

The
FIELD ARTILLERY
Journal



IN THIS ISSUE:

Antitank Defense

MAY, 1941

THE SOLDIER'S HANDBOOK

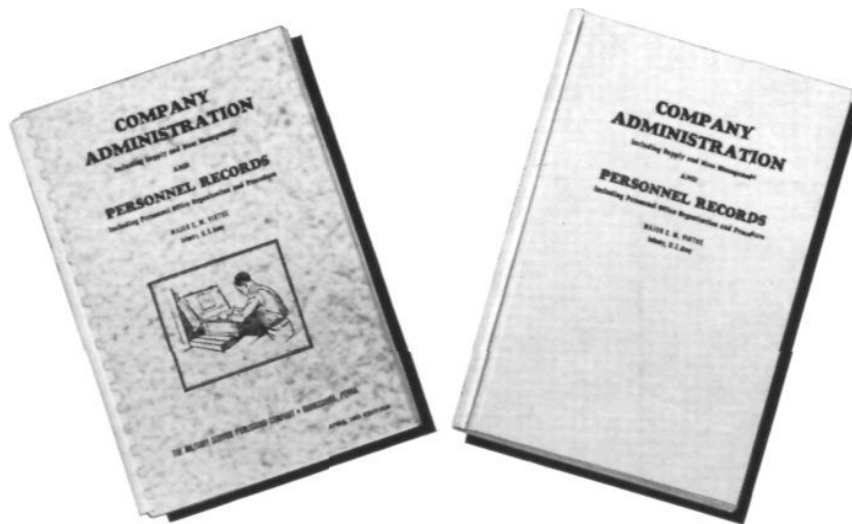
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By MAJOR C. M. VIRTUE

The readoption by the Army of a personnel system similar to that in use from 1926 to 1933, thus freeing the unit commander and first sergeant from responsibility for practically all individual records and concentrating these personnel records in the unit personnel section, has required a considerable rearrangement of the matter in this text.

In addition to the rearrangement, new chapters have been added on the following subjects: "Company Supply and Supply Procedure," "Mess Management and Records," and "The Company Fund." A chapter on the new personnel system, including a discussion of the organization and operation of the personnel office in the regiment, also has been added. The new edition contains pay tables for enlisted personnel, including air mechanics' pay and flying pay. 396 pages.

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MAJOR W. S. NYE, *Editor*

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OUR OFT REPEATED slogan. "THE FIELD ARTILLERY JOURNAL of today is the training regulations of tomorrow," will be supported by our lead article on Antitank Defense. This study, prepared especially for THE FIELD ARTILLERY JOURNAL by Maj. Wedemeyer, is destined to have profound effect on the development in our army of a sound and comprehensive antitank doctrine. Already, in manuscript form, it has received close attention by a number of authorities who are intimately concerned in determining future plans. The realization of the importance of the subject *for all arms is growing.*

NO FINER PIECE of military writing has come from the School than the pamphlet on Conduct of Observed Fires, which we are running serially, beginning with this issue. The authors of that text have achieved the ideal of saying exactly what they mean in crystal-clear language, and briefly. Note how the rules are all-inclusive yet not so dogmatic as to preclude the use of judgment and common sense in those borderline cases frequently encountered in firing. The School is to be congratulated on this model of textual writing, and the JOURNAL feels deep satisfaction in again being able to conform to its slogan referred to above.

THE INCLUSION HEREIN of two other brand-new and splendid Instruction Memorandums from Sill place this issue of the JOURNAL in the favorable position of nearly covering the field of "what's hot" in technique. Extra copies are available, but they won't last long, if we are to judge by the sales of all numbers since December. Subscribers who are slow in sending in renewals are apt to be disappointed if they ask for back issues.

SOON WE EXPECT to start a series entitled "With the Other Arms and Services." This will tell, in brief and handy form, yet quite complete, all the essential facts concerning the other branches of the army. There will be an article on the War Department itself, too.

YOUR JOURNAL is growing rapidly. Over twelve hundred new members have joined since the first of the year. But there are still many stubborn "gunners" who have not come into the fold, and many batteries who are denying their men the privilege of reading the only magazine of their arm. You would be doing all these a service, and yourself too, if you urged nonmembers to "join up." The output of the JOURNAL depends solely on the input of the members.

The United States Field Artillery Association

ORGANIZED JUNE 7, 1910

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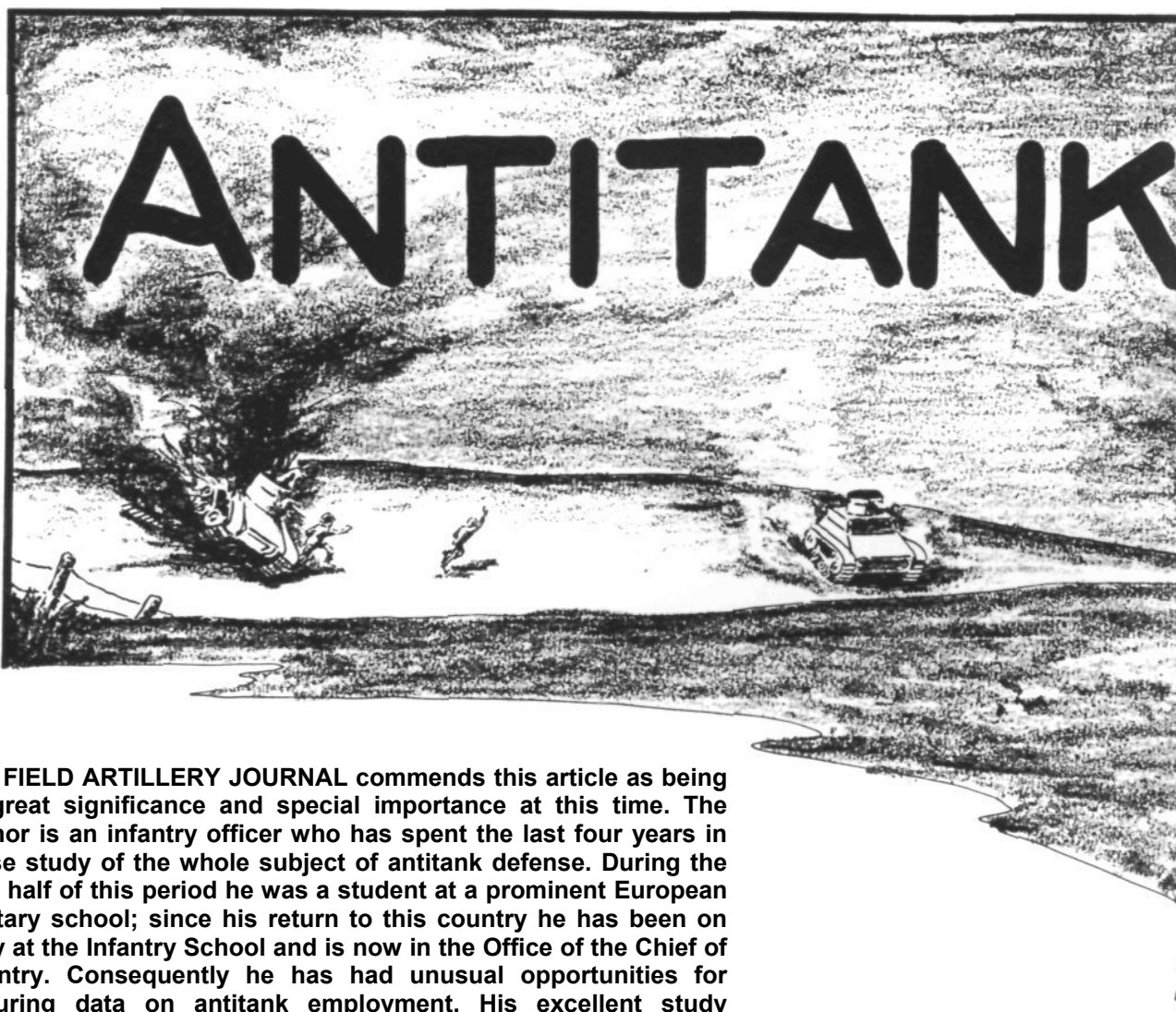
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The FIELD ARTILLERY JOURNAL commends this article as being of great significance and special importance at this time. The author is an infantry officer who has spent the last four years in close study of the whole subject of antitank defense. During the first half of this period he was a student at a prominent European military school; since his return to this country he has been on duty at the Infantry School and is now in the Office of the Chief of Infantry. Consequently he has had unusual opportunities for securing data on antitank employment. His excellent study should greatly assist us all in coordinating and integrating our thoughts—heretofore a bit nebulous—on this vital matter, and in forming a sound basis for the development of a practical and inclusive doctrine. The opinions expressed and proposals made, however, are solely those of the author.



