown that it is possible to build jacketed tubes, the interior lining of which can be withdrawn in a few minutes without using machinery, and can be as easily replaced by a new lining. The necessary thickness for such a lining is only 1/10 of the caliber, so that its weight is on the average the equivalent of that of twelve shells. It is therefore possible to

* The footnote on page 281 shows what were the requirements in gun steel and the considerable deficit that existed in the raw matériel, beginning with 1917.

carry spare linings, if not within the firing units in action, at least in close proximity to them in the division or corps ammunition trains.

There remains for consideration a final point which relates to the very considerable strains to which carriages and recoil mechanisms are subjected in firing with such high velocities. It may be feared, unless a considerable increase in the weight of the matériel is accepted, that the carriages and recoil mechanisms would be incapable of supporting such increased stresses. A recent invention, the *muzzle brake,* happily offers a solution to the problem by greatly diminishing (by from 15 to 30 per cent) the shock coming on the matériel. The question of the adoption of the muzzle brake, if not for all matériels, at least for high power guns, has been theoretically studied and practically tested, and although all difficulties have not as yet been completely met, we are at least on the eve of so doing.

Muzzle velocity may be still further increased, without raising pressures, by using perfectly progressive powders of a high potential.*

We know that our B powders made entirely of nitrocellulose are not satisfactory in this respect; far from being perfectly progressive they are slightly retrogressive or degressive, and their potential is not as high as that of powders consisting of a mixture of nitrocellulose and nitroglycerine. A perfectly progressive powder—that is to say one giving, throughout the period of combustion, constant pressure equal to the admissible maximum pressure—would give us an 8 to 12 per cent increase in muzzle velocity. Such a powder, we hasten to say, is difficult of realization. However, without pretending to attain this theoretical perfection, we can try to practically improve our service powders in this respect. As for potential, the adoption of powders of a low nitroglycerine content (20 to 25 per cent) would accomplish an appreciable improvement.†

The final available method of gaining increased range is to improve the ballistic characteristics of the projectile. Before the War this question did not receive much attention from artillerymen. Great range was not considered of importance and all the oblong-shaped projectiles gave without trouble the ranges deemed necessary. However, the infantry, although increased range of the rifle seems to have been less necessary to it than increased range of its gun was to the artillery, had adopted the D bullet which was the outgrowth of the remarkable work of General Desaleux. This bullet was perfectly satisfactory from the points of view of flat trajectory range, and the way it held itself on the trajectory.

The War caused the resumption of studies relative to artillery projectiles and the results obtained were quite encouraging. The necessity of giving projectiles a logical form with a lengthened body, a pointed ogival head, a boat-tailed base, and a profile without projections, was recognized. In this way interesting increases in range were obtained, which for certain matériels exceeded 50 per cent (for example the 19 cm. gun firing the F.A.T.O. shell). A theoretical study of the question shows that by lengthening the ogival head to three or four calibers

* For definition and description of potential, reference may be made to page 77 et seq., Tschappat's Ordnance and Gunnery.—EDITOR.

† Powders with greater than 20 to 25 per cent nitroglycerine content are too hard on the matériel because of their high temperature of combustion which causes rapid wear in the tube.

length, instead of making it one caliber in length as has generally been done, the ballistic properties of the projectile are remarkably improved. There is a corresponding diminution of the stability of the projectile resulting both from the lengthening of the projectile and from the reduced ratio between the longitudinal and transverse moments of inertia. Thus, unfortunately, there are limits in this method. The use of a false ogival head with a slightly truncated point, coupled with an increase in the rotating velocity of the projectile may largely compensate for these deficiencies. Boat-tailing the base, if carefully calculated and if not exceeding a limiting inclination which must be ascertained for each projectile by test, gives excellent results. The fuze which arms the head of the projectile must conform very exactly to the form of the ogive.

The problem is affected not only by the exterior form of the projectile; its weight per unit of surface also affects the range.*

Weight has two opposing effects. The muzzle velocity imparted to a projectile by a given powder charge, diminishes as the weight of the projectile is increased, and the projectile should not go as far. However, a heavy projectile retains its velocity in flight better than does a light projectile and should consequently go further. In the case of small and medium caliber cannon, up to about 155 mm., it is the second influence which predominates. Thus, in the case of the 75, the shell A.L.R./2 which weighs 7.98 kg. has a maximum range of 11,200 meters, whereas the high explosive shell, model 1900, which weighs only 5315 kg., has a range of only 8000 M. On the other hand, in the case of large caliber cannon, that is to say over 155 mm. caliber, the increase in muzzle velocity has the predominate influence and a lighter shell goes further. Thus, during the War, the German 380 mm. naval gun fired a heavy 700 kg. shell which had a range of 38 km. (firings on Dunkerque) and a light 400 kg. shell which carried to 50 kms. (firings on Meaux and Coulommiers). It will be seen that we have a valuable means of improving the qualities of guns for long range interdiction, for which long range is more important than a powerful projectile.

To sum up, by the simultaneous application of various measures, such as increasing muzzle velocity, using powders that are more progressive and have a higher potential, and improving the ballistic qualities of the projectile, we are now capable of obtaining the long ranges which we believe to be necessary.† However, it should not be thought that unlimited progress can be made along these lines. Increase of service

* Two principal factors affect the ballistic qualities of a projectile in almost direct proportion to their value. These are half the ogival angle γ and the unit weight $\frac{P.}{a^3}$ Prewar projectiles had an average γ of about 40° and values of $\frac{P}{a^3}$ of around 12. At the end of the War, we had by improving the shape and increasing weight, succeeded in obtaining values of γ around 18° and of $\frac{P}{a^3}$ of around 17 (for example the 75 mm. shell A.L.R/2).

† We do not here consider other measures such as the use of the Chilowski shell with an ogival flame, the grooved ogive of M. Echlangouor, or the vaned head shell of Lieutenant Colonel Duchêne, tests of which are incomplete. However, these unquestionably should be thoroughly investigated.

pressures submits the matériel to stresses to which there are limits, and lengthening of the projectile is limited by stability and accuracy requirements. The values we have assigned for the ranges of our future matériels take into account these various factors and seem to be in the neighborhood of the maximum possible to obtain.

B. ACCURACY

It is futile for a matériel to be capable of firing a powerful shell to a great distance if its accuracy of fire is inadequate, that is to say if its projectiles are distributed in a considerable zone of dispersion around the target.

The accuracy of a matériel depends on a great many factors.

It depends first on the variations in muzzle velocities which must be reduced to a minimum. In order to do this, powders of extremely constant characteristics must be used. Such powders require the greatest care in manufacture and storage. Humidity being the greatest enemy to constant qualities in a powder, the first step is to use only slightly hygroscopic powders. In this respect nitroglycerine powders, whose better potential has already been noted, are very much superior to our B powders. They also have better ballistic stability than the latter.

Accuracy depends on variations in seating of the projectile, on irregularities of ignition, and on variations in projectile weights. All these defects can and should be avoided by care in manufacture.

Accuracy also varies inversely with the sensitiveness of the cannon, which increases when the powder charge used approaches that giving maximum power. It therefore follows that, while from the standpoint of power it is advantageous to use the maximum powder charge, the accompanying defect of inaccuracy may prohibit such use. Thus, there must be a compromise between these two factors. However, we now have power enough to be able to sacrifice some for accuracy.

To sum up, the accuracy of a matériel varies greatly depending upon how it is used. To determine what should be the methods of use, the admissable limits of dispersion must first be determined.

Dispersion is measured by the probable errors in range and deflection. All matériels have rather small deflection probable errors, amounting to only a few meters, and accuracy in direction is in general satisfactory. It is not so with accuracy in range. Probable errors in range may reach large values. In theory, range probable errors increase with the range and moreover faster than the latter, so that in the vicinity of the maximum range of a matériel, this error often becomes unacceptable. It is the current opinion that there is adequate accuracy when the range probable error does not exceed 1/200 of the range used. For this condition to obtain at maximum range, it is necessary that the probable error at 2/3 of the maximum range does not exceed 1/300 of the latter distance.

We must require our future matériels to have the following accuracy:

> A probable error of 1/300 of the range used when firing at 2/3 of the maximum range;
>
> A probable error of 1/200 of the range used when firing at the maximum range.

Recent tests, which should be confirmed, indicate that accuracy can be about doubled by providing the shoulder of the projectile with a second rotating band made of soft metal, copper for example, which is smooth and fitted without appreciable play on the lands, or which is rifled to exactly correspond to the grooves of the tubes. If continued test corroborates preliminary results we must require that such a band be provided at least for projectiles to be used in very long range firing, if not for all projectiles. This will surely entail complications in manufacture resulting in a slower rate of production but this defect will be largely compensated for by a corresponding saving of ammunition in long range firing.

II. TACTICAL CHARACTERISTICS

A. MOBILITY

History shows that during war itself, all combatants unanimously demand more and more powerful artillery and rarely complain of its defects as to mobility. In peace time, on the contrary, when there is still a great deal of maneuvering done but when effective fire is no longer of the greatest importance, mobility becomes the order of the day and the tendency to lighten matériels to the detriment of their power crops out.

The bloody lessons of the last war are still so fresh in our memories that we have not as yet reached this stage. For this reason the primary consideration in this study of our future matériels has been power and not mobility. As a result the matériels which we have proposed are all more powerful, but also heavier, than the analogous matériels in service at the end of the war.

This increase in weight immediately raises the question of their mobility.

The pre-war conception of the mobility of artillery was entirely a question of its flexibility on the battlefield, that is to say of its capacity for moving across any type of terrain, of the time necessary to place it in position, and its ease of manhandling in changing targets. Today we designate this particular kind of mobility by the more restrictive name, *tactical mobility*. The extensive and varied theaters of operation in the last war and the large scale maneuvers which were necessary, brought out the necessity for another kind of mobility which we now call *strategic mobility*. This may be defined as the capacity for rapid long distance movement from one part of a theater of operations to another or to a different theater.

This new conception immediately brings up the question of means of traction. Of the two available means, horse draft and mechanical traction, which one will give us the greatest tactical mobility and which will give real strategic mobility?

In so far as concerns tactical mobility, the weight of a matériel is the predominating factor. Certainly the time is past for expecting the artillery to go into action in varied terrain at a trot or gallop. The war showed us that the walk is the normal gait, even for light artillery, for movement across country as well as for long road marches. The trot is an exceptional gait only to be used for short distances on good roads. As for the gallop, it should be absolutely forbidden. These restrictions as to the use of fast gaits allow us to be a little more liberal in fixing the weights to be pulled by horses.

We are today of the opinion that we can go up to 3000 kg. for the weight to be pulled by six horses and up to 4000 kg. for that to be pulled by eight.

The comparative tests carefully conducted at Mailly in 1919 showed that carriages weighing within the above limits are, everything considered, handled more rapidly and with more flexibility by horse draft, than by motor traction. While mechanical traction proves better in marches requiring prolonged effort over soft ground, horse draft has the advantage in crossing obstacles requiring a temporary effort. The danger of wetting the magneto prevents motors from crossing fords of such medium depth as can easily be crossed by horses. Automotive artillery carriages always weigh more caliber for caliber than those of horse drawn artillery and therefore are stopped longer by broken bridges, because of the longer time necessary for the more substantial repairs. Then too, horse drawn artillery has a capacity for quiet and easy movement at night which motor traction will perhaps never equal.

On the other hand, it must be considered that motorized artillery requires less personnel by as much as from 20 to 30 per cent, that it does not occupy as much road space, that its ammunition supply is easier and that its motors are not affected by gas from which it is almost impossible to protect horses.

However, for matériels which must have great tactical mobility and whose weight is not too great, the advantages of motor traction do not seem to be as great as those of horse draft.

Accordingly the matériels for direct support, the light gun and light howitzer, and the matériel for interdiction, the 105-mm. gun, whose weights are within the prescribed limits, should have horse draft.

In the case of the 155-mm. howitzer for destruction, whose weight will be considerably over 4 tons, there is a question. If it is to have great tactical mobility it too must have horse draft. This would require that it be constructed so as to be carried in two loads. This however would result in a certain complication in its use, and if this complication is considered too much, it would be necessary to have it motor drawn.

One light matériel not included in the above discussion is the infantry accompanying cannon. Experience has shown that for this weapon, the horse is too vulnerable to bullets and gas to permit it to closely follow the infantry everywhere. The accompanying gun will therefore have mechanical traction.

In discussion of the relative advantages of horse draft and mechanical traction, one argument is often brought up which to many is of great importance. This argument is to the effect that a general motorization of the field artillery would result in enormous gasoline consumption and that since we are dependant on foreign sources for our supply of gasoline, we have not the right to risk being immobilized by failure in supply. It follows that we should at any price retain horse draft wherever it is applicable.

To our mind this argument is not sound. The motorization of light artillery would result in only a slight increase in the great number of automotive vehicles which we will be absolutely compelled to use. The great consumers of gasoline will always be the innumerable trucks in general transportation service, and the aviation.*

Either we will have practically unlimited quantities of gasoline, and therefore the question of the general motorization of field artillery is not affected from that viewpoint, or else we will be menaced by a lack of gasoline in which case it would be better to immediately refuse to fight and acknowledge ourselves conquered in the first place.

This argument can be turned around and made at the expense of horse draft. It is well known that beginning in 1917, the lack of horses was keenly felt in the armies of all the belligerents, who tried in vain to buy them in all the markets of the world.

Nevertheless the question of the adequacy of our gasoline supply is from the general viewpoint a most serious one. We can insure it only by maintaining alliances with countries producing gasoline and by maintaining control of the sea. It would be otherwise if French industry solves the problem of a national motor fuel, whether this be alcohol, vegetable oils or the poor gas from carbon, all of which matériels we can always produce in sufficient quantities in France itself or with the aid of our colonies.†

Animal draft provides a perfectly satisfactory tactical mobility for light matériels, and for this purpose can not be equalled by other means of traction. This is not true as to strategical mobility, which with horse draft is mediocre. This is remedied by depending on the railroads for the strategical movement of horse drawn artillery. During the War this defect was felt a great many times, especially at Verdun in 1916, when the infantry which was moved by truck, went into action without its division artillery, which was marching overland, and could not join until later. The same thing occurred in 1918, during the German offensives in the spring, but with less serious consequences by reason of the support given by the portée artillery whose strategical mobility was such that it could be rapidly thrown in to support the infantry pending the arrival of the latter's own division artillery.

We should note this fact in passing, because we will have to consider it when we come to the discussion of organization. Let us say right here that from it we will draw the conclusion that all the light artillery should not be within the division, but that there should be a considerable portion in the hands of the High Command, and that this portion must necessarily have mechanical traction. The same conclusion applies moreover to the 105-mm. matériel for interdiction. We will see that part of this matériel too, must be in the general reserve and must have mechanical traction.

From the above discussion we may draw the conclusion that all matériels of over 4 tons weight, and such matériels of less weight as are not part of the organic artilleries, should be motorized.

There are several ways to motorize matériels. They may be carried or drawn, and in each of these two systems the motor vehicles may be of the wheel type or may be of the caterpillar track type. Also,

* In the spring of 1918, the 90,000 trucks with which Marshal Foch maneuvered, consumed 50,000 tons of gasoline per month. What would the consumption of light artillery amount to compared to this?

† The adoption of a motor which can use vegetable oils is the ideal solution. Such a motor has been developed.

the motor may be built into the cannon carriage, or may be separate from it.

All these solutions are possible. The problem is to choose in each particular case that solution which best suits the matériel under consideration.

In the case of light matériels it will be recalled that the solution adopted during the last war, was that of portée artillery. The matériel was loaded on a truck for road travel and was unloaded at the battery position. This matériel had perfectly satisfactory strategical mobility but its tactical mobility was, on the other hand, mediocre. Wheeled trucks and tractors proved so inadequate for cross-country movement that the portée artillery was practically tied to the roads and under many circumstances were deficient in maneuvering ability. On the other hand the tractor with metal tracks, of the caterpillar type, always had sufficient cross-country mobility but proved to have little strategical mobility. Moreover, it wears out roads rather rapidly and long movements, in which it wears out the roads and is itself worn out, should be avoided.

A combination of these two methods of traction, wheels for road traction, caterpillar tracks for cross-country traction, immediately suggests itself. Such a combination would be a happy solution of the problem of mobility. It can be designed in two ways:

First, the wheeled motor vehicle,* which already carries the gun carriage, may be so arranged as to also carry a light caterpillar tractor. This combination has good road mobility. To place in battery position, the gun crew unload the cannon and caterpillar tractor alongside the road as near the position as possible and the tractor tows the gun to its firing position. The tractor then serves to bring ammunition from the point on the road to which it is brought by trucks. Several types of light caterpillar tractors are now used in agriculture. The artillery will surely find among these farm tractors a type which will be satisfactory and which with slight modifications will be suitable for its use.

Or else the tractor is provided with wheels for rapid travel on roads and also with tracks for slow movement in bad terrain. A fairly simple mechanism permits the tractor to be mounted on wheels or on tracks as is desired. Such a tractor is being studied but its weight and cost are still excessive and it does not seem probable that it will be adopted in commercial use.

A much nicer solution would be provided by a tractor equipped with the flexible Hinstin-Kégress track. Citroën cars equipped with tracks of this type have this year made remarkable performances not only on roads but on varied terrain, in the snows of Mount Revard and in the sands of the Sahara. These tests should be closely watched. The English, who are more advanced along these lines than we are, have great hopes in the flexible track.

In the case of heavy matériels, carrying is impracticable, because of the difficulties of loading and unloading the cannon, and because of the excessive weight of the motor vehicle when loaded with the cannon. There remains only the solution of towing, which moreover gave satisfaction during the War.

* It is quite apparent that this wheeled vehicle may be either a commercial truck drawing the cannon on a trailer or a motor vehicle carrying the cannon itself. The latter solution is however preferable because it takes up less road space and because of its greater flexibility in making turns and turn arounds.

The cannon should be mounted on a suitable carriage, capable of being towed on the road at a rate of speed at least equal to that of commercial trucks, or 10 kilometers per hour. At such a rate of travel the reactions of the road are very hard on matériels. It would seem necessary to provide the matériels with springs which would be free to function during travel but which would be blocked out for firing.

Some of the heavy towing vehicles would trail the cannon, others would tow trailers on which would be mounted the heavy caterpillar tractors necessary for placing the cannon in position and for ammunition supply. The ammunition would be carried in heavy trucks.

The capacity of such towing vehicles would limit the weight of the matériels which could be towed, to from 15 to 18 tons. In the case of heavier matériels we would doubtless have to use caterpillar track, self-propelled mounts. This is a very nice solution from the tactical standpoint because it assures great flexibility of maneuver and an all round field of fire, but is less advantageous from the strategic standpoint because the weight of such matériels would be almost double that of the same matériels mounted on ordinary carriages. Strategical mobility could only be obtained by railroad. These matériels should be loaded on cars for movements of any great distance. It would be necessary for the railroads to have sufficiently large and strong cars.

These matériels mounted on caterpillar track, self-propelled carriages, would form a sort of transition between road artillery and railroad artillery. The railroad is incontestably the most advantageous means of transport from the strategic standpoint by reason of the railroad's capacity, as much as because of the speed of movement thereby. On the other hand matériels which are inseparably bound to the railroad have no tactical mobility, at least unless there is available plenty of time and railroad matériel so that the number of usable railroads can be increased. However, we have seen that matériels weighing as much as 18 to 20 tons must be of the railroad type.

To sum up, automotive vehicles of our future artillery should include the following types:

Wheeled tractors of two types, one heavy and one light;

Light caterpillar type farm tractors, and heavy caterpillar tractors;

Matériel and ammunition trailers;

Heavy trucks for carrying personnel, supplies and ammunition;

Vehicles with flexible tracks with both good road speed and the ability to go across country;

Caterpillar track self-propelled mounts;

Very powerful locomotives, capable of pulling the large A.L.V.F. matériels over tracks with a steep grade and rough road-bed.

(Noted for the sake of completeness: light vehicles of the touring car type.)

Some of these vehicles can be obtained in abundance by requisition, such as: touring cars; 3-, 5- and 7-ton trucks, the numbers of which in commercial use is daily increasing; farm tractors, if we can get our agriculturists to adopt them; flexible track tractors, if the qualities of these turn out to be as good as they seem and they become appreciated by the commercial world.

All the others must be especially manufactured to meet army requirements.

B. FIELD OF FIRE

We have demanded considerable range for our future cannon and we have given the reasons for our insistence in this respect.

One of the greatest of these reasons is the importance of mass action. We wish that the greatest possible number of cannon be capable of concentrating their fire on the same target at the same moment, and then an instant afterward switch their fire to another target which will often be far removed in range and direction from the first target, and this no matter what may be the deployment of the cannon. The complimentary characteristic of long range is therefore the *ability to switch targets,* without which long range will often be only a useless luxury because it can not be used.

The weight of the field artillery matériels of the past was made rather small, so that gun crews could shift the carriage by hand and point it without great difficulty on successive targets. No mechanical arrangement to facilitate this maneuver was deemed necessary. Furthermore, the range of these matériels was so short as to make them inapt for concentrations of fire. However, during the War, we saw larger and heavier and still larger and heavier matériels appear on the battlefield. The weight of these matériels was so great that moving them by hand was a long difficult operation and they were thus poorly suited for the frequent changes of target which were required of them. Thus, there arose the necessity of providing the matériels with a mechanism which would permit of rapidly changing the direction of fire.

One of the improvements contained in our 75-mm. matériel, obtained by abatage of the carriage and anchoring it in the soil, was the axle traverse which gave the cannon a lateral field of fire of 100 mils (about 6°) without having to shift the wheels or the trail.

Most of the matériels built during the War such as the 105-mm. gun, the Saint-Chamond and Schneider 155-mm. howitzers, the 155-mm. guns, L 77-14 and L.S. 17, were equipped with a similar arrangement and had lateral fields of fire of the same extent.

Experience showed these fields of fire to be totally inadequate.

During the period in which we were considering the question of the adoption of a new light field gun, Colonel Deport presented an ingenious carriage system, a split trail with two opening flasks, which gave the cannon a lateral field of fire of 600 mils (about 33°). The advantage of a great lateral field of fire for a light field gun of only 5 to 6 km. range, did not seem sufficient to compensate for the complications in manufacture of the split trail, for its greater weight and for its greater difficulty in manhandling, and Colonel Deport's proposition was declined.*

However, the same solution, applied during the War by Lieutenant Colonel Filloux in his 155-mm. G.P.F., gave perfect satisfaction. The

* Italy, to whom Colonel Deport offered his gun, adopted it and it was with the Deport matériel that she fought the War. Besides having the large lateral field of fire of 600 mils, this matérial also had a total vertical field of fire of 60°, which permitted of using the matériel to its maximum range and which even made it capable, to a certain extent, of antiaircraft fire.

lateral field of fire of this matériel was 60° and was greatly appreciated by the troops and by the Command.

Today all artillerymen are unanimous in recognizing that, if it is to easily fulfill its battle rôle, all artillery should have a wide lateral field of fire. We will see by what methods and to what extent this improvement can be accomplished.

Leaving aside for the moment the question of an all-round field of fire of 360°, to which we will return later, it may be stated that the only satisfactory solution of the problem which is known today is that of the split trail carriage. This solution has, moreover, the advantage of having received the sanction of experience. However, it can be reproached for having several defects, especially the resulting considerable increase in weight of the matériel and also the relative slowness and difficulty of manufacture. It can be answered that these defects are more serious for some matériels than for others. In the case of small caliber matériels, where there is little leeway for much increase in weight and which must be susceptible of rapid mass production, the defects are very serious. They are less grave for heavy matériels which can more easily accept an increase in weight and which, throughout a war, are not required in such large numbers. The proof of this statement is contained in the experience of the last war. The Italians lost a large part of their light artillery in the Caporetto disaster and were obliged to replace it with the least possible delay. They had to renounce the Deport matériel and return to the boxtail Krupp matériel, whose manufacture was simpler and more rapid. On the other hand our 155-mm. G.P.F. matériel triumphantly stood the test of war. We are right in concluding from this experience that, in the case of the heavy gun, the split trail is unquestionably the best solution of the problem of lateral field of fire.

In the case of heavy howitzers, perfected platforms of the type we used toward the end of the War, appeared to be more suitable. However, the field of fire with this type of platform cannot be as large as with platforms of the Skoda type, unless subdivided loads are found acceptable.

There remains the light artillery. As we stated above a large field of fire is the complement of long range. The longer the range of a cannon, the more a large field of fire is a necessary characteristic for it. The ideal condition for a matériel would be for it to be capable of covering at its normal range the front of the unit which it supports without any shift of the trail being necessary. From this it follows that light matériels which principally constitute the division artillery have need of less lateral field of fire than army corps heavy matériels, and of very considerably less lateral field of fire than that of heavy army cannon. It may be admitted that a lateral field of fire of 30° is adequate for division light artillery, that 45° is necessary for army corps artillery and that the army artillery should be 60°.*

It will accordingly suffice in the case of light matériels to find an arrangement which will give a 30° field of fire. The adoption of

* These figures are arrived at as follows: With a field of fire of 30° a cannon covers at 10,000 meters range a front of 5800 meters which is adequate for a division gun. With a 45° field of fire the front covered at 15 *km*. range is 10 *km*. which is adequate for a corps cannon. Finally with a field of fire of 60°, 20 *km*. is covered at a range of 20 *km*. (front equal to the range). Such a field of fire is necessary in an army cannon.

a curved axle has been proposed. This would permit of about tripling the axle traverse of our present 75-mm. matériel and of extending its field of fire to about 20°. It is difficult to go further on account of running into the difficulty of traversing the matériel about its spade embedded in the soil, a difficulty which can not be avoided.

The problem is therefore not as yet completely solved. It should be given to the constructors, and one of them will surely find a satisfactory solution.

An all round field of fire of 360° can be obtained by several distinctly different arrangements which are enumerated as follows:

> For heavy matériels: the caterpillar track, self-propelled mount;
>
> For very heavy matériels: the all round fire railroad carriage, or the German metallic platform;
>
> For antiaircraft guns: the platform carriage and the automobile trailer (French solution) or the chassis with a vertical pivot (German solution). We note in passing that the French auto-gun does not have a 360° field of fire, but only 240°, which is disadvantageous.

The all round field of fire of caterpillar track carriages is a characteristic resulting from the very method of construction of the apparatus, but this characteristic is not imposed by the intended use of the matériels mounted in these carriages.

It is, on the contrary, an indispensable characteristic for railway matériels because the matériels must utilize tracks pointing in any direction. It is an absolutely necessary requirement for antiaircraft matériels whose targets appear from any direction.

C. RAPIDITY OF FIRE

Our 75-mm. gun was the first really rapid fire matériel. Its characteristics in this respect have never been surpassed or even equalled by any other field gun. It is well known that its rate of fire can, under particularly favorable circumstances, be as much as twenty rounds per minute. Practically, however, it is accepted that it does not exceed twelve rounds per minute.

This rapidity of fire has given our gun such a manifest superiority, and it has rendered such striking services in ticklish situations, that it is the universal opinion that it should be maintained in our future light gun at any price.

The question may arise as to whether rapidity of fire necessarily entails having to retain the independent line of sight which is often believed to be indispensable for it. Tests which have been conducted along these lines show that the independent line of sight can be dispensed with provided a rate of fire of over twelve rounds per minute is not desired.

On the contrary, fixed ammunition must be retained to the greatest extent possible, because its use appreciably increases speed in loading.* However the cartridge case cannot be of general use. In the first place it lends itself poorly to the use of multiple charges which today

* The cartridge case has, moreover, the advantage of assuring to a certain extent, good preservation of the powder charge.

are becoming more and more necessary, not only for howitzers for which they are absolutely necessary, but also for guns which, because of the danger of rapid wear of the tube, must not always be fired, no matter what the range, with the strongest charge. Furthermore, it is difficult to obtain satisfactory crimping of cartridge case on boat-tailed projectiles. Then too, the union of the projectile and the charge into a single unit is only practicable in the case of small calibers with little weight. Moreover, the only matériels which require a high rate of fire are the infantry accompanying gun, the matériels for direct support of the infantry, and the antiaircraft guns.

In the case of other matériels we must be satisfied with a slower rate of fire, although we should always try to obtain the fastest rate compatible with the weight of the ammunition, with the ease of operation of the breech-block, and with the angle of elevation. It is difficult to give figures in this respect because too many factors enter. All that can be said is that the rates attained in our most recent matériels should be maintained and if practicable increased for similar future matériels.

The question of the type of breech-block is connected with the solution of this problem. The opening and closing of this mechanism, no matter what may be the caliber and consequently the weight, should always be so easy as not to slow up fire. Because of service pressures of around 4000 kg. per square centimeter such as are today contemplated, because of the considerable temperatures generated by the powder combustion, and because of this essential condition of facility of operation, which we have just referred to, the question of the type of breechblock again becomes of importance, especially for the large calibers.*

D. DESTRUCTIVE POWER

Under the hypothesis that there have been obtained the ballistic characteristics as to range and accuracy which we have previously recognized as necessary, destructive power or the efficiency of the matériel depends only on the composition of the projectile.

This composition should exactly correspond to the result which it is desired to obtain, which is to say that there cannot be a single type for all matériels, nor even a single type for each matériel. Each of the missions which the artillery must accomplish acquires a special projectile so composed as to obtain the maximum returns in the accomplishment of this mission.

On the other hand although the design of cannon must be made with the desired effect which fixes their main characteristics especially in view, it does not follow that in use they will always be exclusively used for a single invariable mission. In addition to this fundamental mission for which it is better suited than any other, every cannon should in addition be capable of fulfilling, if not all other missions, at least a great many of them. It must necessarily be provided with several different projectiles, of which one corresponding to its essential mission will be its principal projectile and will be supplied in the greatest percentage.

* The balanced spherical valve breech-block designed by the Engineer General of Naval Artillerie, M. Charbonnier, may be cited as being satisfactory from all these viewpoints.

Finally, the conditions under which a projectile bursts varies the effect which it produces. Each projectile should therefore have a series of all those fuzes which are necessary for it.

Experience has led us to place in service a certain number of types of projectiles which have been satisfactory and which we have no reason to replace by others. It suffices to make such improvements in them as have been indicated by experience. The projectiles are:

The shrapnel;
The high explosive shell;
Various special shells; toxic gas, tear gas, smoke, etc.

1. *Shrapnel*

The shrapnel question has often been sharply debated. During the War the shrapnel ceded the place of first importance to the high explosive shell which has become the all-purpose projectile. In addition to the difficulty and slowness of its manufacture, the shrapnel has been criticized for its lack of morale effect due to the comparative mildness of its explosion. It has been especially criticized because of the necessity of firing it with a good height of burst which requires very accurate fuzes, great firing ability on the part of battery commanders, and well trained gun crews. It nevertheless remains that the shrapnel when well used is the most effective projectile against animate targets in the open. It has good effect in depth and is the only projectile suitable for searching a torn up terrain such as a region full of shell holes. Moreover, the accurate adjustment of height of burst is of great importance only in the case of small calibers whose balls have a weight of less than 12 gr. In the case of medium calibers, heavy balls (25 to 30 gr.) can be used which retain killing power, even if the height of burst is not well adjusted.

We are of the opinion that the shrapnel should be retained. However, it should be provided for small and medium caliber matériels, and for ranges not exceeding 15 km. Beyond this range the time of flight is too great. It is difficult to manufacture fuzes operating at such a long time of flight without making them of an impracticable size. The probable error of the height of burst increases very rapidly with the time of flight and the dispersion becomes so great as to make fire ineffective.*

Although the tests at Bourges showed that the 12-gram shrapnel ball is very deadly as long as its velocity is not under 180 meters per second, which with the base change shrapnel gives it a killing distance of 190 meters,† the troops frequently asked during the last war that the weight of the balls be increased. To meet this wish 15-gram balls will probably be adopted for our matériels for direct support. Their killing distance will be increased to about 220 meters, a gain which is not to be disdained. Furthermore, the increase in the disabling power of the individual ball will largely compensate for the decrease in the number of balls.

Our 155-mm. matériels should also have a shrapnel which could be without essential change the present shrapnel, having with its 25-gram ball, a killing distance of 300 meters, which is satisfactory.

* See page 302 for a discussion of the time fuze.

† In foreign artilleries, shrapnel ball have barely 10 gr. weight.

It is well understood that if the research now in progress with a view to improved fragmentation of the high explosive shell leads to satisfactory results, the shrapnel could safely be abandoned.

2. *High Explosive Shell*

The high explosive shell may be used against personnel, against matériel, or against obstacles.

Use against personnel and unarmored matériel. The number and characteristics of the fragments of the same shell loaded with the same explosive vary from one round to another. They also vary, and to a much greater extent, with variations in loading and in the character of the metal of the shell body. Thus, with shells of the same metal, the number of fragments is three times as great when the shell is loaded with cresylite as it is when loaded with schneiderite. With exactly the same loading, a steel shell gives four times more effective fragments and a 40 per cent greater radius of action than a cast semi-steel shell.

However, effect does not depend solely on fragmentation. The greater the number of fragments, the smaller are these fragments and therefore the more quickly do they lose their velocity and their killing power.

The question is, accordingly, a rather complicated one. A methodical study of the effect of high explosive shells is now being made by the Field Artillery Board at Bourges.* Preliminary results indicate that maximum effect is obtained with a steel shell which is loaded with quickly detonating explosives such as cresylite and melinite, and which has a good index of loading, that is to say one in which the ratio of the weight of explosive to the weight of the metal of the shell body is large. The semi-steel shell is markedly inferior. However, this inferiority decreases if less quickly detonating explosives, such as schneiderite, are used. In spite of all this the semi-steel shell is a good substitute shell, and it has two advantages which compensate for its defects. It is much cheaper, and it can, in time of war, be more easily and rapidly manufactured.

Pending the completion of research relative to systematically fragmenting shells, we should therefore retain the high capacity steel shell with a very quickly detonating filler, but we should not absolutely abandon the cast steel shell whose two characteristics indicated above may lead us to resume its manufacture in time of war.†

Here, moreover, there immediately arises a related question. In case of war, will we have adequate steel production and resources in quickly detonating explosives to meet our requirements? During the last war our requirements in shell steel constantly increased, reaching 220,000 tons per month in 1917, while our production never exceeded 28,000 tons per month. In spite of large imports, the tonnage available

* Literally "The Testing Board of Bourges." (La Commission d'experìences de Bourges).—EDITOR.

† It is only simple justice to state that General Herment, foreseeing the difficulties of the wartime manufacture of the steel shell and furthermore believing that the capacity of the ordinary cast iron shell, only 5 to 6 per cent, was insufficient, instituted in 1909 the study of the use of semi-steel and the development of the technic of its manufacture. Except for this fortunate initiative, the heavy artillery would have suffered cruelly in its ammunition supply, because of the inadequacy of steel imports, and would have been compelled to use very inferior projectiles.

was always less than our requirements. It was the same in the case of nitro explosives.

The country's resources in coal tars which are obtained either by the distillation of coal, or by the distillation of petroleum, are very limited. Our production of cresylite never exceeded 6 or 7 tons per day while our daily requirements in explosives had risen in 1917 to 940 tons. In spite of the assistance of our allies we were compelled to have recourse to other explosives, notably to nitrated explosives. For these we have for a long time been dependent on the sodium nitrate of Chile and on ammonium nitrates from Norway. The problem of the freedom of the seas and the shortage in cargo boats compelled us, beginning in 1917, to reduce our imports. There were no serious results, thanks to the fact that by 1918 a synthetic ammonium nitrate industry had been established in France which had adequate production. The question should not be lost sight of. We must encourage our researchers to find new processes so as to insure our complete independence of foreign resources.

It is certain that in the next war, the same disadvantageous conditions will recur and will again force us, in spite of our preferences for steel and nitro explosives, to the use of semi-steel and of nitrate explosive shell fillers for most of our shells.

Against obstacles. The question of maximum effect of shell for use against obstacles is better known. The various nitro and nitrated explosives give practically the same effect.* The composition of the metal of the shell is of little importance. The only thing of capital importance is the weight of explosive. Accordingly, it is again the case that the steel shell is very superior to the semi-steel shell, not because of the metal, but by reason of its greater interior capacity.† Furthermore, whereas in firing against personnel, the weight of the shell itself matters only in so far as the index of loading is affected, it is otherwise in firing against obstacles, when the larger of two similar shells of different caliber is better because it contains a larger amount of explosive.

As concerns penetration, it is the total weight of the projectile that is the predominant factor, the weight and nature of the explosive having but a secondary influence.

To sum up, whereas the small caliber shell has excellent efficiency in fire against personnel, fire against obstacles requires heavy, and therefore large caliber, shells.

We note also that the high service pressures which we have set forth as being necessary for obtaining long range, would certainly require strengthening of the shell body with a resulting diminution in internal capacity and there would consequently result a lower index of loading. Let us also recall that long range projectiles should have refined shapes which would still further reduce their interior capacity. From this it follows that it will doubtless be necessary to have two types of shell for use against obstacles: One shell for fire near the

* The chlorate explosives are markedly inferior. Moreover, their use is a delicate matter, their sensitiveness to shock rendering them unsuitable as fillers for shells of high muzzle velocity.

† The capacity of the semi-steel shell compared with that of the steel shell is: 10 per cent as opposed to 25 per cent in the case of the 155-mm.; 20 per cent as opposed to 30 per cent in the case of the 220-mm.

limit of range, and therefore with high pressures, should accordingly be strongly made and with a refined form and would have a mediocre index of loading. The other shell for medium ranges would on the contrary have the maximum interior capacity and an excellent efficiency.

Based on these facts and taking into consideration what we previously stated relative to the ballistic characteristics of projectiles, we see that we should have the following high explosive shells:

For action against personnel and unprotected matériel: a steel shell loaded with nitro explosive having a good index of loading; the interdiction shell for long range firing should be relatively light and should be provided with a pointed nose (or false ogive);

For use against obstacles: a relatively heavy, high capacity steel shell loaded with nitro or nitrated explosive.

For penetrating effect: a heavy steel or cast steel shell, with reduced explosive capacity, loaded with any explosive whatsoever.

For the attack of armor (tanks in particular): a heavy thick-walled shell, with a finely tempered nose, and consequently necessarily containing a reduced explosive charge. This will be the *armor piercing shell*.

3. *Special Shell*

There are generally included in this classification all those projectiles not included in the preceding categories, such as incendiary, smoke, star and tracer shells, but principally toxic gas shells. We will say a few words about only toxic gas shells and smoke shells.

Toxic gas shell. It is understood that the use of these projectiles is forbidden by the Hague Conference, the Versailles Treaty, and by the Washington Conference. In the future, France is clearly decided not to act contrary to signed agreements. However, she may have to deal with an adversary who will not have entered into these agreements or who, having made them, will violate her word. We have paid to find out what "scraps of paper" are worth to certain nations. If we are to avoid the risk of again being caught at a disadvantage, we should therefore be prepared to engage in gas warfare, if not as an offensive measure, at least as a means of retaliation and defence.

Chemical warfare, of still recent birth, has nevertheless had time to make its redoubtable efficacy felt. No one can foresee what progress will be made, in perhaps the very near future, in chemical warfare by the research of specialists. No one can affirm that it will not replace tomorrow, by the will of any belligerent, the war by means of explosives. Experiments were pushed, with great activity and with the clean-cut desire to complete them, by our old enemies, to whom the perfect organization of their chemical industries assures the means of obtaining rapid and certain results. The danger has been quite well understood by at least two of our old allies, the English and the Americans, who have maintained the experimental organizations which they established during the War and have constantly improved them and appropriated large sums for them.