An effective defense against warfare's latest combat team, armored ground forces and air units, presents one of the most urgent problems confronting military men today. The offensive potentialities of this battle combination were clearly demonstrated in the 1940 campaigns of Europe. Military experts of France and England knew, before the war, that Germany had fully equipped and trained several armored divisions and a vast air armada. What they did not foresee, *or at least did not prepare for*, was the German military achievement in

coordination and cooperation between armored units and the air force. History is replete with examples of a continuous struggle to create new weapons and to evolve new forms of maneuver. From time to time, important advantages accrued to that fighting force which suddenly employed new instruments or strategies. The advantages, however, were temporary, for after initial successes, effective counter-means and methods appeared by which an equilibrium or phase of "superiority disputed" was created.

Antitank Defense Requires Coordination and Cooperation of All Arms

DEFENSE



BY MAJOR A. C. WEDEMEYER

Let us investigate current ideas concerning the defense against armored units. However, to jump forthwith into the heart of an antitank defense discussion without reviewing the more important technical characteristics and tactical employment of the armored foe involves the risk of slighting or disregarding certain factors which greatly influence defensive means and methods.

CHARACTERISTICS OF ARMORED VEHICLES

Tanks combine—in one weapon—the destructive and demoralizing battle characteristics: *protection* against shell fragments and small-arms fire; and *fire power, mobility* and *shock action*. They are track-laying vehicles, carrying armament varying in size from .30 caliber to 155-mm. and are protected by armor from 1 to 3½ inches thick. Visibility for the drivers and gunners within the tank is limited. Modern tanks may travel 40 miles per hour on roads and other smooth surfaces, and operate effectively at lesser speeds over rough terrain. Continued improvement in design increases their ability to overcome obstacles or accidents of terrain that formerly were definite barriers. They are usually employed in large numbers, and advance in combat from 200 to 400 yards per minute. They deploy from 50 to 100 yards apart and attack in waves. To fire their automatic weapons effectively they must decrease their rate of movement appreciably, and to fire their single-shot weapons with any degree of accuracy they must stop momentarily. Improvement in firing mechanism may soon enable the tank to fire effectively without retarding its speed and thus utilize more fully its greatest asset, *mobility*. Tanks vary in weight from 5 to 70 tons. The trend at present appears to favor approximately 25 tons. The radius of operation of modern tank units ranges between 50 to 75 miles.

Other types of motor vehicles used in the military service include armored cars, scout cars, trucks, personnel carriers, and motorcycles, some of which are lightly armored and capable of high rates of speed. They have partial cross-country mobility, particularly those vehicles equipped with part track. Sensitivity to terrain and vulnerability to small-arms fire strongly affect their employment in combat areas. Some are used on harassing, reconnaissance, and counter-reconnaissance missions; others are employed to transport troops and weapons. Their radius of operation varies between 100 to 150 miles.

Weapons especially designed to combat *tanks* should not usually be employed against the *other types of military vehicles*. The distribution of antitank guns with a view to blocking all possible vehicular avenues of approach leads to a dispersion of means. The defense against a *tank mass* requires depth and flexibility in the disposition of especially designed antitank weapons, whereas the *other types of motor vehicles* may be effectively dealt with by protected road blocks and automatic weapons firing armor-piercing bullets. Road blocks should be located so that

vehicles *cannot circumvent them*; their effectiveness may be increased by seeding them with mines.

EMPLOYMENT OF ARMORED VEHICLES

There are several ways in which armored vehicles may be employed. A battalion or a regiment of tanks may be employed in limited-objective attacks and in counterattacks; a similar force may be used to support an attack against a fortified zone in close cooperation and coordination with infantry, engineer, artillery and air units; and a regiment or brigade may be employed as an organic part of an armored division on large-scale operations such as wide envelopments and deep penetrations. The most difficult to combat is the armored division, which includes a mass of tanks (approximately 500) operating with strong supporting and exploiting means, both ground and air.

In planning an attack involving an armored unit the commander must know whether the terrain is feasible for the movement of large numbers of tanks. He must also try to determine the hostile dispositions, particularly the antitank measures. To obtain this information he will employ his observation planes on photo-mapping and search missions extending far back into rear areas of the enemy position. Air superiority in the area of prospective employment is vital. Prior to the attack, observation and fighter units conduct reconnaissance and counter-reconnaissance; after the attack is launched, bombing planes render close support. The tank mass is usually concealed about 50 miles to the rear awaiting the cover of darkness before moving into final assembly areas. Friendly units operating in the area or the infantry and artillery organic within the armored force clarify the local situation, seize ground favorable for the employment of tanks and act as a covering force through which the tanks will pass when committed to action. The important element of surprise is accomplished by rapidity of movement and deception. To preclude hostile reconnaissance, both air and ground, friendly troops conduct vigorous counter-measures.

Immediately prior to the tank attack a severe bombardment of the hostile position is undertaken by heavy infantry weapons, artillery, aviation — using HE and smoke—in order to counteract the defender's weapons and observation. After the attack is launched, supporting artillery shifts its fire to the flanks of the tank zone of advance in order to neutralize possible antitank flanking fire. Friendly light bombardment units assume the supporting role as the attack advances beyond artillery range. Aerial bombing missions are directed against lines of communication, road centers and hostile reserves. The defender's combined antitank measures, disposed in depth to cover the areas favorable for tank approach, will disrupt and delay the attack and may inflict as high as 50% losses. Those tanks which succeed in penetrating the defense will be quickly reorganized with a view to concerted action against other objectives in rear areas.



.50 caliber machine gun, M2. on mount, M3

such as reserves, communication centers, and supply depots. This is a critical phase of the battle, requiring strong air force fighter support to prevent air bombing by the enemy and to permit friendly planes observing the progress of the attack and hostile reaction to radio information and directions to the tanks below to assist in this operation.

AVAILABLE ANTITANK MEANS

Having reviewed the technical characteristics and tactical employment of an armored foe, let us now consider available defensive means and their use. *Active antitank means* possess mobility, and are used aggressively to destroy or immobilize enemy vehicles.

Armor-piercing bullets, prescribed for all .30 and .50 caliber weapons, may be effectively employed (particularly in automatic weapons) against lightly armored or unarmored vehicles. At close ranges they have limited effect against tanks if the fire is directed at tracks and apertures. Their mobility and low silhouette permit employment in forward combat areas.¹

Practically all armies of the world have adopted at least one gun designed primarily to combat heavily armored vehicles.² They range in caliber from 20-mm. to 75-mm. and possess varying degrees of battlefield mobility, being transported or drawn by motor and moved by hand for relatively short distances. The smaller guns, 20-mm. and 25-mm., do not have sufficient power to penetrate heavy armor, but equipped with the automatic feature they are effective against fast-moving lightly armored vehicles. Antitank guns ranging in caliber from 37-mm. upward are single-shot weapons, which penetrate the armor of most tanks employed in combat today. These guns are able to adjust their fire quickly upon moving targets; their low silhouette makes possible their use in forward areas.

¹Foreign Antitank Rifles: *The British* issue one rifle (Boys' Model) to each platoon. It is a .55 caliber weapon, weighs 36 pounds, and is fired from bipod rest. It has high initial velocity, which makes it every effective against lightly armored vehicles. *The Germans* equip each rifle company with 3 rifles, caliber 7.9-mm., muzzle velocity 4,000 fs, weight 22 pounds, effective against light armor at short ranges.