Without insisting further on this question of the preliminary preparation which should be completed in peace time, we will only say that in case of need we should have instead of the twenty odd toxic substances which appeared in the last war, only four types of these products*:

1st. A very toxic non-persistent gas.

2nd. A gas with violent sneezing effect, to keep the masks off or to compel taking them off. It should penetrate the mask if possible.

3rd. A very persistent, toxic or simply lachrimatory gas, compelling the enemy to keep in his masks a long time and in this way causing a very efficient paralysis of his means.

4th. A very persistent vesicant, to accomplish the wearing out of the enemy in the defensive, and for neutralizing his flanking arrangements and his counter attacks zones, in the offensive.

Smoke shell. The intensive use of these shells dates from the last war. The Germans used them in large quantities in their great attacks in 1918, to plunge the defenders of important strong points into semi-obscurity, thus placing the defenders in the position of being unable to see the approach of the attackers or to make good use of their weapons against them. On our side they were especially in demand for use in masking from enemy observation points, the advance of our tanks which are so vulnerable to artillery if they can be seen.

Although the smoke shell is to some extent a double edged weapon, because the smoke cloud it produces often hinders the assailant as much as the defender,† its use must nevertheless be contemplated in some particular cases, when atmospheric conditions are favorable.

In the last war, we used two types of smoke shell, the white phosphorus shell which produced a voluminous, thick, and persistent cloud, but whose smoke had the inconvenience of being very irritating and even poisonous; and, towards the end of the War, the O.C.S. shell (oleum-chlornydrine sulfurique) which produced a rather thin and fugitive mist.

It will be necessary to find a substance giving better results, which is non-toxic and is capable of giving a very large amount of heavy and persistent smoke so that there may be a reduction in the enormous ammunition expenditure which is now required to establish and maintain a smoke cloud.

If the enemy's initiative compels us to manufacture toxic shells, in what proportion should they enter into our supply?

The Germans, in their 1918 offensives, used enormous quantities of toxic shells. In the attack of May 27th, on the Aisne, their VII Army provided its artillery with:

For counterbattery units, 80 per cent toxic shell;

For rolling barrage units, 40 per cent;

For batteries with protective missions, 70 per cent.

Our General Headquarters asked in September, 1918, that toxic shells should constitute about 30 per cent of our ammunition production.

---

* Let us recall that the Germans, at the end of the war, used only three kinds of toxic shells: the blue cross shell (sneezing and vomiting gas), the green cross shell (non-persistent gas); the yellow cross (a very persistent vesicant).

† Even more so, if the wind is from the wrong direction and blows the smoke back on the attacking troops. Tanks especially, whose vision is already limited by the nature of their construction, risk being completely blinded.

It is difficult to fix on any figure now. If there should be discovered some substance which is much more effective than those we have heretofore used and which could be used independently of weather conditions (wind, rain, heat radiation, etc.), the toxic shell would take on a preponderant importance. In the present state of affairs, it would be wise not to exceed the proportion of 30 per cent requested by our General Headquarters in 1918.

In any case, moreover, the high explosive shell will always be indispensable; it also has effect on matériel obstacles; its use is not affected by the weather; no mask can protect from its effects.

For the smoke shell, it is necessary to be still more modest.

The great drawback of this multitude of different projectiles, each of which is effective only if circumstances and conditions are right, is that the questions of ammunition to be carried by the troops and of ammunition supply are complicated beyond measure. A battery which is entering action can carry only a limited number of projectiles in its chests. If in this limited number there must be included some of each type of all existing projectiles, the battery would never have a sufficient quantity of any type and would run the risk of finding itself helpless, although plentifully supplied with projectiles, because it would not have that type of projectile whose use would be effective.

Only the high explosive shell is good for all missions and can be used under any conditions. Until further orders, it is the essential weapon of the field artillery.

4. *Fuzes*

During the last war we had simultaneously in service, seventy different types of fuzes. It is useless to dwell on the drawbacks of such a mixture.

Fuzes giving the following effects are necessary:

For surface destructions: instantaneous percussion, or slight delay, permitting of ricochet;

For demolitions: variable delay;

For fire against personnel: time fuze.

All fuzes should moreover have instantaneous percussion effect, which is by far that which is most generally required. The fuzes of the future should therefore be of the following three types:

A percussion fuze, normally giving instantaneous effect, but which has a simple arrangement, operable at the time of fuzing the shell, giving slight delay effect. This fuze would be used in fire against personnel, unprotected matériel and light obstacles, and would then be in the nose of the shell. It would also be used with the armor-piercing shell, and would in this shell be placed in the base.

A percussion fuze with a variable delay running from 0 seconds to 0.25 seconds, for use in demolitions.

A combination time and instantaneous percussion fuze, for use with shrapnel and all kinds of time fire with high explosive shells.

We have already made the observation that, in order not to injure the ballistic characteristics of the projectiles, all these fuzes should exactly extend the best ballistic form of the shell. This would naturally result in special fuzes for each caliber. In the case of base fuzes and of nose fuzes which are to be placed within a false ogive, external form of the fuze is evidently of no importance.

The mechanism acting by inertia has clearly proved itself to be inadequate to obtain instantaneous action. The set-back mechanism has on the contrary proved itself. This latter arrangement should therefore be continued, unless the tests now in progress relative to detonation by distance influence give good results.

It is rather difficult to get a variable delay fuze without making the fuze too large. However, our fuze experts overcame plenty of other difficulties during the War. They will know how to solve this new problem.

Time effect can be obtained in several ways. Compressed powder trains in rings (German system) or a continuous cone shaped spiral train (French system) is satisfactory for a short time of flight. The ring system gives more regularity but is more affected by humidity than the continuous spiral train system. The adoption of the ring system, with a waterproof sealing to protect against atmospheric influence, is therefore indicated.

For a time of flight of over forty-five seconds, time train fuzes have inadmissable variations in time of burning. For ranges which we today contemplate, times of flight equal to, or greater than one minute will be frequent. Only a mechanical fuze with a clockwork system will give a solution. The Germans and the Americans have developed models of this type fuze which seem to be satisfactory. We must do as well as, and if possible better, than they.

EUSTACE

BY "FADOL"

"Now, Eustace, you leave that alone!"

Eustace gave no indication that he had heard.

"Eustace, you heah me! Get away from theah. That's not eating hay even if it is from Californy; that's rigging hay."

Eustace, a large, black, glossy-coated mule, raised his head and gazed at Sergeant Burk in a quizzical manner and disdainfully moved away.

"Theah now, I didn't aim to hurt yoah feelings," Burk called after him soothingly.

Sergeant Burk grasped a handful of the hay, rammed it down into the boot of the aparejo and spread it with a circular motion of his hand. It was comfortably cool under the rigging shed and peace reigned throughout the stables. So quiet that one forgot that a great war was raging somewhere in the world and that, at last, our country had elected to throw its strength into the conflict. But war or no war, there were some new aparejos to set up and it was the old packmaster's job to do it. The rest of the battery was up at the barracks speculating on what was to happen to the regiment.

All doubt as to the fate of the regiment was dispelled at Retreat formation. One could tell by looking at First Sergeant Adams that he was bursting with information and was aching to tell it. Scarcely had the last note of the Anthem faded in the clear, still air when Sergeant Adams took a slip of paper from his blouse and began to read.

"Turn in all animals and equipment and proceed to the United States on the first available transport and to Fort Sill, Oklahoma, at which station will be reorganized and equipped as regiment of 155 mm. howitzers."

"Dismissed" uncorked cries and howls of joy from every one except Sergeant Burk. He stood rigidly, grizzled head bowed, as the battery melted from around him. His mind was in a daze as the familiar features of his old world seemed to slip away. The impossibility of the thing did not agree with what Adams had just said. There must be some mistake; cablegrams had been known to contain mistakes. The regiment had been pack artillery almost since the time of man; it was inconceivable that it could be any thing else. What was going to happen to the mules, to Eustace? The importance of a world war faded in the face of the loss of Eustace.

Burk's mind turned back to the time of Eustace's arrival from the States in a shipload of mules and how he had picked him out for his own mount. It had been a case of love at first sight; Burk had gone straight to the young, upstanding mule as if drawn by a magnet. Burk knew mules; he knew them as well as any who hailed from Audrain county, Missouri, and there was something strangely familiar in the perfection of the conformation of Eustace. He wasn't Eustace then, of course, just a number but the brand he bore completed the capture of Burk's heart; it was that of an Audrain county mule raiser.

"Honey," Burk had said in his slow Missouri drawl, "how did you leave the folks to home?"

Burk and Eustace, from that time on, were inseparable and Eustace, basking in the affection of the packmaster, flourished like a young bay tree. Even now at an age when most mules lingered only in the memory of the voracious Negritos, Eustace was without a blemish and as sound as a new nutmeg. Given the birthright of good breeding, the loving care lavished on him by Burk guaranteed him many more years. Burk had never allowed himself to think about the time when Eustace might pass on to the Great Stable; life without Eustace was unthinkable.

A slap on the shoulder cruelly brought him back to the grim realities of the situation.

"Well, old timer, what do you think of the news? We'll get a chance to show what the regiment can do in a real war."

"Air you shoah we have to turn in ouah mules, Adams?" asked Burk tremulously.

"Sure as shooting," answered the First Sergeant. "If you don't believe me, you can ask the Old Man, here he comes."

"You've heard the news, Sergeant Burk?" asked Captain Banton.

"Yes, Sir," replied Burk. "It shoah ain't welcome news to me."

"Why, Sergeant, I am surprised. What is the trouble?"

"Well, Sir, I kinda hate to leave Eustace, seeing as how we've been together for so long. I don't know nothing but pack artillery and it's kinda hahd to learn an old dog new tricks."

Captain Banton laughed.

"No use worrying about that. We are all in the same fix, but that will be taken care of. As a matter of fact, we are going to start a motor school in the battery at once. It won't be long before you will forget all about Eustace; you will be flying around on a motor cycle."

"I've heered it ain't healthy to breathe gasoline and such," suggested Burk.

"Tut, tut, Sergeant, we are living in a motor age and we must be up-to-date."

Burk went to his quarters at the stables with laggard steps while Captain Banton watched him curiously.

"What's the matter with the old man, Sergeant?" he asked Adams.

"Pretty hard hit, I think, Sir. He has thought nothing but pack artillery and Eustace so long that it will be hard for him to change over."

In the recreation room, the Youngest Lieutenant was expounding a maze of technical terms to the battery assembled there.

"Inasmuch as all the vehicles of the motorized artillery are equipped with motors of the same type we will take up that important feature first. It is an internal combustion engine of the four cycle type; the engine, broadly speaking, comprises the cylinders, pistons, connecting rods and crank shaft. . . ."

And so on to the increasing disgust of Sergeant Burk, seated well to the rear of the room, who gave evidence of his displeasure by emitting occasional grunts of disapproval. The grunts were hardly loud enough to be heard by the Youngest Lieutenant but they served to relieve Burk's feelings somewhat. Burk voiced his complaints after dismissal.

"Hell fiah! Trying to learn a jughead outfit to be a bunch of taxicab drivers. An en-jine is too derned complercated. Take a mule, fr'instance, ain't no trouble to know what's inside a mule. If you know what's inside of yoahself, then you know a mule."

"Hey, Sergeant," called a flippant young soldier, "are you going to pack a 155 howitzer on that old hardtail of yours?"

Burk fixed him with a piercing gaze from under bushy eyebrows.

"Sonny," he drawled, "you hadn't oughtah be a-talking bout yoah bettahs that-a way."

For the battery, awaiting embarkation, time passed like a six-months hitch in the guard house but for Burk the time set for turning in the animals approached with the speed of a typhoon. Day by day, the old man became more silent and morose; he avoided every gathering of the men of the battery lest he hear the hated talk of gears and differentials. He spent more time at the stables, perfecting the fit of aparejos destined to mildew in some warehouse and grooming the ever immaculate Eustace. He repeatedly soaped his saddle and bridle, slowly and thoroughly, and did many things considered as entirely useless by the other members of the battery. The execution of the old, familiar duties helped to dim the thoughts of the approaching catastrophe and ease the leaden pain in his breast.

The night before the day set for the turn-in was one of moonlit splendor, of fragrant beauty that so often follows a brassy hot tropical day. Had the stable sentry tarried he might have seen a lank figure move quietly among the mules in the corral and heard softly whispered farewells. Natives, returning from a fiesta in a nearby barrio, were affrighted by the startling spectacle of a man mounted on an animal that appeared unnaturally large in the moonlight. They shrank aside, nervously fingering *anting-antings* and muttering *"Sus y Maria,"* as the strange horseman and his gigantic mount passed silently, hoofbeats muffled in the thick dust of the road.

Sergeant Adams, after reveille, found an envelope on his desk addressed to himself. He tore it open, removed a note scrawled with a blunt pencil and softly swore. He read:

> "dear Sergeant,
>
> I've took Eustace and deserted. there is bin nary a blotch on my record for 20 yrs but I cant stand it. dont bother looking for us becauz we ant eny more use to the guvermint. Eustace wud have died if I had left him and I wud have two.
>
> yur old pal,
> Burk"

After breakfast Captain Benton bustled in with a paper in his hand and a happy smile on his face.

"Send Sergeant Burk to report to me. I've an order here that will put a grin on that old joy-killing countenance."

Sergeant Adams colored, gulped and said:

"Why, Sir, Burk wanted the morning off. If the Captain wants him I'll send for him."

"No hurry. This is an order to organize a pack train for the Quartermaster and Burk is to remain in the Islands as packmaster. Here is a copy: Give it to him as soon as you see him; it will change his outlook on life."

Outside the orderly room, Adams stopped and wiped the sweat from his face.

"The old fool, why couldn't he have waited. I wonder where he is," he thought with a burning sense of shame for what he had told Captain Banton.

The battery was at the stables grooming the animals on the picket line when a thud of hoofs caused every man and animal to raise his head and look in the direction of the noise. A large, black mule, riderless and saddleless, trotted up to the picket line and nosed his way into place.

"Eustace!" ejaculated half of the battery to the other half who responded, "I wonder where Sergeant Burk is."

The return of Eustace without Burk gave Sergeant Adams considerable anxiety for the safety of the old man and he resolved to start some men out to search for him as soon as he could manage it.

However, before the opportunity presented itself Burk trudged wearily into the stables, threw down his saddle and faced Adams.

"Hyah I am, Adams, back because I trusted a doggone mule. Eustace done me a dirty trick foah the fust time in his life."

Sergeant Adams grinned broadly at the ludicrous picture of dejection that the old man presented. He then handed the order to Burk. After several minutes of perusal, Burk looked up with tears in his eyes.

"I might have knowed it. I was jest a danged old fool to put my jedgement up agin Eustace's."

ARMY CENTRAL POLO COMMITTEE BULLETIN

WITH the beginning of the polo season close at hand, orders have been issued by the War Department for the assembling of the following named officers at Mitchel Field, Long Island, May 15th, as the Army Polo Squad for 1928:

Major George S. Patton, Jr., Cavalry, Office of the Chief of Cavalry, Washington, D. C.
Major C. C. Smith, Cavalry, Fort Leavenworth, Kansas.
Captain George E. Huthsteiner, Cavalry, Fort Sam Houston, Texas.
Captain Candler A. Wilkinson, Quartermaster Corps, Fort Reno, Oklahoma.
Captain Chester E. Davis, Cavalry, Fort Bliss, Texas.
Captain Peter P. Rodes, Field Artillery, Fort Bragg, North Carolina.
Lieutenant Morton McD. Jones, Cavalry, Fort Bliss, Texas.
Captain Charles H. Gerhardt, whose services will be required at West Point, New York, until after the Intercollegiate Polo Tournament, will join the Squad June 20th.

Lieutenant Mark McClure, Sixteenth Field Artillery, Fort Myer, Virginia, was wanted for the Squad, but is not available for the detail.

Major G. S. Patton will captain the team that defends the Junior Championship title won by the Army last year. Major Patton represented the United States in the Modern Pentathlon at the Olympic Games at Stockholm in 1912. In this event Major Patton was awarded fifth place, in a field of forty-two competitors, the first four places having been won by Swedish entries. He is an experienced polo player. He was a member of the Army Squad that played on Long Island in 1921. Later he played in Washington while stationed at Fort Myer. In 1926, he captained a team which won the Inter-Island Polo Championship in Hawaii for the first time since 1912 when, with the arrival of the Fifth Cavalry at Schofield Barracks, an Army team first entered the annual competition. Major Patton's string of private mounts will enable him to be well mounted.

Major C. C. Smith, a hard rider and bold player, joined the Army team on Long Island last summer for a few weeks. Major Smith was a member of the Fort Leavenworth team that won the Inter-Circuit Championship, and the Twelve Goal Championship in 1926. For the past few years he has played on the Fort Leaven-worth and Cavalry School teams in the Rocky Mountain Circuits, at Fort Snelling, Kansas City, and elsewhere. Prior to this he played at Fort Bliss, Texas.

Captain Peter P. Rodes, captain of last year's Army team, has had a wide polo experience in recent years. In 1925, he went to England on Major L. A. Beard's team that won for the second time the British-American International Military Championship. Last summer he led the Army team on Long Island that competed creditably in the Open Championship. Captain Rodes is a graduate of the United States Naval Academy, where he captained the Navy football team. He first came into prominence as a polo player at Camp Grant, Illinois, in 1921, when his team won the Mid-Western Circuit Cup and the Westleigh Cup. During the past winter while on duty with his battery at Fort Bragg, North Carolina, he has found time to work on some prospective mounts for the Army team.

Captain C. A. Wilkinson needs no introduction to the polo world, having achieved the distinction last summer of being the first Army officer ever named a member of the American International Squad. Captain Wilkinson first gained considerable polo experience on the Pacific Coast in 1921. He came east as a member of the 1924 Army team. In 1926, he played on the Fort Leavenworth team that won the Twelve Goal Championship and the Inter-Circuit Championship. Last season he led the attack of the Army Junior Championship team, and of the Army team that played in the Open Championship. He also played on the 1927 Cavalry School team in the Twelve Goal Tournament. His spectacular play stamped him as one of the most colorful players ever developed in the Army. By virtue of his phenomenal progress on Long Island last year, he was boosted from four to seven goals handicap by the United States Polo Association, a handicap only held in the Army by Captain Wilkinson and two of his team-mates, Captain Rodes and Captain Gerhardt. During the past winter Captain Wilkinson has been on duty at Fort Reno, Oklahoma, where, in addition to his other duties, he has aided materially in the special training of mounts.

Captain Charles H. Gerhardt, a member of last year's Army team, is an all round athlete by instinct and training. After his West Point days, when he played on the varsity football, baseball, and basketball teams, he turned his attention to horsemanship and polo, along both of which lines he has been uniformly successful. His playing at Fort Riley in 1924 attracted the attention of Major L. A. Beard who took him to England in 1925 as a member of the United States Army team, which defeated the British Army team in the second British-American Military Championship Tournament. In 1926 and 1927, Captain Gerhardt played prominently on the Army Junior Championship team. His most recent accomplishment in polo was his leading of the West Point Officers' team that won the Class A Indoor Championship of the United States in New York in April of this year.

Captain George E. Huthsteiner played back on the Army Junior Championship team last year, and the team entered by the Army in the Open Championship. He also played on the First Cavalry Division team which won the 1927 Twelve Goal Championship, and the Inter-Circuit Championship and Twelve Goal Championship in 1925. Captain Huthsteiner has been stationed in Texas for a number of years, and, therefore, has had an unusual opportunity to play continuously year in and year out. During the past winter he has been playing on the Fort Sam Houston team in the San Antonio Mid-Winter Tournament. He is a sturdy and experienced player.

Captain Chester E. Davis has reached the Army Squad by way of the Inter-Circuit Tournament. After having played on the Cavalry School and Fort Leavenworth teams during the past few years, he came east last summer as a member of the First Cavalry Division on teams that won the Twelve Goal Championship and reached the final in the Inter-Circuit Tournament at Narragansett Pier. In February and March of this year, he played on the Cavalry Division team that won the Southwestern Intra-Circuit Championship and Southwestern Handicap Elimination Tournament at San Antonio, Texas. Reports from those tournaments indicate that his playing during the past winter has been uniformly dependable.

Lieutenant Morton McD. Jones is a young player of promise who started his polo in Germany. For a number of years he played in San Antonio on the Eighth Corps Area Headquarters team. In 1926, he accompanied an Army team to Mexico City where the Americans were successful in winning all of their games. The following year he played civilian polo at Colorado Springs with the Houston Polo Club, and at Denver with the Denver Club. This past winter he has been in California with a First Cavalry Division team. Lieutenant Jones is an accurate stroker.

The above list will permit of a new team being trained for the National Junior Championship Tournament. This will give an opportunity for the training of further players and will widen the pool of selection for the British-American International Military Matches, probably next year. Captains Rodes, Wilkinson, and Gerhardt are included to form the nucleus of a team for the Senior Championship, Open Championship, and other high goal events, in order that they may have the added experience of one more season of fast polo prior to the British challenge. It is quite possible that some of the lower handicapped players brought on this year will give them a hard run for their places on the team.

In connection with the next British-American Military Tournament, which may be played in 1929, it has been suggested that the

British and United States Armies be represented by the champion regimental teams of the respective services, rather than by an all-Army team as in the past. While such representation may be desirable in Great Britain, it is not looked upon with favor from our point of view. The excessive distances separating some of our regiments, the interruption of training that would result, make almost impossible the holding of any kind of a tournament necessary for the determination of the championship regimental team of our Army. Also, the constantly shifting personnel of our American regiments prevents that permanency of line-up which is conducive to the quality of polo desired in international tournaments. Accordingly, the Committee does not share the opinion that the International Military Tournament would fulfill the purposes for which it was inaugurated in 1923, were it to be limited to a match between regimental teams representing the two countries.

Army polo enthusiasts are gratified over the success of the Cavalry Division team from Fort Bliss in the recent San Antonio Mid-Winter Tournament. Major Terry Allen led his four through the 1928 Southwestern Intra-Circuit Tournament and the 1928 Southwestern Elimination Handicap Tournament, winning both, thereby repeating the feat of the team which represented the Cavalry Division in 1925 and 1927. As a result the Southwestern Circuit will be represented by an Army team in the Inter-Circuit Championship to be held in Cleveland, Ohio, during the coming summer. In commenting on the play of his team, Major Allen stated "the principal asset of the team was its well balanced team-work." This opinion was confirmed by all who saw the games.

The Cavalry Division team lined up as follows:

Captain C. E. Davis	No. 1
Major Terry Allen	No. 2
Captain T. E. Voight	No. 3
Captain C. L. Stafford	Back

The scores for the Southwestern Intra-Circuit Championship were:

Air Corps Training Center 11	Twelfth Field Artillery 4
First Cavalry 13	Fifteenth Field Artillery 6
Fifth Cavalry 19	Fredericksburg 8
Austin 22	Stonewall 16
Camp Wood 13	Eighth Corps Area 12
Cavalry Division 15	Alamo Freebooters (San Antonio) 9
Air Corps Training Center 6	First Cavalry 5
Fifth Cavalry 12	Austin 11
Camp Wood 11	Ninth Infantry 8
Cavalry Division 10	Abilene 9
Air Corps Training Center 6	Fifth Cavalry 3
Cavalry Division 14	Camp Wood 11
Cavalry Division 12 (Finals)	Air Corps Training Center 9

The Southwestern Elimination Handicap Tournament resulted in the following scores:

Air Corps Training Center 24	Fifteenth Field Artillery 6
Fort Sam Houston 12	Alamo Freebooters 9
Twelfth Field Artillery 9	Stonewall 7
Fifth Cavalry 7	Austin 6
Fredericksburg 19	Ninth Infantry 4
First Cavalry 5	Abilene 4
Cavalry Division 14	Air Corps Training Center 7
Fort Sam Houston 20	Twelfth Field Artillery 7
Fifth Cavalry 13	Fredericksburg 6
Cavalry Division 16	First Cavalry 10
Fort Sam Houston 13	Fifth Cavalry 8
Cavalry Division 10 (Finals)	Fort Sam Houston 9

In a letter from Mr. F. S. O'Reilly, Secretary-Treasurer of the United States Polo Association, recently received, the Committee was informed that the Open Championship will be played at Meadow Brook Club in September. The Inter-Circuit and Twelve Goal events will be played at Cleveland, Ohio, approximately the last two weeks in August. The time and place of the Junior Championship have not been decided. With reference to the Junior Championship, the Committee has recommended that it be played on Long Island during the month of July.

Colonel Henry C. Whitehead, Quartermaster Corps, has been designated as the Polo Representative, Eighth Corps Area, Fort Sam Houston, Texas, to succeed Lieutenant Colonel William F. Jones, who has been relieved from duty at Eighth Corps Area Headquarters. Colonel Whitehead's experience in matters pertaining to the horse, and his interest in polo assures a continued enthusiasm in the game in the Eighth Corps Area, which boasts of more actual play, the year around, in the numbers of teams participating in games, than any other part of the country.

FOREIGN MILITARY JOURNALS A CURRENT RÉSUMÉ

FRANCE

"Revue d'Artillerie," November, 1927

Since the War, the French government has concerned itself actively with the development of trucks operated by gas generated from wood or charcoal. Subsidies have been granted in order to encourage construction and yearly competitions have been held. Lieutenant Colonel Mannessier, in his article, **"The 1927 Competition for Gas Generating Trucks,"** reports the results of the tests.

A bench test and a road test were given. The bench test required the motor to be run continuously for eight hours at normal speed and full charge, followed by three hours at variable speed and charge. In this test the consumption of fuel, the mean effective pressure, and the purity of the gas were measured. Also, the governors were regulated and sealed.

The road test required a march of 2500 km. (1550 miles) at about 60 miles a day over a route which included Paris, Troyes, Chaumont, Dijon, Lons-le-Saunier, Lyon, Clermont-Ferrond, Bourges, and Orleans. The minimum mean speed for pneumatic tired vehicles was set at 12.5 miles per hour; for others, at 10 miles per hour, except for the five ton trucks, whose minimum speed was to be 7.5 miles per hour, and each vehicle was required to tow another of the same type up a 5 per-cent slope.

Eight different types of three ton and five ton trucks competed. The combustibles used were kiln dried hardwood and charcoal. The bench tests were passed with ease. On the road tests the mean speeds attained varied between 15 and 16.5 miles for three ton trucks and between 10 and 12 miles for five ton vehicles. The slopes were negotiated at about 5 miles an hour.

The gas generating truck consumes 13.2 pounds of charcoal per ton-kilometer as compared with 1 gallon of gasoline for the ordinary truck. One quart of gasoline per day was allowed for starting motors in the test. This was not exceeded by any vehicle and two used no gasoline at all.

The average time for starting motors was about 10 minutes, although 20 minutes were allowed.

Improved filters which have to be cleaned only once or twice a week have rendered the gas as clean to use as gasoline and tests have shown it no more dangerous from a toxic standpoint.

"A Simplified Method for Calculating Initial Corrections," by Lieutenant Colonel Benoit. The employment of sudden mass fire of short duration is at present generally favored by artillerymen. The concentrations used in such fire will require battery commanders to make frequent changes of objective, and there will be little possibility of previous adjustment on the various targets. Hence, battery officers must be given a thorough training in map methods, in the calculation of corrections, and in transfers of fire.

Unfortunately, the calculation of initial corrections is a relatively long process, often too long to be used in the rapid shifts required. To meet these conditions, the author gives a means of quickly obtaining and applying corrections of a sufficient degree of accuracy.

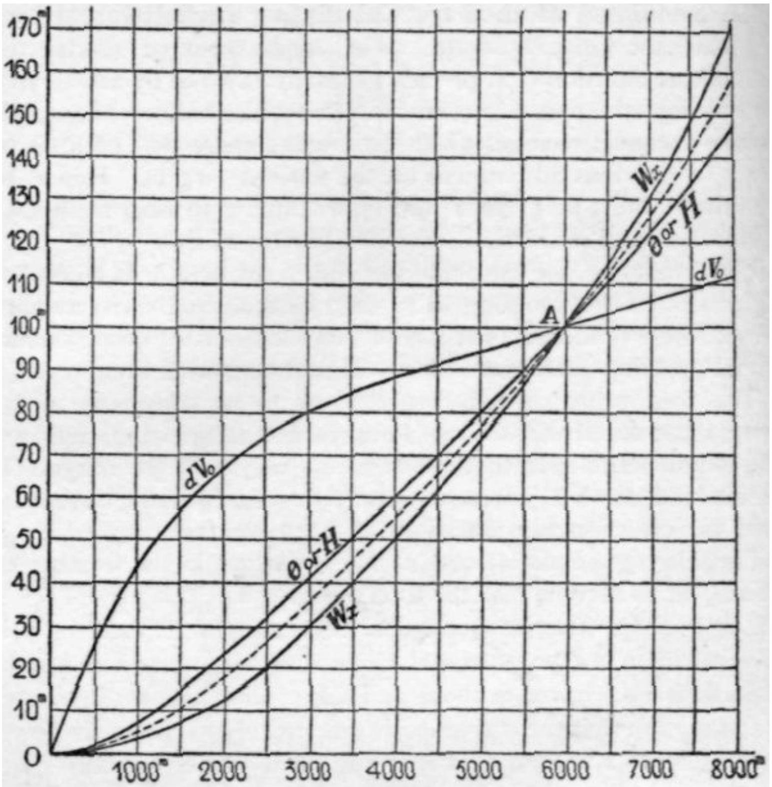
The four principal range corrections to be considered are, of course, those for air density, air temperature, range wind, and variations in powder temperature, all of which vary with the range. The position and matériel corrections may be calculated in advance or, in the rapidly changing situations of open warfare, neglected.

Considering a concrete case of the variations in the weather corrections, let us assume that the total correction is 100 meters for the M.I. shell, short fuze, at a range of 6000 meters. From the firing tables calculate the proportional correction for every five hundred meters difference in range above and below 6000 meters; first, under the assumption that the correction is due entirely to change in powder temperature dV_o, second, that it is due entirely to either atmospheric temperature (θ), or density (H), and third, that it is entirely a range wind effect (W_x). The results are plotted in Figure A.

It will be observed that the curves of the temperature, pressure, and wind corrections conform closely to one other, but that the dV_o curve is distinctly different. Hence, it is preferable to consider the dV_o correction separately if dV_o is known or if it can be approximated. This correction changes little at ranges greater than 3000 meters and in open warfare a mean value may be used without great error. In stabilized situations, the value of dV_o can usually be verified by registration. In any case, since the powder temperature is ordinarily known only approximately, by choosing a mean powder temperature for the season, the dV_o correction may be calculated in advance and applied along with the corrections for site, weight of projectile, etc.

The corrections for wind, atmospheric temperature, and atmospheric pressure remain. Their combined value may be obtained from the chart. The use of a mean value for the three introduces no great error, especially at the mid and long ranges where the mean error is only about one tenth of the total correction.

CORRECTIONS



RANGE
FIGURE A

The following tables give the values of the corrections plotted in Figure *a*. Table A applies to normal shell and shrapnel. It is figured on the basis of a total correction of 100 meters at a range of 6000 meters. Table B gives the values for long range shell, using a base range of 9000 meters.

TABLE A

Nature of corrections	Value of Corrections for Ranges Shown																
	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500
dV_o	25	43	56	66	74	79	85	88	91	94	97	100	103	106	109	112	114
Mean atmospheric correction............	1	5	11	18	26	36	45	55	65	76	88	100	113	126	142	159	175

TABLE B

Nature of corrections	Value of Corrections for Ranges Shown																
	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500	9000	9500	10000	10500	11000
dV_o	60m	67	72	77	81	84	87	90	92	94	96	98	100	103	105	108	110
Mean atmospheric correction............	20	25	30	36	42	49	56	62	70	77	85	92	100	108	117	128	141

The correction for wind is included in the mean of the atmospheric corrections in spite of the fact that the longitudinal component varies with the direction of fire. On the offensive, the general direction of fire varies little and we may calculate W_x for the mean direction of the zone of action. On the defensive, mean values must be calculated for the various sectors covered.

With the values given in Tables A and B, we may construct charts for quickly obtaining the corrections desired. An origin is chosen and ranges laid off along the Y-axis at distances proportional to the numbers 1, 5, 11, 18, etc., *i.e.,* the atmospheric corrections from Table A. Equal distances are laid off along the X-axis to represent the values of the total corrections. The chart for the long range projectile is constructed from the values given in Table B. The variations of dV_o in Tables A and B may be combined in a single table for all types of projectiles. In a similar manner, a chart giving sufficiently approximate dV_o corrections may be constructed. (See Charts A, B, and C.)

Having these charts, we now calculate the total corrections of the moment for our chosen base range using the most accurate meterological data available. Then, laying off this correction on the base range line and drawing a diagonal from the origin to this point, we may obtain the correction for other ranges by measuring along any given range line to the diagonal. For example: Just prior to an attack, a battery is given a certain number of objectives within its normal zone of action which covers 400 mils. The captain prepares his fire, calculating at once his position and matériel corrections, also his dV_o correction using a probable powder temperature estimated for the season. Using the latest meteorological data, he then performs the following operations:

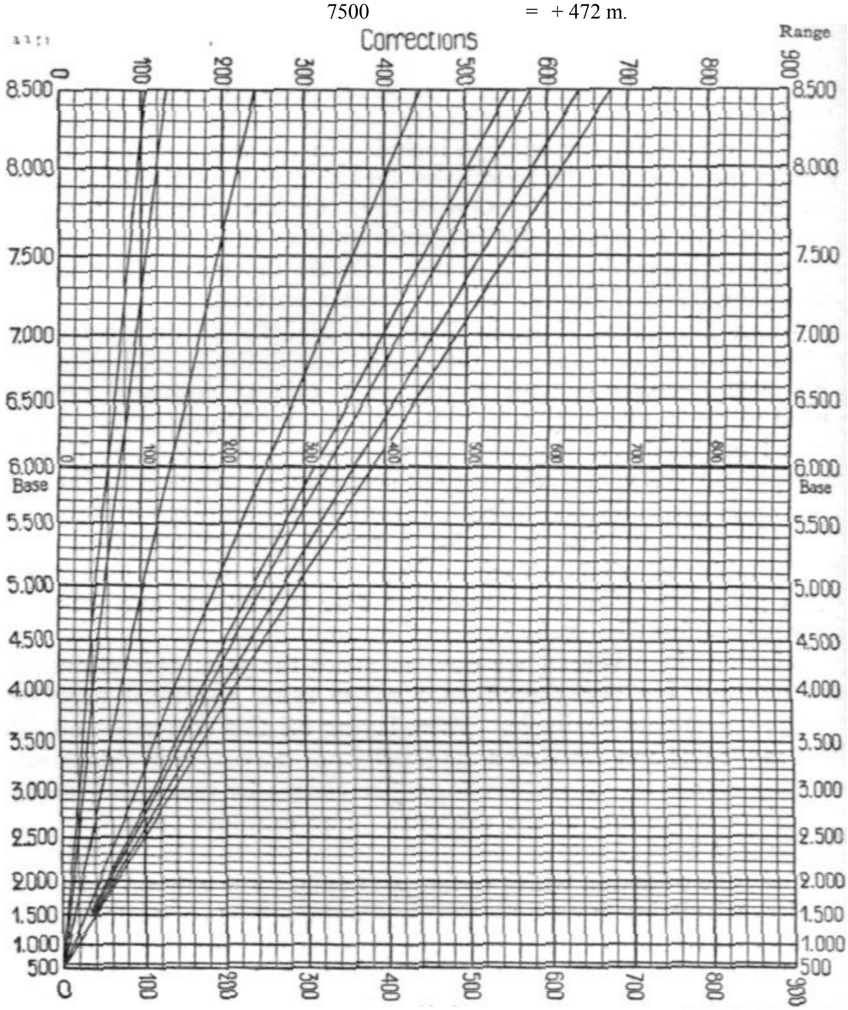
1. Calculates the wind component correction, W_x, for the mean direction of his objectives.

2. Calculates the total correction for his mean range, say 6000 meters. Suppose this correction to be plus 331 meters.

3. Draws a diagonal line from the origin to point 331 on the 6000 meter line. Reads the corrections for other ranges at the intersection

of this diagonal and the range line considered. If the ranges to be used are 2400, 4500, and 7500 meters, the corrections, read at once from Chart A, are:

Range 2400 m., Correction	=	+ 80 m.
4500	=	+ 215 m.
7500	=	+ 472 m.



Corrections

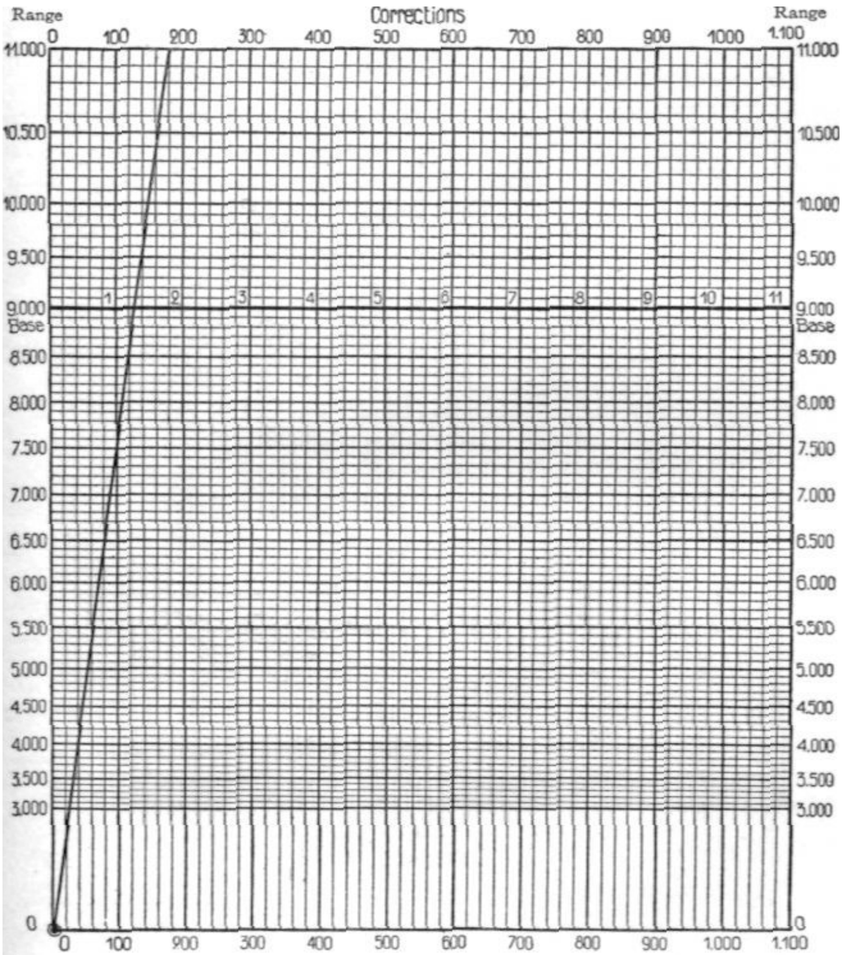
CHART A

Base range, 6000 m.

The results obtained by the usual calculation from the firing tables are:

Range 2400 m., Correction	=	+ 75 m.
4500	=	+ 215 m.
7500	=	+ 492 m.