The data on materiel from which this and following footnotes are taken were extracted from: *Taschenbuch der Herre; Wissen und Wehr; Panzertruppe; Rivista di Artiglieria e Genio*; and *Die Schweizerische Monatsschrift fur Offiziere alle Waffen*.

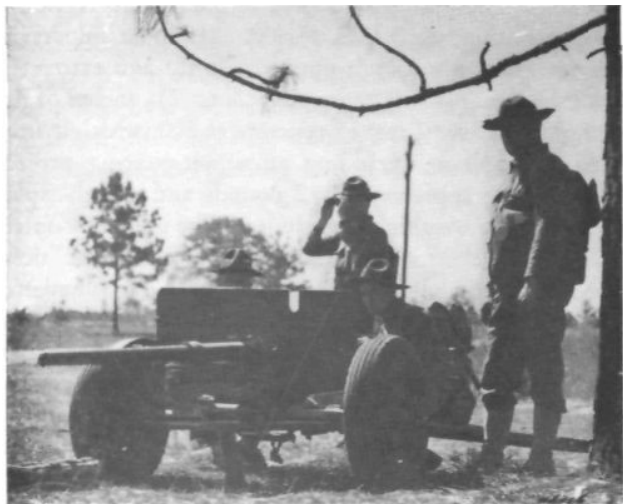
²Comparison of Antitank Guns:

	British	British	French	*French	German	German	American
Caliber	40-mm.	57-mm.	25-mm.	47-mm.	37-mm.	47-mm.	37-mm.
Wt. Projectile	2.4 lbs.	6 lbs.	.916	3.8	1.5	3.3	2
M. V. (f/s)	2,600	2,700	3,000	2,800	2,657	1,860	2,700
Penetration	—	—	1.6" at 400 2.4" at 100	4" at 700	1.6" at 400	2" at 500	—
Wt. of Gun	1,848	2,352	750	2,730	970	1,637	930

*Used in fortified emplacements.

The 37-mm. gun was adopted as the primary antitank weapon within the U. S. Army. Its more important characteristics are a high muzzle velocity and extremely flat trajectory. It will penetrate at least 2½ inches of armor plate or over 2 feet of concrete at 800 yards. It fires fixed ammunition, including an armor-piercing projectile weighing approximately 2 pounds and a high-explosive projectile weighing slightly less. The gun is mounted on a carriage of split-trail type with pneumatic tired wheels. Concealment is facilitated by its low silhouette. The traversing mechanism affords a wide field of fire (60° traverse), and the elevating mechanism permits a 30° change in elevation (15° plus and 15° minus). One man operates the sighting, traversing, and elevating mechanism and fires the gun. The effective rate of fire is limited more by observation and crew training than by mechanical properties of the piece. The gun is towed by a truck, which also transports crew, accessories, and ammunition. The weight of the gun (about 950 pounds) restricts its movement by hand over rough and hilly terrain. When limbered to the truck, it will negotiate steep slopes and has considerable cross-country mobility. Employing direct fire, it is designed to operate against ground targets only—primarily tanks. Guns are located irregularly in depth across and along the flanks of the tank approaches and sited so that hostile tanks will be compelled to advance against an increasing volume of frontal, oblique and enfilade fire.

Antiaircraft guns are effective antitank weapons when provided with armor-piercing ammunition and mounted on a carriage which will permit firing at moving ground targets. Their high initial velocity and ability to fire rapidly contribute to their effectiveness. A carriage which permits firing at air and ground targets must of necessity be relatively large and heavy. The resulting high silhouette and weight restrict their employment in the forward areas of the battlefield. There are many important objectives in rear areas which may be attacked by hostile air or armored units, such as artillery, communications centers, reserves, supply centers; obviously greater flexibility and economy of means would be effected by the employment of dual-purpose weapons for such protection. Indirectly AA weapons contribute to the antitank defense by affording strong protection against the hostile air action which usually precedes and accompanies the tank attack.



37-mm. antitank gun

Artillery is effective against tanks accurately located in assembly areas or moving through restricted avenues of approach, such as defiles. During the tank attack our artillery should be employed on its essential missions, including neutralization of enemy infantry, counterbattery, and interdiction; tanks approaching artillery positions, however, should be immediately taken under fire.³

Tanks are the most effective means by which a hostile armored attack may be stopped. When operating on antitank missions they should be equipped with weapons definitely capable of stopping the enemy tanks. They must have sufficient mobility to insure timely arrival and favorable employment in the combat. Tank units employed on defensive missions in mobile situations may advance by bounds from covered position to covered position, prepared to launch counter-blows against hostile tank attacks. In every situation the action of available tank units should be integrated with the antitank defense plans of the command as a whole. They usually are employed to launch counter-blows against those hostile tank groups which penetrate the forward antitank defensive means.

Assuming that the enemy initially has air superiority, every effort is made by our own air force to promptly dispute that superiority. Aerial reconnaissance may provide timely information relative to the hostile dispositions, composition, strength and movements. Hostile air reconnaissance must be prevented and enemy bombardment aviation which usually precedes and accompanies the tank

attack intercepted. Also attacked by air units are hostile tanks located in assembly areas, along routes of advance, and those tank groups which successfully infiltrate the forward defensive position. Aerial photographs will be one of the most important contributions to an effective antitank defense, for in this way the influence of the terrain and often hostile dispositions and plans may be predetermined. In mobile or stabilized situations, interpreted photographs of the terrain in which the unit is operating are issued when practicable to commanders of units down to include all battalions and antitank companies.

Smoke and gas may be used under certain conditions to disrupt tank formations and to create confusion. Gas decreases the efficiency of the tank crews by compelling them to wear gas masks and reducing their already limited visibility. In using smoke, care must be exercised to insure that the fields of fire for antitank guns are not masked.

Tank grenades consisting of fragile containers holding a highly combustible fluid may easily be improvised. When thrown against the tank body they burst and simultaneously ignite, the burning fluid generating high temperatures within the tank. A stick of explosive or a grenade may be tossed into a sprocket or tread. Setting fire to wooded areas, high grass and brush, or the employment of burning oil may also prove effective.

Passive antitank means are immobile and are effective only when the enemy contacts them. Passive means are always protected by small-arms fire to preclude their derangement or neutralization by hostile forces. They are arranged or selected so that the advance of enemy tanks or other motor vehicles is either canalized or effectively blocked.

Mines are a very efficient antitank means. They are easily concealed and may be quickly installed. Artillery has little effect upon them, and the ability of minesweepers to neutralize them remains unproved. A pressure of about 400 pounds detonates the mine, which will immobilize any known tank. Dummy fields induce deception; they may be quickly improvised. Friendly troops are always informed of the location of mines to prevent injury to their tanks and other motor vehicles. Foot troops may operate among them with comparative safety.⁴

Natural obstacles include heavily wooded areas containing trees at least 8 inches in diameter, overhanging cliffs, 30 to 40 degree inclines, swamps, canals, streams, lakes, villages, deep ditches, railroad embankments, boulders, stone walls, dense thickets, all of which greatly

³There were numerous occasions in the 1940 Battle of France in which the Germans effectively employed their 105-mm. light howitzers against the slow-moving heavy French tanks. Similarly the British made wide use of their 18-pdrs. and 25-pdrs. as antitank guns during the retreat to Dunkerque.

⁴Comparison of Antitank Mines:

	British	British	German	French	American
Weight (lbs.)	8	10	22	30	(Details have
Wt. of Explosive (lbs.)	4½	8	11	20	not been
Size	—	9" diameter 5½" deep	—	12" diameter	published)
Pressure to detonate	—	—	330 lbs. (Adjustable)	700	
Distribution in Div.	2,000	2,000	2,300	—	



U. S. Signal Corps

37-mm. antitank gun and prime mover

restrict or block tank movements. Trees felled about 2 or 3 feet above the ground form piles upon which tanks may become pinioned. Village streets may be blocked by mine craters or by dynamiting buildings.