The errors introduced by the use of the chart will not amount to more than about one-tenth of the total absolute value. If the inevitable uncertainty of the meteorological data and the approximations introduced



CORRECTIONS

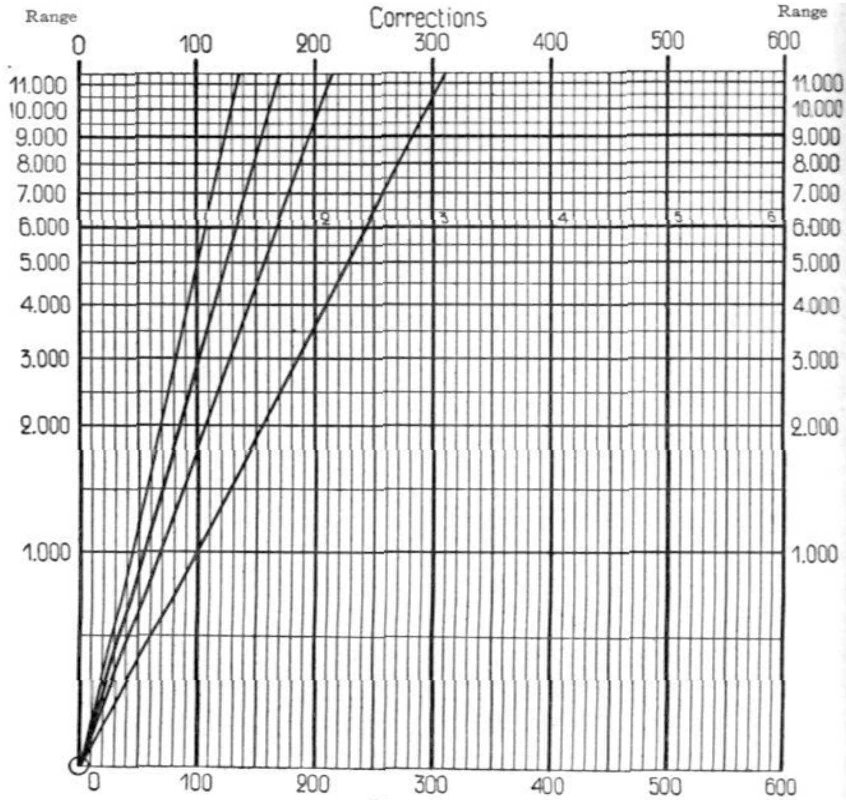
Base range, 9000 m.

CHART B

in the firing table calculations are considered, we may conclude that the method can be applied without misgiving. Of course, if there is one objective only, the correction should be calculated from the firing tables. With many objectives to be fired on, the use of the chart will prove of great advantage.

Transfers of Fire

The French regulations give three methods for transfer of fire, the simplified method for rapidly changing situations, the K method, and the dV_o method. In the simplied method, the correction obtained by registration



Correction

Base range A, 6000 m.
Base range B, 9000 m.

CHART C

on one target is applied without change in firing on other targets. The other methods need no description. Of these, the dV_o method is best, though the K method is usually employed.

In all three methods, the correction varies considerably according to the cause to which it is attributed. For example, the simplified method is best if the correction is caused entirely by a change in powder temperature (dV_o). But if it is due to a change in atmospheric temperature or pressure, the error becomes considerable. The

K method gives a proportional correction between the dV_o correction and the atmospheric correction. Both these methods are only roughly approximate.

The dV_o method provides for stripping the range according to the latest meteorological data available and is the best, but its accuracy depends on the correctness of the data received. In general, owing to sudden and large variations in which the wind is the chief factor, all meteorological data more than fifteen minutes old must be considered doubtful. For this reason, it appears better to utilize a value of dV_o based on the season and on previous firings. An experienced battery commander can make this estimate accurately to within 5 or 6 meters and, once determined, the estimated value is considered a constant factor necessitating no complex measurements prior to firing.

If the value of dV_o is known within 5 or 6 meters, the problem of transfer of fire is much simplified. It is only necessary to prepare the firing data, correcting for matériel, position, and dV_o (evaluated from the tarage tables for the powder lot used, corrected by previous firings of the battery and for the mean temperature of the season). With these data, adjust on an auxiliary target. The difference in range obtained will be attributed to atmospheric causes entirely and treated according to their law of mean variation given graphically by Chart A or B according to the projectile used. The correction is laid off on the proper chart at the range of the auxiliary target and the diagonal drawn from the origin to this point gives the corrections at other ranges.

Example: A battery of 75's receives a number of targets, B_4, B_2, B_3, etc., to be attacked with shell, short fuse. They are situated within a 400 mil field of fire and their map ranges are as follows:

R_1	=	3830 meters
R_2	=	4680 "
R_3	=	6920 "

The auxiliary target (B) is chosen near the center of the zone and at a range (R_4) of 5150 meters.

The captain calculates the corrections for site, weight of projectile, and dV_o. The dV_o is corrected for the mean seasonal temperature. In this example its corrected value is — 33 meters. With this value, we obtain the corresponding range correction for the base range (6000 meters in this situation) from the firing tables. Laying off this correction of + 241 meters on Chart C (the chart giving corrections due to dV_o for all types of projectiles) we join it to the origin by a diagonal and then read the values of the correction due to dV_o at the ranges desired, as shown below:

For R_1, the dV_o correction = + 203 m.
R_2 = + 221 m.
R_3 = + 253 m.
R_4 = + 228 m.

The following table is then constructed:

TABLE C

OBJECTIVES.	B	B_1	B_2	B_3	B_4
Map Range dV_o correction	5150m +228	3830m +203	4680m +221	6920m +253	
Corrected range	5378	4033	4091	7173	
Atmosphere correction given by adjustment	– 353	– 230	– 305	– 550	(1)
Adjusted range	5025	3803	4596	6623	(1)

(1) The values in the two last lines are obtained after the adjustment.

The adjustment on the auxiliary target is then made and the difference between the adjusted range and the corrected range gives the atmospheric correction to be applied. Laying off this correction (—353) on Chart A at the range of the auxiliary target, 5150 meters, we obtain a diagonal from which the corrections at the other ranges are obtained, as given below:

B_1, – 230
B_2, – 305
B_3, – 550

Using these values in the table, we obtain the adjusted ranges shown there.

The accuracy of the method depends on the exactness with which dV_o is obtained. It is much shorter than the usual V-V_o method and is more exact as soon as the meteorological data becomes doubtful, as it replaces the meteorological data by the fire for adjustment. Of course, if the value of dV_o can not be ascertained, one of the other methods must be used.

December, 1927

General Estienne completes his **"Introduction to a Rational Theory of Errors in Measurement"** which should be of interest to students of probability and dispersion. He shows by theory and by the results of experiment that:

1. The choice of a unit of measurement greater than one half the mean error of measurement $\left(\frac{e}{2}\right)$, prevents the utilization of all the precision permitted by the instrument used.

2. The choice of a unit less than $\frac{e}{2}$ is of no advantage but causes no particular inconvenience except a complication of the reading.

3. The maximum approximation that may be attained is within $\pm\frac{e}{4}$ of the true value. The number of measurements necessary to attain this precision is determined by the experience of the operator. After a certain number of measurements, the operator perceives that by prolonging the series he will only obtain the mean between two numbers which vary by approximately $\frac{e}{2}$.

General Estienne also shows that, owing to constant errors of which the operator is unaware, a series of observations made under exactly identical conditions may be precise without being equally accurate. The utility of a large number of measurements made under such conditions may often be less than that of a shorter series systematically varied in order to compensate for the operator's constant error.

If, as is indicated by experiment, $\frac{e}{4}$ is the ultimate limit of approximation to be expected, a further increase in precision can be attained only by improvement of the instrument used. Hence, as many experienced operators now maintain, the time and money expended in long repetitions and costly calculations could, perhaps, be better spent in refinements of matériel.

General Camon in his article **"The Problems of Motorization"** states that a motorized army will have immense strategical and tactical advantages over one not so equipped. It can concentrate much more rapidly and can remain longer on the field of battle owing to the invulnerability of the motor as compared to the horse, especially its invulnerability to the action of gas. However, a certain number of problems must be more satisfactorily solved before motorization can be a complete success. The principal ones have to do with fuel, matériel, and costs.

The lack of natural oil reserves in France often serves as an argument against motorization. A war condition, however, would show a similar shortage in horses and in forage. Also, other sources of motor fuel exist, such as beds of oily shale and lignite and the by-products of coke ovens. Moreover, constant research and improvements are being made in the development of motors utilizing compressed methane from the blast furnaces and the gases generated by the distillation of wood and charcoal. Finally, effective oil burning motors of the Diesel type are being developed.

It may be stated as a principle that the matériel necessary for mobilization must be on hand in the nation at the moment when war is declared. The number of passenger and cargo vehicles in general use would meet the demands of mobilization but, at present, the cross country vehicles required are not on hand in sufficient number.

The problem of artillery motorization is particularly difficult as the pieces must be transported both on roads and across country. Portée artillery as developed during the War offers one solution. However, the weight is great and the cost is large, as two motor vehicles, a truck for roads and a tractor for cross country, are required. A simpler solution would be the utilization of farm tractors with wheels transformable for use on or off roads. Wheel arrangements of this sort have been provided for the Fordson and other commercial tractors. Special gear ratios must be provided to secure proper road speed for the artillery of the general reserve. The tractor must be sufficiently light to cross improvised bridges and should be furnished with a winch. General Camon believes that the motor-cycle with side car is the ideal reconnaissance vehicle.

The cost of motorization is considerable. In time of peace, however, the army requires only those vehicles necessary for training and for equipping the active units. Also, a considerable stock of motor matériel remains from the War. Finally, the change must be made by increments as the 157,000 animals now on hand in the army can not be replaced at one time.

Without doubt motors consume fuel but they do so only when in use. In this connection, the 1927 budget provided 357 million francs for horse supply and upkeep.

In conclusion, the author states that the change must be made if France is to keep abreast of other nations. "What a saving in upkeep and overhead! What a great simplification in training! The change must come and our officers must ardently devote themselves to the task of preparing a truly modern army for France."

In his **"Diary of an Artilleryman in Morocco,"** Lieutenant Colonel Mazen writes interestingly of the part played by the artillery of the 11th Division in the 1925-26 campaign against the Riff. Fifteen batteries, mountain and light, 65's, 75's, 155 H, and 155 L, constituted the artillery force supporting twenty-three infantry battalions. With no roads and few trails available, the pack artillery alone was able to follow in close support of the infantry. However, it was kept under divisional control and not dispersed as accompanying artillery. This necessitated close liaison with both infantry and higher artillery headquarters.

Roads had to be constructed for the movement of horse drawn artillery, making displacement extremely difficult and tedious. Entire freedom of choice of route and position was allowed, however, for the enemy had neither guns nor aviation. Concentration of positions was the rule in order to facilitate security and communication. For example, on one occasion a groupment of four batteries of 75, one battery of 155, and one battery of 105 was placed in position for direct fire with all batteries close enough together to be controlled by the voice of the groupment commander.

The wide fronts, the unusually broken terrain, and the lack of telephone matériel made visual signalling of major importance. Liaison with the infantry was secured by direct observation and visual signals.

Mass fire was the rule in Morocco: observed concentrations on skirmishers, trenches, machine guns, etc., and zone fire on fleeting targets of which many were revealed to the trained observer. Maps were few and inaccurate, hence map firing was rare. Airplane shoots were frequent. The best results were obtained by laying on the plane and quickly firing two salvos, 400 meters apart. Sensings on the better of the two salvos were reported immediately.

Observation posts were at times 4500-6000 meters from the guns, necessitating visual communication—arm signals, heliograph, and blinker. Arm signals could be used up to 4500 meters. The heliograph gave excellent results, being visible to the naked eye at 7, 8, and even 10 kilometers.

Care of animals was difficult. Some batteries lost a third of their horses from exposure and lack of food and water. Many horses were lost through accident on the steep and insecure mountain trails. Pack mules were attached to horse drawn batteries to carry observation instruments, telephone equipment, officers' baggage, also daily supplies and ammunition.

"Revue Militaire Francaise," January—February, 1928

In his article *"Anti-avion Artillery,"* Commandant Vauthier reviews the principal rules which govern the employment of that arm and outlines a plan of anti-avion organization. Throughout his article he attempts to clear away the haze of mystery which seems to conceal from the uninitiated the employment and technique of anti-avion artillery. He remarks that the average Field Artilleryman should be able to understand the employment of anti-avion artillery after a few hours study and that a few days application should enable him to master its technique.

Commandant Vauthier, to support this assertion, compares the employment of Anti-avion and Field Artillery and concludes that the

Field Artilleryman has a much more difficult task. The observation post of an anti-avion battery is at the guns. Therefore the observer is not concerned with offsets. Since the anti-avion artilleryman has no masks or minimum ranges to consider, he is independent of the terrain; he can choose any battery position which is accessible to a road and which is hidden from enemy observation. Whatever emplacements he chooses, his preparation and conduct of fire always follow identical rules.

Anti-avion Artillery has two missions: (1) to defend the friendly troops from the enemy planes, and (2) to help the friendly combat planes by signalling to them the presence of enemy planes. Of these two missions the most difficult is the first because it necessitates a continuous observation of the sky and an intimate liaison with the ground troops. To simplify this problem Commandant Vauthier advocates the assignment of anti-avion units to infantry divisions and to army corps. The second mission, which consists in helping the combat planes, is comparatively simple. To carry out this mission it is sufficient that the anti-avion batteries be warned of the hours of passage and the zones of action of the friendly planes, in order that they may avoid firing during those hours or in those zones.

The organization of Anti-avion Artillery is more difficult than its employment. The most important questions of organization are those which concern the matériel, the allocation of batteries to large combat units, and questions of personnel.

As to matériel, the types of armament vary with the types of targets, that is to say types of hostile planes. All planes may be divided into two classes: planes of regular and those of irregular speed and direction. In the first class are reconnaissance, observation and bombing planes. They fly at high and medium altitudes (above 1000 meters), and follow straight lines or regular curves. In the second class are combat planes and those planes which fire on ground troops from low altitudes. There are then two corresponding types of anti-avion armament: (1) medium or large caliber guns for use against planes of the first class, for police of the higher and medium altitudes, and (2) pieces of smaller caliber for use against the fast moving planes which fly at lower altitudes.

For the first type of armament Commandant Vauthier advocates a heavy type of gun which requires motor traction. For the second type a lighter gun of a maximum weight of 3 tons, whose tube, ammunition, and traction make it suitable to accompany an infantry division.

The second problem in organization, that of assignment of anti-avion artillery to large units, Commandant Vauthier solves by allocating to each infantry division and to each army corps 1 battery of

4 light guns, and 1 group of 6 automatic weapons. In addition to these assignments the general reserve of anti-avion artillery will include the batteries of heavy anti-avion artillery.

In discussing the third problem of organization, that of personnel, Commandant Vauthier again compares the anti-avion artillery to field artillery. He shows that more specialists are needed in a battery of field artillery than in an anti-avion battery. By specialists in field artillery he refers to gunners, instrument operators, and officers conducting the fire. He places the number at 12 in a light artillery battery. In an anti-avion battery of 4 guns he names 8 specialists: 2 officers conducting fire, 2 telemeter operators, and 4 operators of listening apparatus. The rest of the personnel such as recorders and gun pointers are not specialists since they can be trained in a few days or weeks.

In conclusion, Commandant Vauthier again calls attention to the simplicity of the employment and organization of anti-avion artillery and believes that it will continue to be simplified with increased utilization of machinery and mechanical devices.

"The 2nd Infantry Division of the Prussian Guard on the 21st and 22nd of August 1914," by Commandant Maury ends in the January issue. The principal lesson learned from the study of this engagement is that the artillery on both sides proved to be incapable of preparing and supporting the attacks of the infantry. The causes were several: the extension of the field of battle since the last European war, more open formations adopted by the infantry to offset the increase in artillery power, and decrease in the visibility of infantry firing lines due to the use of smokeless powder. The artillery was poorly informed of the position of their own infantry lines and fearing that their fire would fall short the artillery picked out distant targets for demolition, thereby neglecting to fire on the advance elements of the enemy infantry.

The two infantry bodies as a result stopped each other's attacks with automatic weapons which were unmolested by Artillery fire. Neither infantry could successfully advance. The side which won and wore out its opponent was the one that remained on the defensive.

"The Question of Tangiers," by Commandant Galy is a discussion of the claims advanced by the various powers to strategical, commercial, and political rights in Tangiers.

Tangiers, which is to the southwest of the strait of Gibraltar on the road to the east and at the portal of Morocco, has a strategic and political importance which causes this international conflict.

Holding Gibraltar and controlling the navigation through the strait, England sees in Tangiers a possible menace to British naval supremacy in general, and in particular to free communication with the Mediterranean and the East. For England then, Tangiers has an importance which is purely strategical.

Spain looks upon Tangiers as a future great port and an important tourist center. Her claim is based on geographical and historical rights.

Italy sees in Tangiers a means of expansion, a colony for her overflow population.

Finally, France, protector of Morocco, is interested in Tangiers as the terminal of the great Fez-Tangiers railroad, and as the principal port of Morocco on the Mediterranean.

In **"Lessons in Aviation Learned from the War in Morocco,"** Colonel Armengaud points out certain lessons learned from the Colonial war.

The aviation in Morocco at the beginning of the campaign of 1925 had many tasks, all of which it performed creditably. It maintained communication between the outlying posts and the high command, and carried supplies to these posts. It carried out continuous reconnaissance. It opposed the advance of the revolting tribes as they broke through the line of posts and marched on Fez. It supported the mobile groups of land troops.

As a covering force the aviation proved to be the most effective arm in this Colonial warfare. Because of its great mobility and its large radius of action it was able instantly to mass at critical points. Although the aviation alone was unable to hold terrain it was able to transport detachments of combat troops to critical points and work in liaison with these land forces.

Colonel Armengaud believes that these same characteristics and capabilities that the aviation exhibited in Morocco will exercise a great influence in any future European war. Airplanes will greatly increase the defensive strength of a line lightly held by land forces. It will be invaluable in a holding action in a situation similar to the one which confronted the Allies in Belgium in 1914.

Commandant Girves reviews political and military **"Events in China"** for the year of 1927.

A few years ago, a Russian envoy, Borodin, and several technical advisers were sent by the Soviet Republic to Sun-Yat-Sen, chief of the Canton Government. Borodin's influence soon spread rapidly throughout southern China, and he circulated soviet propaganda by means of workers' and peasants' unions. Under the strict discipline of their Russian advisers, the Cantonese had a series of successes, and on the 24th of March, 1927, they entered Nankin, completing the occupation and control of that part of China south of the Yangtze river.

Although the workers and peasants were enthusiastic followers of Borodin, the Chinese generals, particularly Chiang-kai-Shek, grew tired of fighting for mere principles, especially when the principles were those of Karl Marx. In April, Chang proclaimed his independence of his Soviet advisers, and led the movement of disunion in South China.

Commandant Girves continues to trace the events which led to the present chaotic condition in all of China and particularly in southern China.

In conclusion Commandant Girves points out that the Russians have succeeded no better than other foreigners who have tried to lead the Chinese into organization. The Chinese leaders do not trust their foreign advisers and, casting them off, repeatedly fall into disorder and disunion. China seems less and less able to organize a government unaided, and fears any foreign intervention which might aid it in its work of unification.

Other articles appearing in the January and February numbers are: "The Organization of Terrain in the Champagne sector during the World War," "In French Morocco in 1925," and "Serb Victories in 1914."

CURRENT FIELD ARTILLERY NOTES

Field Artillery Ammunition Allowances and Quarterly Reports of Target Practice

ARMY REGULATIONS NO. 775-20, 1928, give the new Field Artillery ammunition allowances at present effective. As will be seen from the condensed table shown, allowances have been drastically cut. Allowances of 37-mm. low explosive shell have been added. Mountings for the 37-mm. are not yet available but will be produced as soon as possible by the Ordnance Department. It is expected that they will consist of the standard 37-mm. tube and recoil mechanism, externally mounted on the Field Artillery matériel.

The allowances as shown may be varied from year to year by the "Annual Conversion Factor." The allowances as given in Army Regulations 775-20, multiplied by this factor, give the actual allowance for the year in question. The factor for this year is unity. In the future, this factor may be greater or less than unity, depending upon the ammunition available for issue and the funds appropriated by Congress.

In many cases substitutions of other calibers or types for the specified ammunition on the basis of equal money value of the allowances may be made, except that in most cases 37-mm. allowances can not be converted into other calibers. In some cases smoke shell may, subject to certain restrictions, be substituted for other ammunition on the basis of equal money value. When 3-inch guns are available, the maximum practicable substitution of 3-inch ammunition, round for round, for the 75-mm. ammunition of the same type will be made.

The target year of each command and activity has now been changed to be coincident with its training year.

Field Artillery Memorandum No. 10, November 30, 1926, relates to Field Artillery target practice, to the Quarterly Report of Field Artillery Target Practice (Form 820), and to the accompanying Reports of Problems (Form 820-A). This memorandum appeared in Information Bulletin No. 86, for the information of National Guard and Reserve officers not receiving it by official distribution.

Form No. 820 (Revised January 9, 1928) differs somewhat from that previously used and is shown in reduced size.

FIELD ARTILLERY AMMUNITION ALLOWANCES
A. R. 775-20, 1928

				75-mm., 3″, and 2.95″				
	8″ or 240-H.	155-mm. Gun	155-mm. How.	Shp.	Shl.	Total	37-mm. L.E.	Cal. 30 Sub-Cal
Regular F. A.								
Btry. Officer, less than 5 yrs. serv. etc.	*14	*16	*20	36	24	*60	100	
Capt. or Lieut., more than 5 yrs. serv. etc.†	*10	*10	*14	28	20	*48	100	
Capt. or Lieut., D.O.L.				24	18	42	20	
Chief of Field Artillery				1000			1000	
Field Artillery School	50	50	500	3000	1000	4000	1000	
Student, F.A.S., B.O.				180	120	300	72	
Student, F.A.S., Adv.				100	50	150	60	
Student, F.A.S., Sp. Course				80	40	120	60	
75-mm., 3″, or 2.95″ Btry.								2000
Reserve F. A.								
Officers, Btry. grade, assigned to Active Regular Army units				24	18	42	20	
Other officers (Btry. grade)				12	8	20	20	
Students, N. G. and R., B.O. Class, F.A.S.				80	40	120	60	
Students, N. G. and R., F.O. Class, F.A.S.				40	28	68	60	
Regt., Medium or Heavy, F. A. Reserve	8	16	32				500	
Btry., 75-mm., 3″ or 2.95″ (Reserves)							500	2000
Btry., Medium or Heavy (Reserves)							250	
R.O.T.C. Student, F.A.				6		6	20	
C.M.T.C. Blue Candidate, F.A				4		4	20	
C.M.T.C. Camp (Minimum allow.)				40		40		
C.M.T.C. Camp (Maximum allow.)				100		100		
Service Schools								
A.C. Adv. Flying Sch., per student officer				12	48	60		
Cavalry School				400	240	3640		
Infantry School				1500	1500	000		
Chemical Warfare School			50-S 30-G		510-S 90-G			
U. S. M. A. for Combat Exercises				100	100	200		
per Cadet, 1st class				6		6	48	

* Alternative allowance, depending upon type of materiel.

† Graduates of the Field Artillery School are classed with those having over 5 years of Field Artillery service.

WAR DEPARTMENT
OFFICE OF CHIEF OF ORDNANCE
FORM 820
REV. JAN. 9, [illegible]

(TO BE SUBMITTED IN DUPLICATE)

QUARTERLY REPORT OF FIELD ARTILLERY TARGET PRACTICE

(See instructions on reverse side before filling out this form)

(Organization) (Place) (Date)

(Caliber) (Model) (Quarter)

Kind	Number of rounds expended during quarter chargeable to allowance of—						Gun No.	Total rounds fired to end of last quarter	Rounds fired during quarter	Total rounds fired to date
	Reg. Army F. A.	Org. Res. F. A.	R. O. T. C. F. A.	C. M. T. C. F. A.	N. G. F. A.					
Shell, H. E.										
Shrapnel										
Other types										

Projectile	Rounds fired	Type of fuse	Number of duds	Number of low orders
Shell, H. E.				
Shell				
Shrapnel				

Comments on functioning of materiel and ammunition

Sights and instruments were adjusted prior to each practice

Commanding Battery.

1st Ind.

INSTRUCTIONS
(On reverse of Form 820)

1. This form is to be used as the cover page only of the collected reports of problems of any battery for a quarter.

2. To be submitted in duplicate through military channels, to the Chief of Field Artillery, on January 1, April 1, July 1, and October 1 of each year by commanding officers of Field Artillery batteries; one copy to be retained by the Chief of Field Artillery and one forwarded by him to the Chief of Ordnance.

3. Intermediate commanders in their forwarding indorsements will make a further report consisting of general remarks and recommendations on the conduct of the practice, the functioning of matériel, and other matters connected with the practice held by their commands during the quarter.

4. If no firing was held during the quarter, the Commanding Officer will so state, using this form.

5. Par. 6, AR 45-30, prescribes the action to be taken with reference to malfunctions of, or defects in, ammunition, in order that detailed information may be available to the Chief of Ordnance as soon as practicable. The information to be furnished on this form is of a more general character and should indicate whether the ammunition is generally satisfactory or unsatisfactory from the standpoint of the Field Artillery.

Premature, including unexpected shrapnel bursts within 500 yards of the gun, and all bursts of shell before impact, will be reported under "Comments."

6. This report will be typewritten.

WAR DEPARTMENT
OFFICE OF CHIEF OF ORDNANCE
Form 820A

(a) REPORT OF PROBLEM No. ________ ________ QUARTER, 19____

(See instructions on reverse side)

(b) ________ (Organization) ________ (Date) ________ (Location of Range)

(c) Officer firing ________ Rank ________

Years commissioned service in F. A. ________ F. A. Schools attended ________

(d) Tactical description of target. Draw diagram showing width in mils and direction of wind.

(e) ORIGINAL DATA	HOW OBTAINED	INITIAL ERROR
Def. ________	________	________
Site ________	________	________
Range ________	________	________

(f) State in yards location O. P. with respect to battery. (If lateral, give angle i) ________

(g) Were commands given in proper sequence? ________

(h) Method of adjustment ________

(i) Method of fire ________ Fuze used ________

(j) Final bracket or adjusted range ________

(k) Show graphically final distribution in relation to target and width of sheaf in mils:

(l) Give ratio airs to grazes in final salvo or volley ________

(m) Would final command give proper range, distribution, and height or burst? ________

(n) Comments of officer critiquing the fire ________

________ (Name) ________ (Rank)

(o) General comments of officer supervising practice ________

8—8016 ________ (Name) ________ (Rank)

As a result of the analysis of the firing reports for the year 1927, in the Office of the Chief of Field Artillery, the following notes were prepared. These relate to Form 820-A, which is also shown in order to give the sub-headings mentioned in the notes. No change is contemplated in Form 820-A except the omission of the instruction (on reverse of Form 820-A) "for headings of paragraphs use simply the letters found on the left edge," (see par. 2 of following notes):

Points to be Noted in Preparing Firing Reports on Form 820-A.

1. Use a separate sheet for each problem.
2. It is better to mimeograph the whole form (820-A), rather than to use only the sub-paragraph letters. The latter practice, while in accordance with instructions printed on the back, has led to very sketchy reports, often incomplete.
3. State the tactical situation of the target: give its width in mils; and indicate direction of wind. In stating the target the purpose is to require the officer conducting fire to decide upon the ammunition to be used, the method of fire, the size of bracket, the necessity for great speed or not.

   Failure properly to designate the target is an error on the part of the officer directing the fire (the critiquing officer), and any error in this connection should be pointed out by the supervising officer.
4. Under (e) fill in the entries under "how obtained" and "initial error." This information is of value to the Office of the Chief of Field Artillery in understanding training practices in the command.
5. From entries under sub-paragraph (f) it is desired to obtain a picture of the dispositions, Guns—OP—Target. In all problems not axial give angle *i*.
6. Under sub-paragraph (h) the remarks entered should show, in part, the decision of the officer conducting fire, and also add to the information given under (f), *e.g.*, "Axial time bracket," or "Lateral percussion bracket," or "Forward percussion precision," etc.
7. Under (i) should be entered the pertinent command given, *e.g.*, if the officer fired by piece, by platoon, and by battery, the entry might read, No. 1 only, then R P S R, then B S R. This gives all the information desired.
8. Entries under (k) are often overlooked, and seem to indicate a failure to provide a means of obtaining this data; carelessness, in other words. Often a distribution less than half enough will be passed unnoticed by the critiquing officer. He should be critiqued on this error by the supervising officer.
9. Probably no remark is made with less care than that under sub-paragraph (m). Reports have been examined where the officer never got a graze burst and yet the entry under (m) is *yes*. The tendency in shrapnel fire is to get the bursts too high:—there must be a percentage of grazes, and not all from the same gun. A good remark under (*m*) was the following,

"No, sheaf narrow and No. 2 out of sheaf." This entry is the final estimate of the officer directing fire and should give his opinion of the solution.

10. Under sub-paragraph (n) the critiquing officer summarizes his critique for the information of higher commanders and the Office of the Chief of Field Artillery. Few problems are perfect, but remarks under (n) would often give that impression. These remarks vary with the experience, interest and ability of critiquing officer. Such remarks as "very good," "well handled," "good problem," "no comments," convey no real information. They are often made on problems, the reports of which show that officer used wrong fuze, had sheaf too narrow, and fired from wrong flank. The supervising officer, if fully in charge of instruction, should critique the errors made by the critiquing officer.

11. In many commands a battalion commander or a designated captain will critique practically all problems. It must be remembered that all firing is for instruction and that all captains and many first lieutenants are officers of more than ten years' service. They should fire and they should direct fire (critique). If the supervising officer considers himself as critiquing the entire problem, including the critiquing officer, better results will be obtained.

12. The Supervising Officer should never make perfunctory remarks. As stated above, he has the general conduct of the problem in mind. Also he observes the functioning of communications and of the firing battery. If an officer does not fire a good problem, the critiquing officer should state (if it is a fact, as it should be, invariably), "Officer qualified in preliminary instruction." For the meaning of this remark see F. A. Memo. No. 10. The following is an entry which might be made by the supervising officer:—"Slow and deliberate; wasted ammunition by not taking obvious sensings; qualified in preliminary instruction; first firing of service ammunition since return from DOL. Battery and communications functioned O. K."

Recent Developments In Wire Laying Equipment

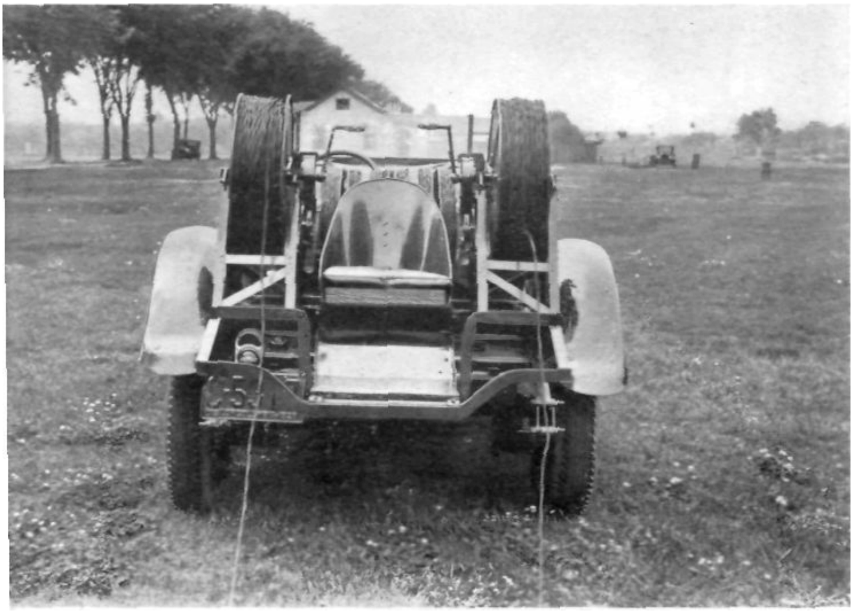
The Signal Corps has been charged with the development of wire laying vehicles as part of the communications equipment, and has made considerable progress with these vehicles during the past year. Perhaps the major developments in this category have been the design and construction of two experimental models of a wire laying car and the design of a new horse drawn reel cart, experimental models of which are now being procured for test.

Wire Laying Car

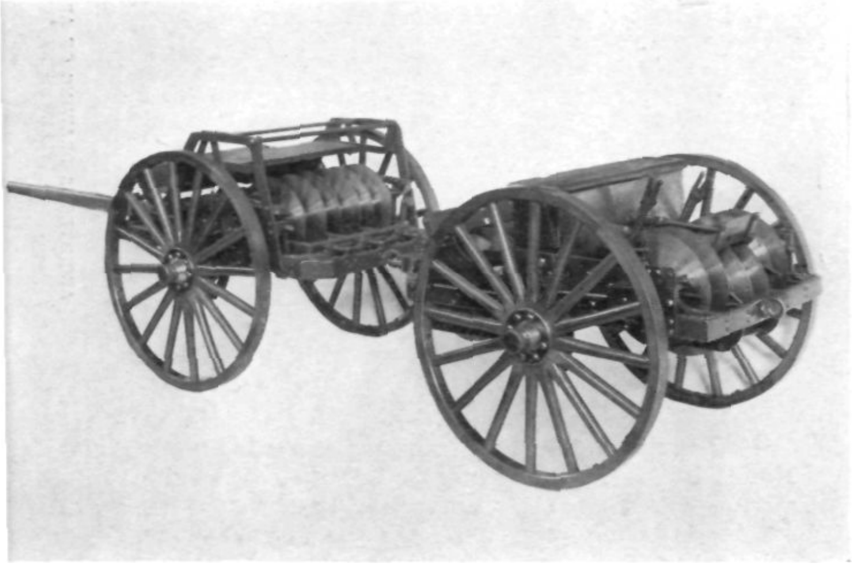
In the fabrication of the wire laying car the chassis employed was that of the commercial Chevrolet. Aside from the fact that wire laying equipment and a single bucket seat are mounted on this chassis in place of the two rear bucket seats, the vehicle is essentially the standard four passenger cross country car which has recently been adopted by the Field Artillery and certain other branches. Two Chevrolet cross country cars with the rear bucket seats omitted were procured from the Ordnance Department. Demountable frames supporting the necessary cargo reels, revolving pay-out and take-up reels, and a single bucket seat facing to the rear were then constructed and installed on the chassis at the Signal Corps Laboratory, Washington, D. C. The requirements for the development of the wire laying apparatus proper, limited the design to one which would permit of the special apparatus being mounted on any cross country car so as not to require a special vehicle for this purpose. Certain minor modifications such as the strengthening of the rear springs, raising of the car fenders, etc. will however be required in any event.

The car as at present designed is capable of carrying about three miles of standard twisted pair field wire wound on eight standard pressed steel reels, Signal Corps type DR-4, which are removable, and three men. The driver and a lineman or non-commissioned officer in charge, occupy the front two bucket seats while the third bucket seat located on the rear end of the car and facing to the rear is provided for the third member of the wire laying detail whose duty it is to control the speed of the two revolving reels in laying out and recovering the wire. Six of the reels, each one of which contains about ⅜ mile of wire, are carried on a rack located immediately behind the two front bucket seats, whereas the remaining two reels are mounted on spindles on either side of the rear bucket seat and convenient thereto so as to be readily controlled by the operator. The speed at which the wire is paid out from these two revolving reels is controlled by means of hand brakes. No automatic pick-up feature is provided, the wire being recovered by means of hand cranks operated by the member of the detail sitting in the rear bucket seat. It is appreciated that automatic retrieving equipment might be very desirable, particularly in time of peace; however when it is realized that in actual combat, the paramount consideration is that of getting the wire laid with the least amount of delay, the added weight and complication incident to automatic apparatus was not thought to be warranted by the advantages to be gained. Recovery can be made at leisure.

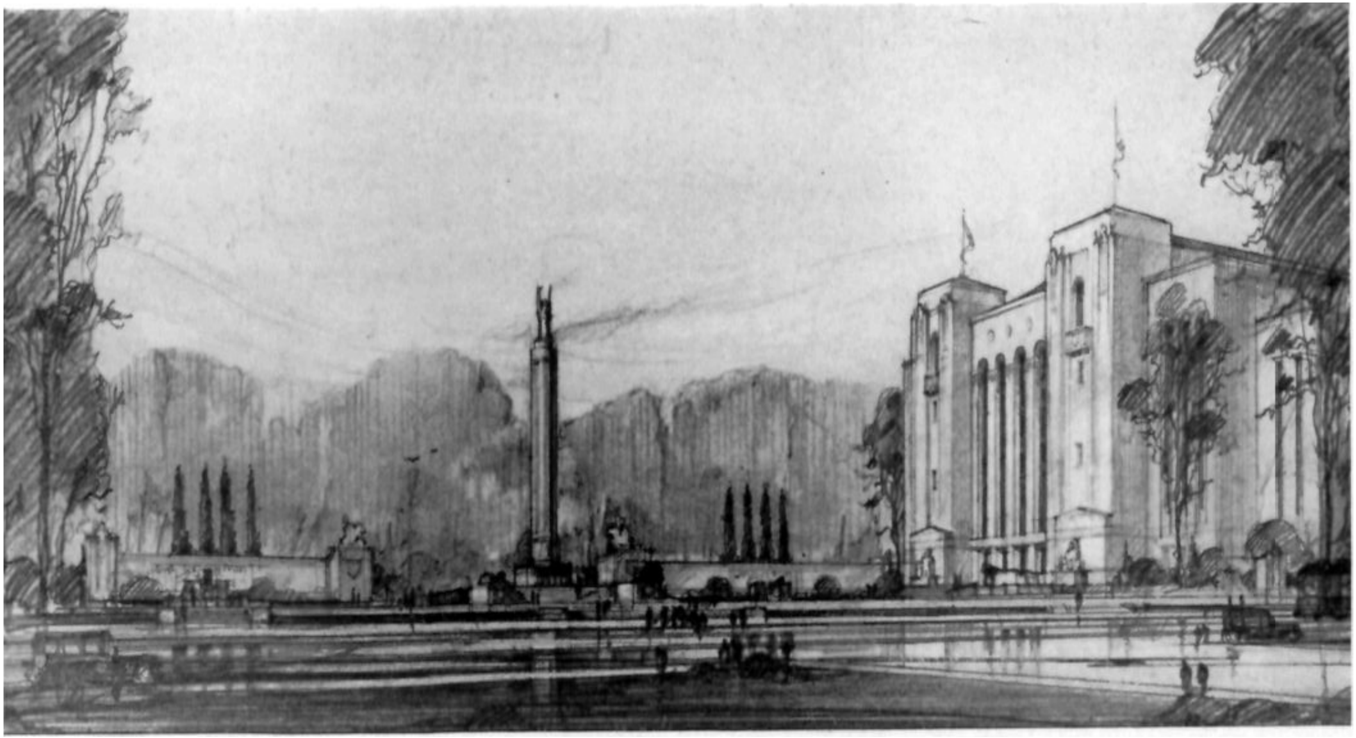
The fact that the reels are removable, it is believed, should prove



EXPERIMENTAL WIRE LAYING CAR. CHEVROLET CROSS-COUNTRY CAR CHASSIS



EXPERIMENTAL REEL CART, HORSE-DRAWN, SIGNAL CORPS



ARCHITECT'S DRAWING OF ARMORY TO BE BUILT FOR THE 124TH F. A. ILLINOIS NATION AL GUARD, CHICAGO, ILL.