In stabilized situations, time, labor, and special equipment may be available for the construction of extensive obstacles. Trenches at least 10 feet wide and 4 feet deep, or water 4 feet deep, form effective barriers. Reinforced concrete poles in staggered rows or railroad iron buried about 6 feet with from 3 to 4 feet protruding and inclining slightly toward the enemy will retard and often stop tanks. Mine craters and farm wagons, farm implements, supplemented by logs and brush, thoroughly contaminated with persistent gas and seeded with mines, create effective road blocks. Steel cables, portable rolls of heavy wire, or barbed-wire may be stretched in several rows across avenues which offer approach to vehicles. Obstacles should be located at defiles so that the enemy cannot avoid them, at road bends, in wooded areas, just over the top of a hill or in deep grass so that he comes upon them unexpectedly.

The following table indicates the distribution of antitank weapons among certain combat units:

Weapon	Inf. Regt.	Tri. Div.	Square Div.	Corps Trps.	Type Army Corps	Effective against:
	(a)	(b)	(c)	(d)	(e)	
.50-cal. MG	12	36	48	—	108	Light armor (1" or less)
37-mm. AT Gun	12	60	84	72	252	Medium armor (1" to 2½")
75-mm. AT Gun	—	8	16	32	56	Heavy armor (over 2½")
	24	104	148	104	416	

- (a) 1 AT Co with 12 37-mm guns; 3 bn dets each 4 50-cal guns.
 (b) 3 Inf regts; 3 light FA bns each 6 37-mm guns; 1 med FA bn, with 6 37-mm and 8 75-mm guns. The Engineer Battalion is equipped with 540 AT mines.
 (c) 4 Inf regts; 1 FA Brig (4 light FA bns; 2 med FA bns).
 (d) 1 AT bn with 36 37-mm guns; 1 H-M Cav regt with 6 37-mm guns; 1 FA Brig with 30 37-mm and 32 75-mm guns.
 (e) Corps troops and 3 triangular divisions.

COORDINATION OF DEFENSIVE MEANS

There are many possible ways of employing antitank means within the American triangular division.⁵ The commander prescribes where, when, to what extent, and how long antitank measures will be provided. Engineers, tank and antitank commanders (both infantry and artillery), may be called upon to submit appropriate recommendations. The command post of the unit is the reception center for combat information and enemy intelligence. It receives the earliest indication of a pending hostile tank attack or motorized movements. Obviously the commander himself is in the best position to decide the

employment of available means, and if reinforcements are required, it is he who requests them from higher authority.

The present triangular division organization does not provide a senior antitank commander or designate a staff member for the specific purpose of coordinating antitank defense. Hence the division staff must initiate the necessary plans to insure cooperation and thorough coordination between all antitank organizations and adjacent, attached, and supporting units.

Antitank units usually provide protection for their respective organizations, but there should be no hesitation on the part of a commander to detach them when the situation urgently requires the reinforcement of another area. The 37-mm. antitank platoon, organic with each of the four divisional artillery battalions, and the 75-mm. antitank battery of the medium battalion, are used in supporting roles within the division. In a coordinated divisional defense, the protection they provide their own battalions will be incidental. Operating usually under division control, they reinforce and supplement the infantry regimental antitank means and afford protection for reserves, gaps, and exposed flanks. Antitank, tank, air and antiaircraft units, which are attached to or in support of the division, must always be integrated in the general plan of defense. Teamwork is vital!

MORALE

Evidence abounds proving that the shock action and fear produced by tanks are quite as effective as their actual destruction of life and materiel. It is, therefore, of the highest importance that all members of the command be thoroughly familiar with both the *enemy* and *friendly* tanks, their strong and vulnerable points, distinguishing characteristics, and tactical employment.

Soldiers who are not equipped with definite antitank

⁵These means may be adapted, with logical modifications, to other types of divisions.

means seek cover and concealment when hostile tanks approach. They should always hold themselves in readiness to deal with enemy infantrymen who usually follow. But not the antitank man! After long minutes or hours of watchful waiting during which he may be subjected to severe air and artillery bombardment, and his observation restricted by smoke, his particular foe arrives. He must calmly wait under cover until the tank is within effective range. Premature fire may reveal his position and result in neutralization before he can accomplish his mission. Deliberate action, courage of the highest order, and determination to keep his gun firing characterize the antitank soldier. The duel between him and his armored foe will last only a few minutes. The degree of his success will be determined principally by his morale, stamina and training.

COMPUTATION OF GUN REQUIREMENTS

Tanks usually advance cross-country in deployed formations at about 200 to 400 yards per minute. In stabilized situations the distance between the tank line of departure and the defender's main line of resistance is between 1,000 and 1,500 yards; thus after the jump-off a tank would require from 4 to 8 minutes to reach the defender's position. Let us assume that the tank attack was discovered promptly—that is, when the leading tanks were 8 minutes from the defender's position. How much readjustment of means or movement to positions could be accomplished and how many rounds of effective fire could be delivered within 8 minutes? The antitank gun towed behind a truck may move to a previously selected firing position at about the same rate of speed as the tank. Without even considering the effect of hostile measures (air and artillery) to prevent such movement, it is apparent that antitank units in the forward regimental areas must be in firing positions or in close proximity thereto *prior to the tank attack*, or they may never reach appropriate positions in time to deliver effective fire.

The time available is further restricted by inability to fire accurately at moving targets beyond 1,000 yards with present sighting equipment and the admonition that fire must not be opened prematurely for fear of neutralization.

Advancing 200 to 400 yards a minute, the tanks *within 5 minutes* will be stopped or diverted, or swarming over the gun position.

The following rule of

thumb is often used by one European military authority and may provide a basis for estimating antitank gun requirements. We have arrived at 5 minutes as a possible duration of a fire fight against tanks. The antitank gun may fire approximately 10 shots per minute. (A trained crew under favorable conditions may fire as high as 20; however, under combat conditions 10 rounds appears to be a more practicable rate.) In 5 minutes each gun will fire 50 rounds. If 10 per cent of the total fired immobilize a tank, each gun will account for 5 tanks. Theoretically, a tank mass of 500 might be destroyed if 100 guns could be disposed in depth irregularly across and along the flanks of the zone of action selected for the attack. Computed on this basis, an infantry division confronted by an armored division (500 tanks) would require 100 antitank guns.⁶

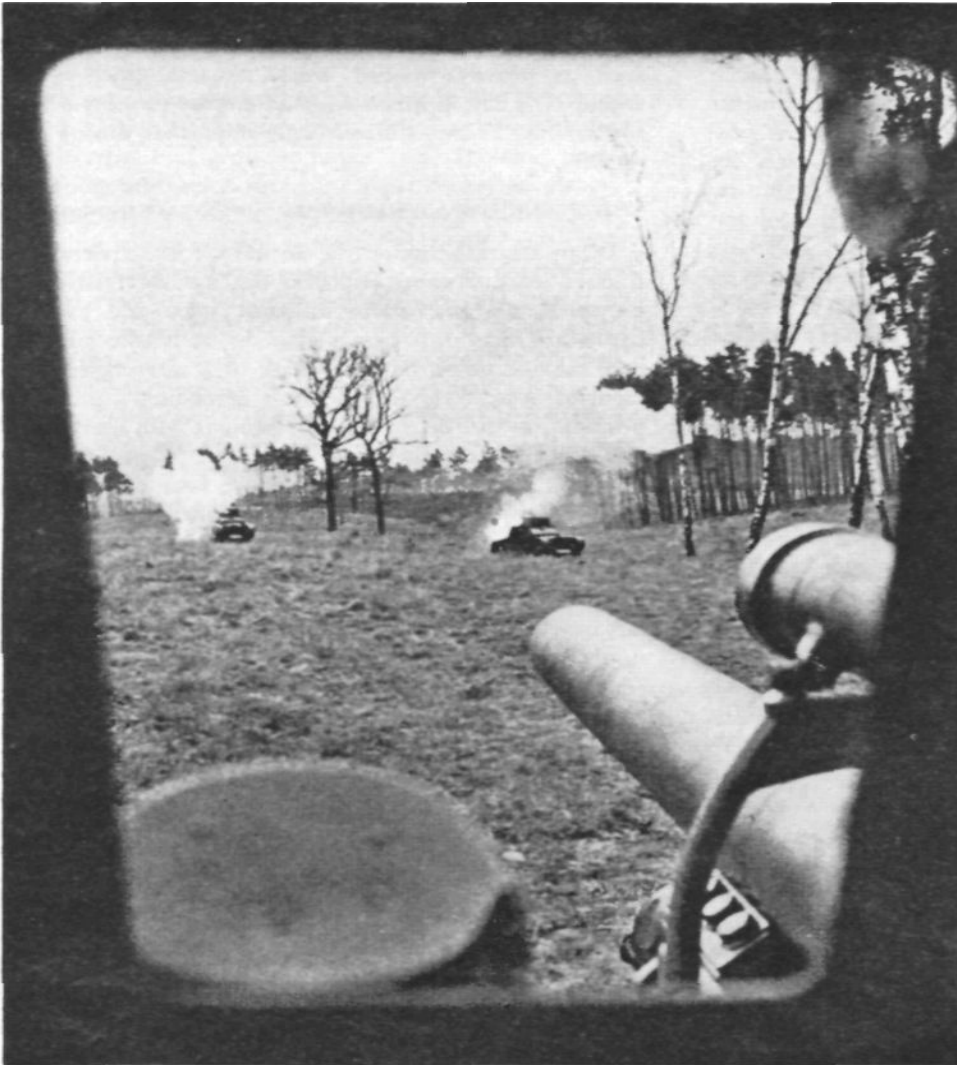
WARNING SERVICE

Any military force, whose size or potential threat may induce the enemy to attack with a mass of tanks, must be provided with a continuous warning service, functioning through organic, adjacent, attached and supporting reconnaissance, security, and communication units. The simultaneous employment of several warning and communication means is recommended. The most effective reconnaissance and security units include airplanes, scout cars, motorcycles, and motorized patrols. The striking power, radius of action, and mobility of modern armored forces compel vigorous action to insure the timely employment of antitank units even though considerable distance separates the opposing armies. The prescribed tank warning signal (3 shots or 3 blasts of any nature) must be understood and quickly relayed through all

⁶The American Division as now organized is equipped with: 36 .50 caliber machine guns, 60 37-mm. AT guns, 8 75-mm. AT guns. Thus, admitting that the .50 caliber may be ineffective against modern tanks, we are rather short of the AT requirement figured on the basis of the foregoing.



88-mm. German anti-aircraft gun employing direct fire at a column of French tanks—a remarkable action photo!



Looking through the port in a shield of a German 105-mm. howitzer which is being used as an antitank gun.

echelons of the command. First priority should be given within the communications net to messages pertaining to hostile tanks and other motorized elements. The radio is the usual means of communication within antitank units. Simple prearranged codes facilitate transmission, and minimize usefulness to the enemy if the message is intercepted. In stabilized situations wire communications are installed and are usually connected with the nearest unit having circuits to higher and adjacent units. Without an effective warning system the most elaborate and carefully coordinated antitank defense plan will obviously be useless.

TERRAIN

Terrain must always be carefully studied with a view to locating cover and concealment for antitank guns and trucks, fields of fire, covered routes leading to firing positions, and alternate positions. The terrain is surveyed *from the enemy viewpoint* to determine avenues of

approach feasible for tank employment, potential assembly areas and obstacles that may block or restrict tank movement. *The proper evaluation and utilization of terrain is of vital importance in defense against armored units.*

PROTECTION ON THE MARCH

During the route march, air and motorized ground detachments as well as strong covering forces will usually precede the marching columns, providing sufficient time at least for hasty defensive preparations against a hostile tank mass. However, air units, enemy scout cars, armored cars and motorized patrols may be very active on harassing, reconnoitering or delaying operations. If the division is marching as an interior one, it is exposed to the front, to a limited depth on the flanks, and possibly to the rear; but a flank division is vulnerable from three directions. When the march order definitely prescribes the time and routes of march, the division commander may not be able to take full advantage of available passive antitank

measures. In the absence of such orders, however, routes are selected to utilize available terrain obstacles; and the march is made under cover of darkness. If conditions permit, advance reconnaissance is conducted with a view to determining the most suitable routes and to select bivouac areas. Although covering forces, air and ground, are operating on reconnaissance and counter-reconnaissance missions in advance of the division, continuous antitank vigilance and defensive measures against hostile motor elements are maintained. The infantry antitank companies provide protection for their respective regiments and are disposed in or along the flanks of the column to combat sudden enemy thrusts. Battalion antitank weapons provide protection for their battalions. The antitank company of the leading infantry regiment may be distributed with one platoon attached to the advanced guard, the company command group with the regimental commander, one platoon between elements of

the main body, and one platoon between the foot and motor elements of the column. If observation is unrestricted, some or all of the antitank units may march in the column. Leaders and reconnaissance detachments continually study the terrain and are alert for the possibility of hostile attack. On terrain that restricts observation it is imperative that antitank units advance by bounds to cover dangerous approaches while the column is passing. Under such circumstances the guns usually occupy firing positions on a flank at sufficient distance to prevent delay or interference by hostile action.

The 37-mm. antitank platoons of the artillery provide protection for their respective battalions, as indicated for the infantry regiments. The 75-mm. antitank battery will march with the 155-mm. howitzer battalion. During the march halts or bivouacs, temporary road blocks are established covering routes leading into the area, and antitank units are assigned missions to provide protection at dangerous avenues of approach. An exposed flank of the division is covered by a flank guard with attached antitank units. If hostile motorized forces are numerous and annoying, a composite force, consisting principally of antitank and motorized rifle units, engineers, and communications means, may be formed as a division blockade unit to establish a tank barrier and a line of protected temporary road blocks at vulnerable points along the exposed flank.

DURING THE APPROACH MARCH

As the distance between opposing forces decreases, or after contact has been made, a mass tank attack is more probable. Hostile motorized reconnaissance elements become increasingly active. Covering detachments during this phase are maneuvering to gain or to hold favorable terrain for future eventualities and are making dispositions to permit freedom of action for their respective main forces.

Antitank weapons of the infantry battalions continue to provide protection for their own units. The infantry regimental antitank companies are employed to supplement and reinforce the antitank platoons of the infantry battalions, and to provide protection for the approach march objectives or assembly areas assigned to their regiments. The artillery antitank units continue to provide protection for their battalions, or may be assigned definite missions by the division commander. Vigorous reconnaissance must be executed by the leaders of all antitank units during this phase, with a view to selecting gun positions that will effectively cover possible approaches for hostile tanks. Guns may be held under cover in mobile reserve prepared to occupy quickly previously reconnoitered positions. The change from route march to the approach may be caused by hostile action, or may be a definite step in the commander's preparation for combat. If enemy action compels deployment, advance planning usually is not possible; orders are fragmentary,

often lacking entirely. Whenever possible, approach-march objectives and assembly areas must be selected with a view to taking advantage of natural tank obstacles such as heavily wooded areas, streams, ditches and swamps. The *coordination of all antitank means within the division* becomes increasingly important during this phase.

ANTITANK EMPLOYMENT WITH AN ATTACKING FORCE

In an attack situation the antitank role requires continuous reconnaissance and flexibility and aggressive employment. As the troops advance, gaps and exposed flanks are constantly being created. A hostile tank attack may occur during any phase of a meeting engagement or attack. If the enemy is defending a prepared position, he will be thoroughly familiar with the terrain and will have definite plans for the employment of his tank units in swift, limited-objective counterattacks, to recover key terrain within his position. During the attack, therefore, antitank weapons are employed with a view to providing protection against enemy tank counterattacks. Antitank weapons of the infantry battalions advance with, or closely behind, the assault echelons. The infantry regimental antitank units, advancing by bounds, endeavor to be in positions that will permit timely fire against hostile tank counterattacks. They should be able to advance to forward positions as soon as friendly infantry units occupy a terrain mask that precludes hostile observation and affords protection from small-arms fire. The artillery antitank platoons and battery will be employed under division control in order to reinforce and supplement the antitank units of the infantry. Careful coordination between all antitank means is necessary to insure continuous protection for the division as a whole, including exposed flanks, gaps, and reserves.