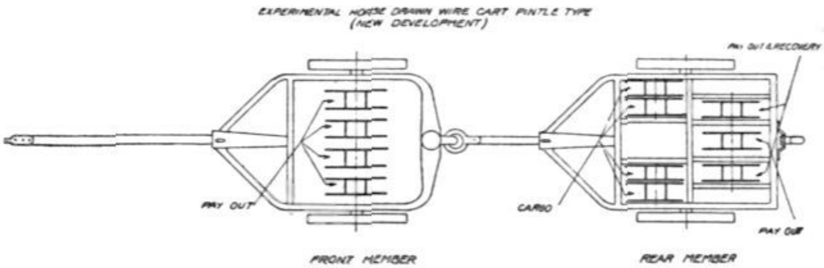
to be a great advantage during operations in the field. Instead of being required to rewind the reels with wire when they become empty, as is the case with the present type K-1 Horse Drawn Wire Cart, the empty reels can be readily removed and replaced with full reels as delivered by the manufacturer. Where it is necessary to rewind permanently installed reels with wire when they become empty, valuable time is lost. Although the fact that each reel contains about ⅜ mile standard twisted pair field wire, of necessity requiring splices at these intervals, it is believed that this advantage is outweighed by the fact that there is no occasion for rewinding the wire on the spools, since the empty spools are simply replaced by those containing wire as furnished from depots.

The question of the maneuverability and ability to negotiate difficult ground off the roads is one which must be determined as the result of extended tests. An effort has been made to provide a maximum amount of wire on the vehicle and consequently the weight involved might prove to be excessive. With three men, eight reels of wire and the wire laying equipment and special frames, it is estimated that the total load will be upwards of 1500 pounds. This question of load is a serious one; however until the car is actually subjected to field tests no prophecy can be made regarding its performance in the field. It is believed that the forthcoming mechanization tests at Fort Leonard Wood will provide ample opportunity for determining the merits of the cross country car as a wire laying vehicle.

Horse-Drawn Reel Cart

It will be appreciated of course that situations may arise where the use of motor-drawn vehicles such as the wire laying car, would be impracticable because of the nature of the terrain. The present type K-1 Signal Corps 2-wheeled wire cart now used by the Signal Corps, Infantry and Cavalry Brigade communication details, was originally designed to meet such situations. However, the type K-1 cart has several undesirable features, among these being the fact that the K-1 cart has a rather limited wire carrying capacity, approximately 2½ miles of standard twisted pair field wire, and the fact that when these 2½ miles of wire have been paid out it is necessary to rewind new wire on the permanently installed drums with the loss of time incident thereto. Furthermore, the type K-1 cart is not perfectly balanced. In an effort to overcome these undesirable features, a 4-wheeled reel cart of the pintle type has been designed by the Signal Corps. This cart has a capacity of slightly over four miles of twisted pair field wire, all carried on 11 removable reels, Signal Corps type DR-4. The accompanying photograph of a one quarter size model, although not depicting the full sized models as they will be furnished for test, affords a general idea of the construction of the new pintle type cart.

The cart is designed to operate as a 4-wheeled vehicle; *i.e.,* limbered for use on roads but provision is also made for the operation of each member



independently. A combination trail (draw-bar) and pole will be provided for the rear member so that in the event there is a requirement for laying wire from the two members simultaneously, this may be accomplished by extending the trail so as to form a pole. The arrangement is such that wire may be paid out from any one, or all, of the reels on the front member and from the two rear outside reels on the rear member, with facilities for automatically recovering the wire with the aid of the last named reels. An instrument box is also carried on the rear member. Although the cart in its present design is not capable of attaining speeds greater than 12 miles an hour, owing to the bearings, this limitation would be overcome should roller bearings for vehicles of this type be made standard by the Ordnance Department.

It is estimated that the total weight of either member without the wire load will not exceed 1500 pounds. The first models of this reel cart should be available for test by the Signal Corps, Field Artillery, Infantry and Cavalry during the late fall of 1928.

124th Field Artillery Memorial Armory

The illustration represents the architect's idea of a front view of the new Armory to be built for the 124th Field Artillery in Chicago. The last session of the Illinois Legislature appropriated $500,000.00 for the construction of part of this building. It is contemplated building the arena (140 feet × 328 feet) and the stables with this amount, construction to be begun immediately. The State is expected to make an appropriation at the next session of the Legislature of $500,000.00 additional, to complete the building, including a four-story head-house.

The last Legislature also passed a law authorizing Park Boards to grant sites for the location of National Guard Armories, acting upon which the South Park Board of Chicago granted a beautiful site in the northeast corner of Washington Park for this building.

This will be the first Armory in the country planned and built from the beginning with the idea of housing a complete regiment of horse-drawn artillery. A field officer of the regiment was sent by the State to inspect some of the best armories in the East, with a view to incorporating in this building the proven best ideas, and eliminating those which have proven unsatisfactory. As a result this building is expected to be a model in training efficiency, as well as affording facilities for various civilian activities and interests, such as athletic contests and civic meetings of all sorts.

The outside dimension of the building proper, exclusive of Memorial Park, the open corral and the parking space in rear, will be 530 ft. × 268 ft. Stables are planned to accommodate approximately 200 animals, and will be of latest approved construction and equipped with modern appliances. Seating capacity around the arena will accommodate more than 5000 spectators. Head-house will contain in addition to offices, officers' club, class rooms, kitchen, and memorial hall, a gymnasium and basket ball court with seats for more than 1500 people.

Other features of the building will be: (a) Numerous and large windows; (b) Battery office, day room, locker room, and store room all in one unit; (c) Materiel Park on same level with arena floor; (d) Stables on same level with arena floor; (e) No basement except for the heating plant; (f) Sub-caliber range built in with arena; (g) Roof garden on top of the head-house for Fire Control Instruction; (h) Club Rooms set aside for Organization Veteran's Club; (i) Separate sound-proof band practice room; (j) Materiel Instruction Room with tiered seats; (k) Modern Repair Shop; (l) Open air corral and parking space in rear of building.

In planning the interior layout of the building the regimental commander, Colonel T. S. Hammond, has required every officer in the regiment to submit his own ideas, and to critique four sets of blue-prints in turn, each set being an improvement over the preceding one. It is believed that the set now in the hands of the architects for elaboration on large scale are practically fool-proof, and that for economical and efficient training the facilities will be the best to be found in the country. Suggestions have been widely sought and are greatly appreciated.

Basic Principles for Mechanized Force

The War Department has instructed the Commanding General, Third Corps Area, that in planning the work of the Experimental Mechanized Force, which will be assembled at Fort Leonard Wood

(Camp Meade), Maryland, about July 1st, the following basic principles will be followed:

"The completely mechanized force is a self-contained unit of great mobility, great striking power, and limited holding power.

"It should not be considered as a divisional unit but rather, because of its special characteristics, as a force of special mission in the accomplishment of which and in exploitation of which troops of Infantry or Cavalry divisions will cooperate.

"The rôle of the mechanized force is essentially offensive.

"Tanks are the principal attack elements of the mechanized force.

"The tactics of the force as a whole shall be predicated upon supporting and assisting the attack of the tank elements, and upon quick consolidation and securing or exploiting the success gained in the tank attack.

"Other arms are added as auxiliaries, to furnish the element of holding power which tanks lack, security, maintenance of command, fire support, facility of movement, and supply.

"Surprise, speed, and depth of penetration in the attack should characterize the operations of a mechanized unit. Its tactics should be devised to assure these.

"All members of the force should be imbued with a spirit of the utilization of the speed which modern equipment will afford.

"The force should be regarded as a tactical as well as technical laboratory. While it will have to operate this year with considerable obsolescent automotive equipment, it is nevertheless expected that much information as to tactics and technique will be derived which will be of benefit to further development.

"The capabilities and limitations of such a force should be studied not only in the light of the bulk of obsolescent matériel as furnished this year, but also in the light of a force equipped throughout with matériel of the more modern experimental types furnished. For this purpose the four MI tanks to be furnished should be used to the maximum."

Committee for Development of Mechanized Force

The Secretary of War has directed that a committee of officers, as named below, be formed to meet in the War Department, at the call of the President thereof, to make recommendations for the development of a mechanized force within the Army and to study questions of defense against such forces:

Colonel Charles S. Lincoln, General Staff
Colonel John L. DeWitt, General Staff
Colonel Rogers S. Fitch, Cavalry
Lt. Colonel Brainerd Taylor, Quartermaster Corps
Lt. Colonel Richard C. Moore, Corps of Engineers
Major Adna R. Chaffee, General Staff
Major E. J. Dawley, Field Artillery
Major Thompson Lawrence, Infantry
Major William R. Blair, Signal Corps
Major Levin H. Campbell, Ordnance.

Instructions to the committee will provide for the organization of the forces within the existing strength of the Army without recourse to new legislation.

Officers' Instruction as Motor Mechanics

Indicating that the rapid progress in motorization makes it mandatory that the training of Army officers as motor mechanics should be emphasized, Major General Charles P. Summerall, Chief of Staff, has stated—"At an early date a situation must be reached where there will always be available officers for assignment to motorized units who have had courses of instruction and have qualified as expert motor mechanics."

To provide these expert motor mechanics, the Secretary of War has authorized the establishment of an advanced motor transport course at the Field Artillery School, Fort Sill, Oklahoma, and the Coast Artillery School, Fort Monroe, Virginia, beginning with the next school year, for a number of selected graduates of the Battery Officers' Courses of the preceding school year.

It is thought that the needs of the Cavalry, with respect to motor transportation, in view of the wide assortment of vehicles with which that arm may at some future time be provided, will best be met for the present by sending specially selected Cavalry officers to attend the various courses in motor instruction at other service schools. The Secretary of War, therefore, has authorized seven Cavalry officers be distributed approximately as follows for the school year of 1928-29:

The Quartermaster Motor Transport School, Camp Holabird, Maryland—4 officers;
The Field Artillery School, Fort Sill, Oklahoma, Advanced Motor Course—1 officer;

The tank School, Fort Leonard Wood, Maryland—2 officers.

In view of the increasing importance of the tank to the Infantry, the War Department believes it would be advantageous to increase the number of Infantry officers pursuing the tank course each year. With this in mind, the Chief of Infantry has been directed to recommend the practicability of increasing the number of officers taking the course.

United States Olympic Equestrian Team to Complete Training at Rye, New York

Colonel Pierre Lorillard, O.R.C., Chairman of the Special Olympic Equestrian Committee, has announced that the United States Olympic Equestrian Team, which is now in training at The Cavalry School, Fort Riley, Kansas, under the direction of Brigadier General Walter C. Short, U.S.A., will be brought East about June 10th. The final month of training will be conducted at the Westchester-Biltmore Country Club, Rye, New York, where Mr. John McEntee Bowman has generously offered for the use of the team his splendid facilities, including stables, horse show grounds and steeplechase course. Training will be conducted there with a view to reaching the desired final condition on the date of sailing, July 10, 1928. Accommodations for the team will be arranged on the chartered Olympic boat, "President Roosevelt," by Colonel Lorillard. General Short states that he expects to have several good prospects for each of the two events in which the team will compete—namely, the Equestrian Championship Three-Day Event and the Prix des Nationa Jumping Event.

Major Sloan Doak, Cavalry, is captain of the team. Members of the squad now at Fort Riley, Kansas, trying out for the team are: Major Harry D. Chamberlin, Major Oliver I. Holman, Captain A. W. Roffe, Captain Frank L. Carr, Captain W. B. Bradford, and Captain Russell C. Winchester, all of the Cavalry, and Major C. P. George and 1st Lieutenant Edwin Y. Argo, of the Field Artillery.

It is probable that the final selection of the team will be made by June 1st. It is anticipated that the team will be composed of the manager, the team captain, a veterinarian, six riders and nine enlisted men. Not more than sixteen horses will be taken. After arriving in Holland the Americans will be trained and quartered at Hilversum, some twelve miles southeast of Amsterdam.

The following nations, in addition to the United States, have signified their intention of competing in the Olympic equestrian events: France, Italy, Poland, Spain, Sweden, Holland, Germany, Austria, Switzerland, and Japan.

This will be the fourth time that the United States Army has sent a riding team to the Olympic games. In 1912, Colonel Guy V. Henry, Third Cavalry, Fort Myer, Virginia, took a team to Stockholm, Sweden. Again in 1920, at Antwerp, the Army was represented by a team managed by General Walter C. Short, this year's manager, and captained by Major Berkeley T. Merchant, Third Cavalry, Fort Myer, Virginia. In the last Olympics at Colombes, France, in 1924, the United States sent an equestrian team captained by Lieutenant-Colonel John A. Barry, Cavalry. Major Sloan Doak, this year's team captain, was a member of the 1920 and 1924 teams. Major Harry D. Chamberlin rode on the 1920 team. Major C. P. George and Captain Frank L. Carr were members of the 1924 team that competed at Paris, France.

Some of the horses being tried out this year are also veterans. Nigra was a prominent participant in both the 1920 and 1924 Olympics. In 1924, Pathfinder, Proctor, and Miss America were all members of the string, Pathfinder having won third place and Proctor eighth as individuals in the Military Championship. All of the horses named above are owned by the Government.

Experience indicates that to compete successfully in the Olympic event, training must be well planned and continuous, also that there must be co-operation of effort. In addition to the Field Artillery officers and horses now in training at Fort Riley, training of remounts at Fort Sill is going on, looking to the 1932 Olympic. The centering of the Field Artillery effort at Fort Sill, is expected to result in developing horses and riders, and is spreading throughout the Field Artillery a knowledge of Olympic requirements, the types of horses required, and the schooling and conditioning necessary. Information resulting from the work at Fort Sill is available to all Field Artillery officers.

Field Artillery Board Notes

Field work stopped on or about May 1st, and the Board is now busy trying to catch up on its reports.

The winter has seen a great deal of firing done in the test of the new 105-mm. howitzers, and the tests of effect of fire. Concerning motors, the light cross-country trucks have been thoroughly tested and a great deal of work done on portée matters.

The light cross-country trucks tested were:

Ford, model T, single rear wheels, 1-ton.
Ford, model T, dual rear wheels, 1-ton.
Chevrolet, M-1927, 1-ton, single rear wheels.
Chevrolet, M-1927, 1-ton, double rear axle, *i.e.,* six-wheeler.

The trucks arrived in the middle of the equipment test of the 240-mm. howitzer, and 155-mm. G.P.F. gun batteries. They were used during that test for carrying equipment, radio, etc., and personnel. They were then issued to the 17th Field Artillery and used during the Pee Dee River firing. They proved so useful in all cases that their "legs" were almost run off. Nobody would use anything else, if they could lay their hands on one. They were then tested in column with the Coleman 1½- and 2½-ton trucks for cross-country ability. Luckily, at about this time, Fort Bragg was pretty nearly inundated by rains; consequently the trucks received a thorough test in wet country. It was found that the Chevrolets would run away from all the others, and would cross softer ground than the others. The Fords did not have sufficient power for hard going, and overheated.

The Colemans had more power than was needed but were so heavy that their pace was slow in hard going and, even worse, they would break through the surface in soft ground, where the lighter trucks skimmed over. The four-wheel Chevrolet appeared to be just as mobile as the six-wheeler, except in very soft going where the six-wheeler stayed on top a little better. The four-wheeler, however, is of simpler construction and is a straight commercial design. On the whole, both Chevrolets seemed to have about the same cross-country mobility as the cross-country cars.

The Board recommended that the Chevrolet 1-ton chassis be adopted as standard and that further testing be done to decide on the details of its equipment, such as 4 or 6 wheels, body, etc. A progress report on these trucks was forwarded in March.

The portée test has included a great variety of matériels, from the 75's to the 155-mm. G.P.F.'s. The idea back of the test is that, if General Headquarters Reserve Artillery is to have its greatest efficiency, it must be capable of rapid movement on good roads. The principal G.H.Q. calibers are the 75-mm. and 155-mm. G.P.F. guns. In addition to these, the 155-mm. howitzer was tested. With the 75-mm. and 155-mm. howitzer, all possible methods of carrying the tractors and matériels were used, such as the tractor in the truck body and towing the howitzer; the howitzer in the truck body and the tractor in a trailer, etc. In general, it was found that on any kind of roads where the trucks could get a footing, the Colemans and modified F.W.D.'s of the different capacities could handle their corresponding loads efficiently and maintain speeds of around 12 to 15 miles per hour. The combinations of matériels and trucks used were:

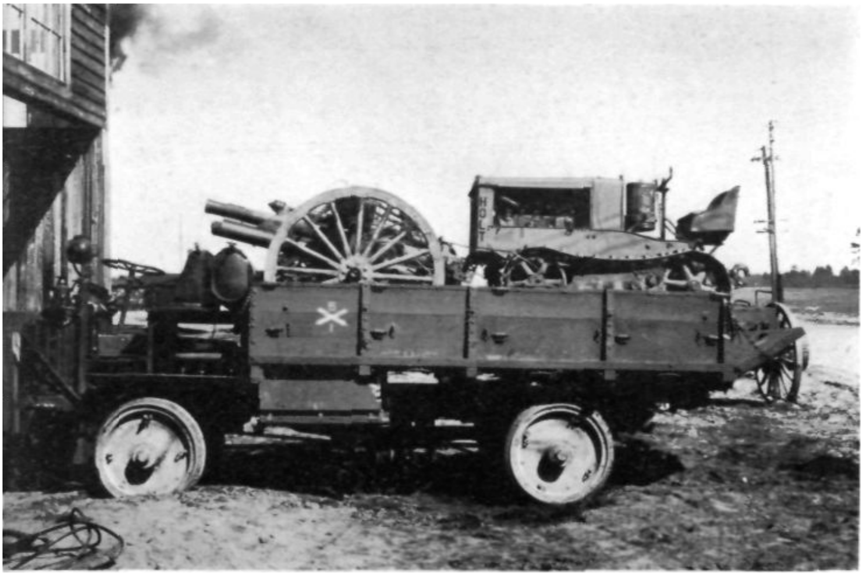
75-mm.	1½-ton Colemen. 3 -ton Coleman. 3 -ton F. W. D.
155-mm. How:	5-ton Coleman.
155-mm. G. P. F:	5-ton Coleman.

As far as the artillery matériel was concerned, it seemed to stand the speeds of around 12 miles per hour fairly well, except for the wheel bearings. The wheel closure on all gun wheels is defective for this type of travel, as it is too loose to retain oil or grease. Consequently, on all portée runs, frequent stops were necessary to regrease wheels. It is believed that the installation of a proper type of wheel closure is all that is necessary, as, when greased, the plain bearings functioned satisfactorily.