It will be recalled that the 37-mm. antitank gun's shell will penetrate about two feet of concrete at 800 yards. Therefore, antitank units equipped with this weapon may effectively support rifle companies and battalions whose mission requires the capture of objectives containing concrete emplacements, metal barricades, masonry defensive works, and similar protective means.⁷

DEFENSIVE SITUATIONS

The antitank role in defensive situations requires thorough reconnaissance, meticulous coordination and planning, selection and arrangement of obstacles, an effective warning service, extended periods of watchful waiting, efficient communications, prearranged signals, flexibility in the employment of available means, deliberate and accurate fire action, and finally the antitank gun crews' dogged determination to keep their guns firing to the last man.

If the enemy is attacking, it may be assumed that he is superior in numbers and materiel. He probably has

⁷It is possible, too, that future supply of AP shell will make the 75-mm. antitank gun useful for such purposes. Appropriate training in this type of fire should receive consideration.

air superiority and is prepared, at least during the initial phase, to prevent or greatly restrict reconnaissance, both aerial and ground. Under such conditions, he can concentrate secretly a mass of tanks close to the defensive position for surprise employment. He may assemble his tanks beyond our artillery range and, at some unexpected time and place, launch a swift concerted attack, employing at least 100 tanks, probably several hundred. Advancing in waves over a broad front, the tank mass will be preceded and supported by aerial bombardment, smoke, the fire of artillery and close support weapons, in an attempt to neutralize antitank guns and observation.

In the past the division commander's greatest concern in selecting a defensive position was available fields of fire and observation. Today he must give high priority to the possibilities offered by the terrain against tanks and motorized units.⁸ After the main line of resistance has been selected and areas have been assigned to the respective infantry regiments and artillery battalions, commanders immediately initiate their reconnaissance. Security measures, however, are not relaxed; antitank units are temporarily disposed to provide protection. To insure an economical use of available means, the division G-3 coordinates the reconnaissance and dispositions. When practicable, the antitank unit commanders contact the division engineer and conduct joint reconnaissance of their respective areas, with a view to determining how the terrain will influence the enemy's employment of armored elements. Definite tank obstacles are located on available maps or sketches. Natural obstacles which, with a little work, may be considerably improved in effectiveness are noted. The location of tank assembly areas and potential avenues of approach available to the enemy are reported.

The plan of defense within the division area is based on the premise that the hostile tank attack must be stopped in front of the main line of resistance. Definite provisions are made to combat tanks entering the division area from the flank or rear. Some of the guns are sighted to fire effectively several hundred yards in front of the main line of resistance and others must be prepared to cover avenues which offer approach from adjacent areas. (Figure 1.) It will be rare indeed when the hostile tank mass approaches the defensive position head-on; consequently, antitank obstacles and weapons must be so flexibly disposed as to permit timely employment in any direction.

Hostile action (air and ground supporting weapons) and the mobility of the tanks may restrict the time available to move antitank guns to oppose the attack. Therefore the antitank guns of the infantry battalions and regiments which occupy advance areas in the defense are usually concealed in close proximity to their designated places of

⁸The French placed great reliance upon stream lines and other natural obstacles, often sacrificing observation and fields of fire in order to stop or at least delay the German tanks. At Montfaucon, for example, the French defended only with weak outposts and established a strong defensive position along a stream line several hundred yards to the rear. In World War I this prominent terrain feature was strongly defended.

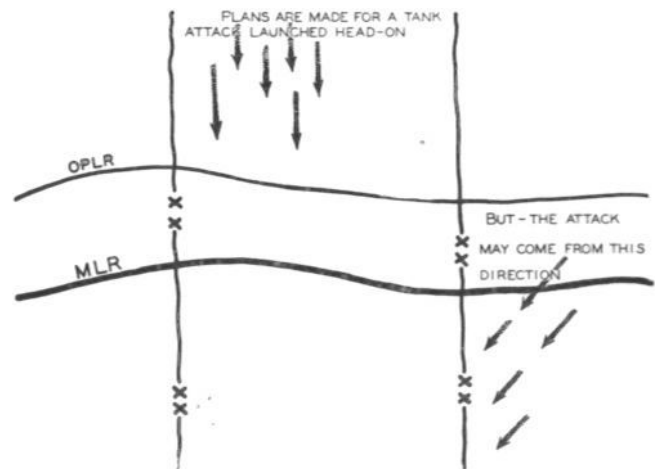


Figure 1

employment; in many situations the guns are actually in firing positions.

The division may defend an area about 7,000 yards in width and about 10,000 yards in depth, and a regiment from 2,000 to 3,000 yards in width and approximately 3,000 yards in depth. (A tank mass [500 tanks] usually advances in a zone of action approximately 2,000 yards wide, which corresponds in width to an infantry regimental front.) Areas protected by natural obstacles such as swamps, overhanging cliffs, and similar barriers, must not be disregarded, but may be given reduced consideration in planning the defense; thus the commander is enabled to concentrate mines, artificial obstacles and gun units at the avenues more vulnerable to tank approach. Arrangements are made with rifle units to cover obstacles and mine fields with small-arms fire, and friendly troops are informed of their location. Dummy mine fields are installed by the engineers in order to deceive the enemy.

Infantry battalion antitank platoons are usually located within their battalion areas, close to the main line of resistance. They are reinforced by guns of their regimental antitank companies. The antitank means of reserve battalions, infantry regiments, and of artillery battalions and attached units may be assigned missions under division control to further reinforce and supplement the forward antitank defense, to cover avenues on the flanks and to protect reserves; or they may be held in mobile reserve, under cover and prepared to quickly occupy previously selected positions. All gun units are coordinated within the division and adjacent areas in an effort to insure depth in dispositions. Firing positions are selected along the flanks and irregularly across dangerous areas and approaches in order that hostile tanks will be compelled to advance through a continuous volume of effective frontal, oblique and enfilade fire.

The organic antitank means of the infantry division, if alerted by an effective warning service and carefully coordinated and integrated within the division defensive

plan, are believed adequate to stop or destroy a hostile tank mass *that does not exceed 100 tanks*. Against a larger armored force, the division antitank defense will make an important contribution by retarding, disrupting, inflicting losses on and canalizing the hostile tank mass; and, in general, will create conditions favorable for the successful employment of the mobile antitank reserves provided by the next higher echelon or general headquarters.

A PROPOSED ANTITANK DEFENSE

Proposals for antitank defense in the American Army are submitted herewith in the hope that they may contribute to the early adoption of an antitank doctrine and a progressive plan for development of armament.

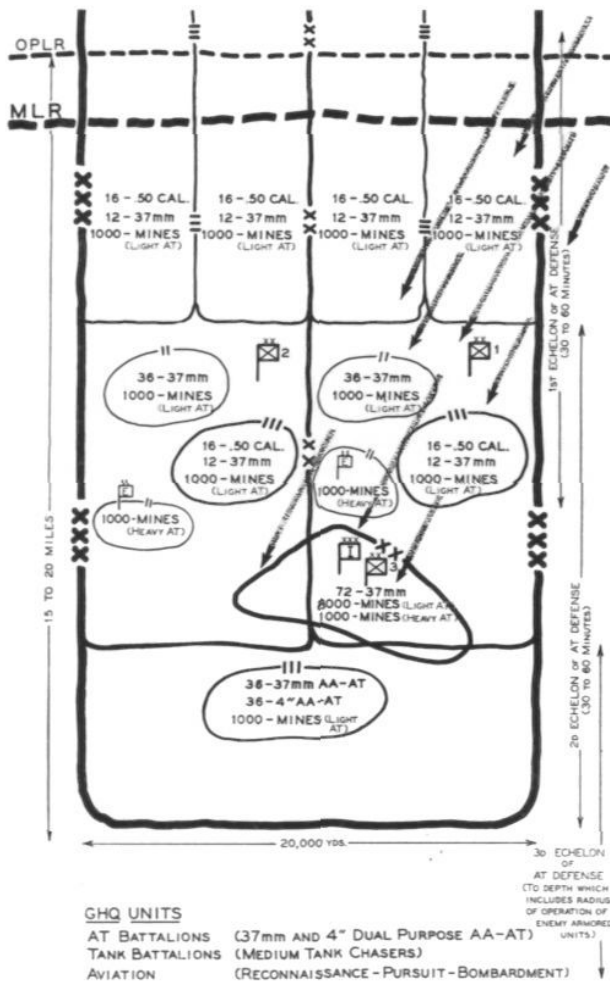


Figure 2

WEAPONS

- 1,000 Antitank Mines (light) carried in the combat vehicles of each infantry regiment, antitank, antiaircraft and artillery battalion.
- 4 Machine Guns, caliber .50 (a platoon), in each infantry and engineer battalion, reconnaissance unit, artillery and antiaircraft battery, regimental,