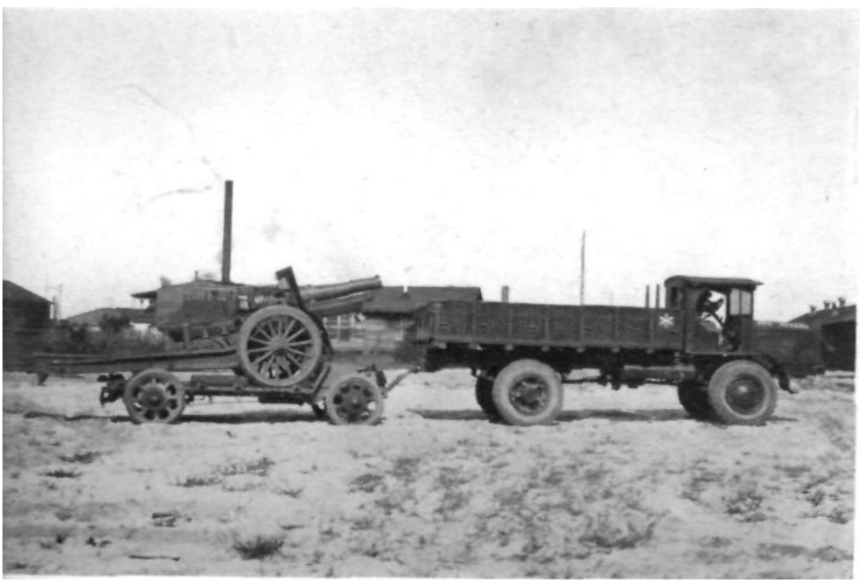
The test to date is by no means conclusive. The Board is recommending that type batteries of G.H.Q. matériel be equipped for portée service and given a thorough test to determine:

Method of carrying matériel.
Method of carrying tractors.
Number of trucks necessary.
Number of tractors necessary.
Mobility of units over various types of roads and terrain.

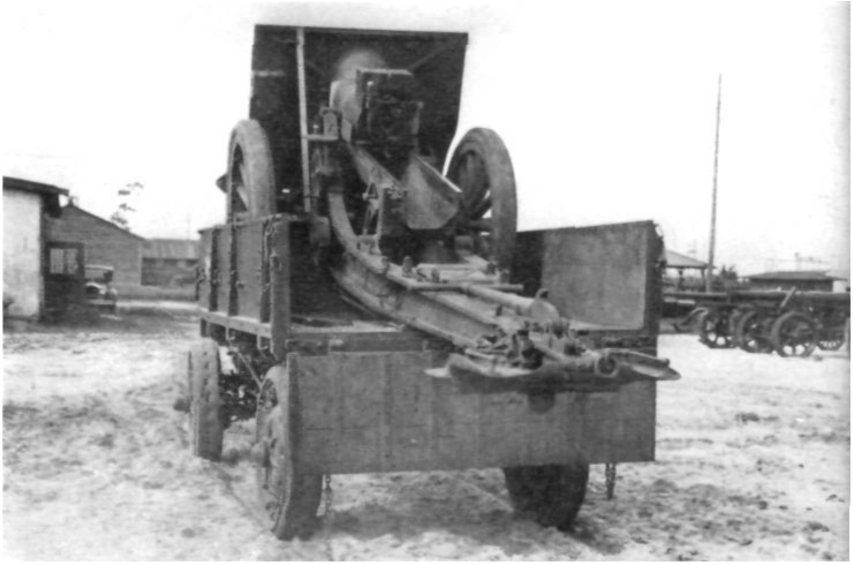
The test of the 105-mm. howitzers has been completed. One progress report has been forwarded and the final report is under preparation. In general, the T-2 howitzer was found to be a very powerful weapon of excellent accuracy and reasonable ease of handling. It is not as mobile as the M-1 75-mm. gun and will probably need an eight-horse team to attain the proper mobility for divisional service. The report is not yet finished, therefore the Board's final recommendations cannot be given. In the first Progress Report, the conclusion was reached that the T-2 was the most satisfactory of the models tested. The characteristics of the T-2 are:



HOLT 2-TON TRACTOR AND 75-MM MODEL 1916 GUN IN F. W. D. TRUCK (NOT MODIFIED)



155-MM. HOWITZER, MODEL 1918, ON 3-INCH TRAILER DRAWN BY 5-TON COLEMAN TRUCK



155-MM. HOWITZER, MODEL 1918, IN MOLITOR TRUCK

155-MM. HOWITZER, MODEL 1918, IN MOLITOR TRUCK

Weight in battery	3750 lbs.
Range	12,000 yds.
Weight of shell	33 lbs.
Zones	4
Maximum M. V.	1550 foot-seconds
Traverse	45°
Elevation	– 10° to + 65°
Rate of fire	4 rounds a minute.

A new type of ammunition for this howitzer is to be tested. As first tested, the loading was done in two parts as with most semifixed types, *i.e.,* loading and ramming of the projectile, and insertion of the cartridge case. The new lot will be loaded as fixed ammunition. To prepare the charge, the cartridge case is removed and the necessary powder bags extracted. It is then replaced on the projectile and both are loaded together as in the 75-mm. gun. This will increase the rate of fire.

In firing at personnel targets, the howitzer proved to be very effective. It was also tested on moving targets travelling at a rate of about 8 miles per hour. Using zone 4, the rate of fire with it was only 4 seconds a round slower than the 75-mm. and it was as satisfactory as the latter in all other respects for this type of fire. Its large shell will give it greater hitting power, here, also.

The 75-mm. time shell has been tested for high burst ranging and effect on personnel targets. Unfortunately, the two lots of fuzes used were in bad shape, resulting in erratic heights of burst and many low orders. Therefore, no definite conclusions can be drawn from the tests to date, but the results were sufficiently promising to make it advisable to continue the test with better fuzes. This type of shell, apparently, will be most useful for fire on troops sheltered in trenches, behind walls, etc. The shell used in the test was the 75-mm. antiaircraft shell equipped with the shrapnel 21-second combination fuze. This is an improvisation and is not intended to be a solution of the type of projectile desired. It was furnished so that the tests of effect of time shell could be started at this time.

Smoke shell have been used by the 16th Field Artillery, during this year's target practice, for locating "lost" rounds. They have proved satisfactory; more so than the shrapnel in many cases, as range observation can frequently be made on the burst. As the smoke shell have very nearly the same ballistics as the MK I shell, all observation made on them are applicable to the latter. Consequently, the two shell can be used interchangeably without wasting time or ammunition.

Test firings of shell and of shrapnel have continued throughout the year, twenty-six problems being fired. The third progress, and final reports have been completed and are being forward.

The test of the modified artillery cart, M-1918, has been completed and the report written. Due to many changes in the types and allowances of equipment, the compartments, drawers, etc., in the present carts would no longer contain the equipment. In order to utilize the 1900 carts on hand, all compartments, drawers, braces, etc., in the cart under test were removed and two large drawers substituted. These drawers were supported on guides mounted on springs to prevent injury to the instruments. A photograph shows the drawers packed with equipment. The canvas flaps, when folded over the equipment, were secured by leather straps.

The Board recommended that several modified carts be issued field artillery units for a service test.

The test of the artillery reel, M-1909, has been completed and the report written. This test was to determine the suitability of the present reel and the number of the reels required for battalion, regimental and brigade headquarters batteries of division field artillery units. Due to there being some 1900 of these reels on hand and the impracticability of so modifying these reels as to permit original spools of wire being installed in them, the only modifications recommended were the removal of the drive chain covers and the installation of an idler or sprocket which would prevent the chains jumping off the gears, and permit of individual adjustment of each chain.

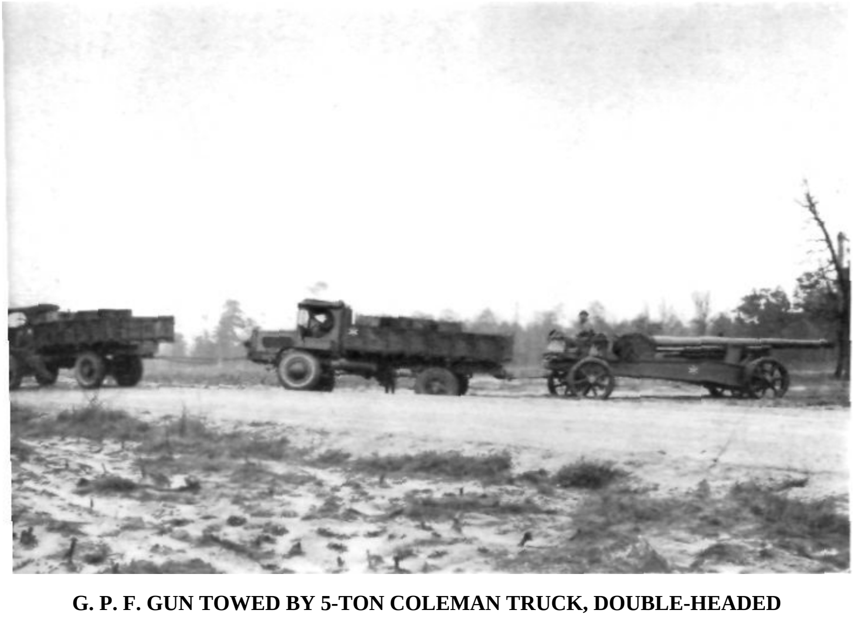
The Board also recommended that each battalion and regimental headquarters battery of division field artillery be issued two artillery reels, M-1909, and the brigade headquarters battery, three such reels.

The Board also recommended that in the event it becomes necessary to give up the present mountain wagon in order to obtain a second reel in the battalion and regimental headquarters battery, due to road space, that a radio cart to be limbered to the second reel be constructed and sent to the Board for test. The proposed radio cart was to be nothing more than a cargo cart equipped with a liner mounted on springs in the body of the cart, and with low bows and a canvas cover.

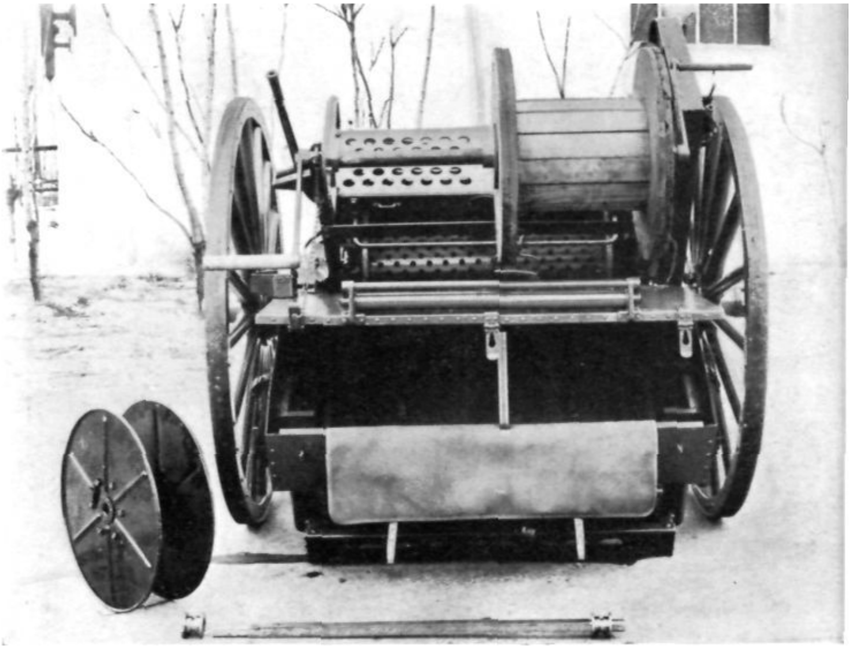
The Signal Corps has under development a wire cart on which steel spools each containing ⅜ mile of field wire can be mounted. If field telephone wire is issued on these spools it will obviate the delay in winding wire on the drums. However, as these carts will probably not be available for general use until the present supply of artillery reels and battery reels are consumed, it becomes necssary to remodel those reels.

As a result of the Board's recommendations on modifications to the battery reel, M-1917, the Ordnance Department modified one reel and shipped it to the Board for test before proceeding with the modification of additional battery reels, M-1917. In general the modifications appear satisfactory. The position of the arms supporting

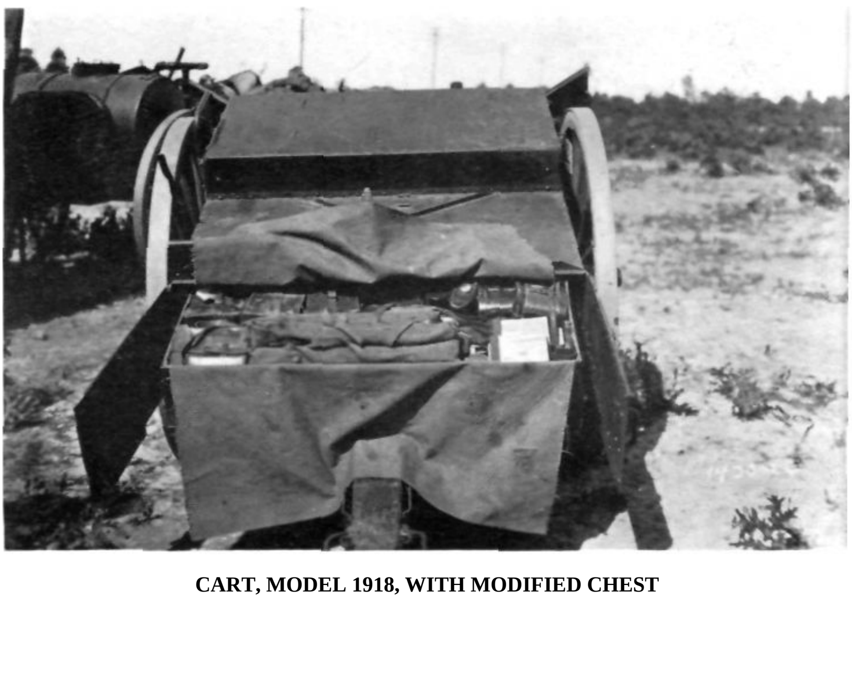
CATERPILLAR "30" TRACTOR IN 5-TON COLEMAN TRUCK



G. P. F. GUN TOWED BY 5-TON COLEMAN TRUCK, DOUBLE-HEADED



BATTERY REEL, MODEL 1917, MODIFIED TO ALSO CARRY TWO COMMERCIAL SPOOLS OF WIRE



CART, MODEL 1918, WITH MODIFIED CHEST

the axle which carries additional spools of field wire as illustrated, will have to be changed. The wooden liner may have to be removed and the interior of the rear chest padded and lined with canvas. This will provide more space for instruments. In order to prevent injury to the instruments, the present rather stiff support springs of the rear chest may have to be replaced by weaker springs. There are 1250 of these reels on hand and while they will ultimately be replaced by the Signal Corps wire cart referred to above they will probably have to be used for some time to come.

The main object of the modifications are to permit the changed allowances and types of equipment to be packed in the front and rear chests and increase the present wire capacity of about one and seven tenths miles to two and one half miles of field wire.

In addition, a test is being made of two modified battery reels in place of one modified reel, the mountain wagon and store limber for the transportation of all fire control, topographical and signal equipment, including wire, now authorized a 75-mm. horse-drawn gun battery.

In this connection, the allowances of wire now authorized in Circular 25, War Department, 1926, was based on the assumption that each gun battery would be equipped with two modified battery reels, each carrying 2½ miles of field wire, and each battery and regimental headquarters battery would have two artillery reels, each carrying four miles of field wire. In the battalion, there would still remain a reserve of eight miles of field wire which it was proposed would be transported by the battalion combat train for issue to the gun or battalion headquarters batteries as conditions required.

It is proposed that for the transportation of the reserve eight miles of field wire, the one escort wagon allotted each battalion from the service battery for the transportation of reserve wire be eliminated, and a limbered cargo cart, drawn by artillery horses with artillery harness, be substituted in each battalion combat train.

The Training Regulations Section of the Field Artillery Board, during the current month, completed a review of Training Regulations 430-165 "Dismounted Formations and Ceremonies", and Training Regulations 430-70, "The Firing Battery"; the latter being sent to the Field Artillery School, Fort Sill, Okla., for review and comment.

The Field Artillery Field Manual is approaching completion in the rough draft form. This manual, which is in effect a compilation of the Field Artillery Training Regulations, is to issue in the event of war, in conjunction with similar field manuals compiled by the other services, in lieu of the present regulations. It is not proposed that this manual supersede the present regulations and in any event it must of necessity be supplemented by certain of the present regulations such as "The Service of the Piece." Progress on this manual has been somewhat delayed due to the incomplete status of certain of the regulations upon which it is based, and the necessity of drafting new chapters not covered at the present time by current regulations.

A final review of Training Regulations 430-60, "Service of the Piece" 240-mm. howitzer, is being made at the present time and should be forwarded for approval of the Chief of Field Artillery during the current month.

Questions of particular moment which are at the present time under consideration, concern the necessity for increasing the liaison detail of the battalion; the disposition of machine guns both during the march and when in action, and questions relative the amount of wire necessary for the various headquarters of a field artillery brigade and the means for carrying this wire.

Reports forwarded since the last notes are:

Campaign hats.
Caterpillar "30" tractors.
T-29 tractors.
155-mm.—8-inch howitzer motor carriage.
Test of parallel sheaf.
Coleman trucks.
F. W. D. trucks, modified.
Aiming circle, M-1918.
Study of effect of fire.
Firing tests of shrapnel and of shell.
Time shell.
Smoke shell.
105-mm. howitzer.
Basic allowance and equipment tables.
Tool equipment, 5- and 10-ton tractors.
Fordson tractors.
Modified pump, 155-mm. gun.
Athey trailers.
Type 1004-A telephones.
McCormick-Deering 10-20 tractor.
Warner 7-ton trailer.
Highway 4-ton trailer.
D. A. Lubricants.
Globes, red lantern.
Radio truck, SCR-108.

All members of the test section of the Board complete their tours this summer. The officers being relieved are:

Major P. W. Booker ....Equipment and modifications on standard matériel.
Major W. C. Young, O.D. ....Ordnance member.
Major J. G. Burr ....New matériel, ammunition, etc.
Major R. P. Shugg ....Motor section.

THE UNITED STATES FIELD ARTILLERY ASSOCIATION

PROPOSED AMENDMENT TO THE CONSTITUTION

Washington, D. C.
May 12, 1928.

The Secretary, United States Field Artillery Association,
Washington, D. C.

Sir:

In conformity with Article IX of the Constitution of the United States Field Artillery Association, the undersigned, being active members of the Association, hereby propose a certain change in said Constitution for the following principal reasons:

> The usefulness of the Association to its active members is needlessly impaired by the requirement that all publications shall be furnished to active members without payment other than the annual dues. Much available matter, of vital interest to field artillerymen, might be published and offered for sale to active members, which cannot be published gratis on account of the expense involved. It is believed that the interest of the active members in this regard will be safeguarded by the Executive Council.

The proposed amendment to said Constitution is clearly set forth as follows:

It is proposed to amend Section 3, of Article V, by striking out the period at the end of said Section, substituting therefor a comma, and adding to said Section the words "except such publications, other than the Journal, as may be designated by the Executive Council.", so that said Section shall read, when amended, as follows:

> Sec. 3.—Active members shall be entitled to receive all publications issued by the Association without payment other than the annual dues, except such publications, other than the Journal, as may be designated by the Executive Council.

Respectfully submitted,

ANDREW MOSES, Col., F. A.
E. P. KING, JR., Major, F. A.
G. R. ALLIN, Lt. Col., G. S. (F. A.)

E. H. DEARMOND, Lt. Col., F. A.
E. R. REDMOND, Col., F. A. Res.
MILES A. COWLES, Capt., F. A.
T. G. M. OLIPHANT, Major, F. A.
C. A. SELLECK, Major, F. A.
J. N. GREELY, Major, G. S. (F. A.)
CORTLANDT PARKER, Major, G. S. (F. A.)
R. E. D. HOYLE, Major, G. S. (F. A.)
H. W. HUNTLEY, Major, G. S. (F. A.)
A. C. MCBRIDE, Major, G. S. (F. A.)
R. S. PRATT, Lt. Col., G. S. (F. A.)
K. S. PERKINS, Major, G. S. (F. A.)
A. C. SANDEFORD, Major, F. A.
A. F. BREWSTER, Lt. Col., F. A.
R. M. DANFORD, Major, F. A.
D. C. CUBBISON, Major, F. A.
E. J. DAWLEY, Major, F. A.
H. L. LANDERS, Lt. Col., F. A.
J. A. CRANE, Major, F. A.
H. PARKHURST, Major, F. A.
LEROY W. HERRON, Col., F. A. Res.
D. M. BEERE, Major, F. A.