Our present infantry triangular division is a well-balanced combat unit, capable of either sustained offensive maneuver or stubborn defensive action. If we greatly increase the number of antitank weapons in the division, we will jeopardize that balance by adding large numbers of essentially *defensive means or weapons of opportunity*. If the division is confronted by an armored force of several hundred tanks, it may not stop the enemy with the organic means recommended in Figure 2, but it can inflict many casualties and create conditions (disruption,

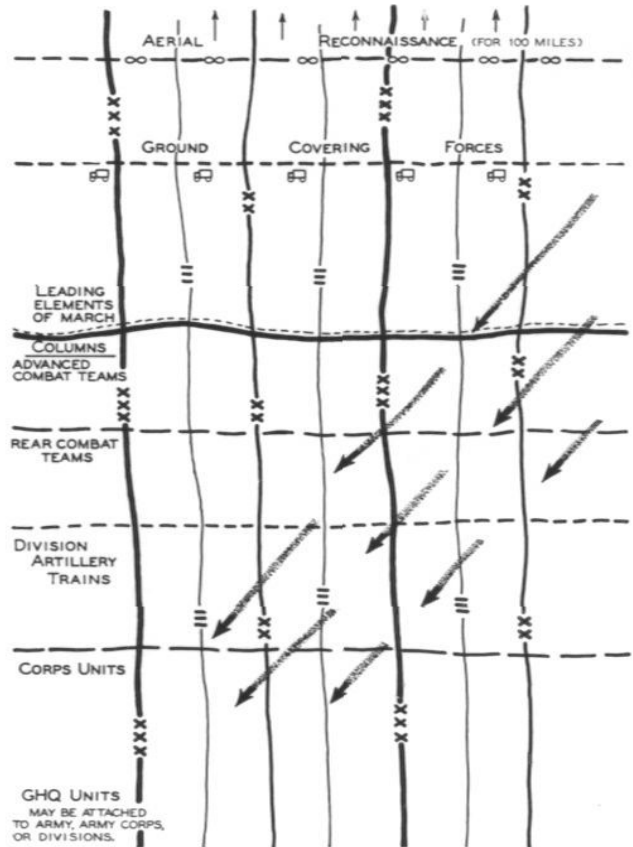


Figure 3

- division and army corps headquarters.
- 12 37-mm. Antitank Guns (Company) in each regiment.
- 36 37-mm. Antitank Guns (Battalion) in each division.
- 1,000 Antitank Mines (Heavy) in each Engineer Battalion.
- 72 37-mm.-4" AA and AT Guns (Regiment) in each Army Corps.
- 5,000 Medium Tanks (approximately 100 Battalions) in G. H. Q.
- 3,600 37-mm.-AT-AA Guns (100 Battalions) in G. H. Q. Pursuit units from G. H. Q. Air Force, light bombing units from G. H. Q. Air Force, operating in direct support of an Army. Observation units from corps and army aviation.



Actual battle scene—German antitank gun being used in attack on village

delay, and canalization) that are favorable to the employment of mobile antitank means of the next higher echelon or G. H. Q. Another important consideration is the grave danger of dispersion when timely *concentration* of antitank weapons in the critical area is vital. The bulk of the antitank units are therefore pooled in G. H. Q. They are usually attached to armies or to army corps and are held highly mobile, in centrally located positions, prepared to move rapidly to areas of hostile tank employment. Their mobility must be insured by friendly air units, otherwise hostile air action may delay or prevent them from reaching points from which to fight the tanks.

Combat units to include the squad and all vehicles should always be provided with positive means of defense against armored units. Such a general distribution facilitates depth and flexibility in antitank defense. It also has a

psychological advantage, for men like to feel that they have effective, readily available protection against the onslaughts of an armored foe. A light antitank mine, not exceeding 10 pounds, preferably lighter, is recommended. Ten of these mines should be distributed to each cargo vehicle, prime mover, and weapons-carrier within the infantry regiment and the antitank, antiaircraft and artillery battalion. The mine should be designed to detonate under a pressure of approximately 400 pounds, and must be capable of immobilizing any type of tank. A heavy mine, not to exceed 20 pounds and capable of destroying any tank, should be issued to each engineer battalion, their employment to be determined by the division commander. The number of mines suggested (1,000) for the engineer battalion would provide an effective mine barrier 600 yards long and 15 yards deep. The employment of mines must always be

carefully coordinated to effect economy, to insure effectiveness and to preclude injury to friendly vehicles.

An automatic or semi-automatic weapon should be available for local security (antitank-antiaircraft) as follows: 4 for each infantry battalion, divisional reconnaissance unit, engineer battalion, artillery gun battery, searchlight battery, headquarters of regiments, divisions and army corps. This gun should be capable of penetrating 1½ inches of armor at about 500 yards. It should be provided with a dual-purpose mount, permitting automatic fire at air or ground targets. A weapon between 15-mm. and 25-mm., and weighing approximately 250 pounds, is suggested. Until such a gun is provided, the .50 caliber machine-gun should be distributed as indicated above.

The 37-mm. antitank gun is sufficiently powerful to stop tanks protected by 2½ inches of armor. If the constantly reported trend to thicker armor on tanks (over 3 inches) becomes an established fact, the present 37-mm. gun may be modified to increase its penetration, or a 47-mm., a 57-mm., or even a 75-mm. antitank gun may be necessary. The 12 37-mm. antitank guns allocated to each infantry regiment are considered adequate for the protection of that unit except when opposed by several hundred tanks. The 6 37-mm. antitank guns assigned by tables of organization to each of the divisional artillery battalions should be removed from those units and organized into a divisional antitank battalion. It is further suggested that the 8 75-mm. antitank guns now assigned to the medium artillery battalions be removed entirely from the division and that 12 more 37-mm. antitank guns be added to the recommended division antitank unit. This would result in a battalion of 36 37-mm. antitank guns. The commander of the unit would act as antitank advisor on the division staff.

The 36 37-mm. and the 36 4" dual-purpose guns should comprise the corps antiaircraft-antitank regiment. All weapons in this regiment should be capable of 10 depression to permit firing at ground targets. They should be provided with high-explosive and armor-piercing ammunition. The guns should be drawn by motor, should have considerable cross-country mobility, and should require only a few minutes to prepare for action. The 4" gun should have a vertical range that would permit effective fire up to a height of 40,000 feet.

These suggestions do not increase the number of guns appreciably but they do provide an organization which greatly facilitates coordination and flexibility in the employment of antitank means within the division.

The medium tank is considered one of the most effective antitank weapons. It should mount at least a 3-inch gun and stress should be laid on its mobility and speed, rather than its armor. This tank is visualized primarily as a "tank chaser"—a positive means to seek, overtake and destroy enemy tanks. Therefore the battlefield characteristics, "destructive power and cross-country mobility," must be emphasized in its design and construction. A "tank chaser"



German tank "chaser." Reproduced from the Spanish army review "Ejercito," this shows that the Germans are making use of captured vehicles and weapons to construct armored self-propelled antitank guns which they apparently will use in large numbers in their new Panzer divisions. Illustrated here is a captured British Bren machine gun carrier in which is mounted what may be a 47-mm. or larger antitank gun. The resulting vehicle is not exactly a tank, but it carries light armor for protection of the crew, while the gun shield furnishes protection against tank fire. Note that the vehicle has low silhouette, and that the gunner will have good visibility for all-round fire. Previous photographs reproduced in THE FIELD ARTILLERY JOURNAL indicate that the Germans will employ their own light tank chassis, with the turret removed, for similar purposes.

is more desirable than the frequently-discussed mobile mount, because the chaser may be used offensively as well as defensively, whereas the gun on a mobile mount is restricted to defensive use.⁹ These tanks should be organized into G. H. Q. groups, each comprising 3 battalions of about 60 tanks or approximately 200 per group. They may be used either to combat hostile tanks or to reinforce divisions and corps in offensive and defensive action. This organization would facilitate administration, maintenance, and training, and would in no way militate against the effective tactical employment of the battalions. It is not believed desirable to employ the armored division or its tank elements in an antitank role. Armored divisions and corps are decisive means in the hands of the commander, to be employed primarily in large-scale offensive and defensive operations.

The number and types of airplanes maintained at

⁹If this country adopts heavy as well as medium tanks, the numerous light tank chassis now on hand may be used to excellent advantage as mounts for antitank and close-support heavy infantry weapons.

G. H. Q. are obviously influenced by tactical and strategical considerations.¹⁰ Corps and army air units may be called upon to perform the following antitank missions:

1. Photograph the area in which the unit is operating and promptly interpret and disseminate copies to all air and antitank gun units and infantry, artillery, antiaircraft, engineer, and tank battalions. This will greatly assist in determining hostile tank assembly areas, and routes of approach, and will usually make possible definite plans for the defense (observation).

2. Conduct continuous and vigorous reconnaissance, especially in those areas where hostile activities are strongly protected by air and ground counter-reconnaissance means (observation).

The GHQ Air Force units which have been placed in support should perform the following missions:

1. Prevent the hostile aerial reconnaissance which is so essential to the successful employment of large armored forces (pursuit).

2. Attack hostile tank assembly areas and avenues of approach (bombardment).

3. Intercept enemy dive bombers attempting to support the tank attack (pursuit).

4. Attack hostile tank groups that penetrate the defensive position and attempt exploitation in rear areas (bombardment).

A SUGGESTED ANTITANK DOCTRINE

The best *defense* against the lightning-like, destructive blows associated with modern warfare is the *offense*. Therefore *tanks* and *planes*, with their recognized offensive powers, are the most effective defensive means against armored forces and air units. All other antitank measures make important contributions to the defense by disrupting, delaying, inflicting casualties and canalizing the tank mass, and thus creating conditions favorable for the employment of medium tank units and combat aviation.

In disposing his means, the commander must prepare to defend against swift blows at the most unexpected places and times. The French General Staff couldn't conceive of an armored thrust of any magnitude driving successfully through the rugged terrain of the Belgian Ardennes. Yet five armored divisions and three motorized divisions successfully penetrated this deep forest and crossed the Meuse River in an unprecedented employment of armored forces.¹¹

If the American Army is successfully to combat such an attack, each military force throughout the theater of operations must be provided with:

1. An effective warning service.

2. Antitank means flexibly disposed in depth and reinforced by strong, mobile reserves.

3. An air force of sufficient strength to neutralize hostile aviation.

An effective *warning service* is predicated upon continuous and vigorous ground and air reconnaissance, simple prearranged signals, and alternative means of communication. The hostile tanks will attack over a broad front initially, with the succeeding echelons flexibly disposed in rear so that they can quickly exploit penetrations and break-throughs determined by the leading waves. If friendly air force units have successfully disputed "air superiority" over the area concerned, our reconnaissance planes may determine the developments of the hostile tank attack and radio their information to ground units, indicating the points where enemy vehicles are infiltrating or massing in depth. Taking aerial photographs of the area in which the force is operating and the terrain contiguous thereto, integrating and distributing them to all antitank units down to platoons and to all other troop units to include battalions, should be standard procedure in modern warfare. Using a prearranged grid system, the movement and exact location of hostile tanks may be quickly followed on the photographs as the reports of air and ground observers are received. Such information should be sent in the clear in cryptic prearranged form at very short intervals. Continuous and accurate intelligence relative to the enemy tank movements would enable the commander to make timely readjustments in the employment of his means.

Modern warfare makes new demands upon military commanders in connection with the handling of military and civil traffic, and the conduct of civilians living in combat areas. There are no zones or areas immune from the attacks of air and armored units. In fact, rear areas are particularly vulnerable. It devolves upon the antitank-antiaircraft warning service, in close collaboration with military and civil police organizations, to establish and enforce definite regulations pertaining to the control of traffic, the operation of the communication systems, the destruction of bridges, the operation and protection of public utilities, and action of civil residents under various sets of conditions. Civil authorities must insure that the population is fully informed relative to its role in the plan of military operations within the area. Measures must be taken to insure strict compliance with the regulations and to preclude subversive activities. There were many instances in Poland, Holland, and France of bridges not being destroyed as ordered, and of French troops reluctant to fire upon the German armored columns that were flanked and interspersed by French refugees.

In moving or stabilized situations the dispositions suggested in Figures 2 and 3 would furnish immediate and effective protection against small scale tank operations. If large masses of hostile tanks attack, sufficient depth and flexibility are provided to create conditions (delay,

¹⁰The French front-line commanders begged for air support in their desperate efforts to stop the armored foe in May, 1940. But, according to reports, friendly air units were operating on "strategical missions" in the Rhine Valley and were not available for tactical missions. The tricolor might still be floating from the Eifel Tower, had the German air superiority at Sedan been decisively disputed.

¹¹Approximately 45,000 motor vehicles were employed in this particular phase of the German advance.

disruption, and canalization) favorable for the employment of mobile reinforcements (tanks, antitank and antiaircraft weapons, and combat aviation) of the next higher echelon and G. H. Q.

Antitank measures may be classified in three echelons, according to their location and prospective employment. In the first echelon, extending from the leading to the rearmost combat elements of the division, a distance of approximately ten miles, we will usually find all of the organic antitank means of the advanced divisions. The exact location of the antitank weapons will be fixed by their mobility, silhouette, the terrain, field of fire, observation, mission, and the enemy situation. Hostile action to prevent movement and the rapidity with which modern situations may develop require that the weapons in this echelon be in firing positions or in close proximity thereto. In addition to inflicting casualties, disrupting and canalizing the tank mass, the first echelon may delay the advance so that from 30 to 60 minutes will elapse before those enemy tanks that survive the antitank fire, mines, and obstacles of the first echelon can reach the area protected by the second echelon. We should never smugly assume that the enemy will not employ his armored units in force merely because he has not established local air superiority. On the other hand, he will usually make every effort to have control of the air. In the time required by his armored units to penetrate our first echelon of defense, our combat aviation and mobile antiaircraft units must vigorously dispute his air superiority. This is of vital importance; otherwise the enemy will immobilize our forces, while retaining complete freedom of action for his own.¹²

The antitank means of the reserve divisions and the corps regiment of dual-purpose weapons will usually comprise the second echelon and should utilize the available thirty to sixty minutes to readjust their dispositions in order to stop the hostile tanks that succeed in penetrating the forward wall. Light and heavy mines may be quickly installed in the path of the reported tank movement and gun units should move quickly to positions previously selected to block the hostile vehicles. Further delay, disruption, casualties, and canalization will result as the enemy tanks advance through the gauntlet of antitank measures in the second echelon, which will vary in depth from 5 to 10 miles. Highly mobile and effective means must now be available to seek out, overtake, and deliver knockout blows against those tanks that emerge to wreak havoc and destruction in our rear areas (communication centers, industrial areas, public utilities, road and railroad nets, supply depots, airdromes, and strategic reserves). Medium tank battalions (tank chasers), mobile antitank and antiaircraft units, pursuit and bombing planes will constitute a third or final echelon of antitank defense,

extending from the rear boundaries of Army Corps to the extreme range of operation of the enemy armored force. They all should have previously conducted reconnaissance in order to be thoroughly familiar with the area of employment and to formulate effective plans of operation.

The numerous antitank measures proposed, including the warning service, mines, weapons and obstacles, will be effective to the degree of *coordination* and *cooperation* accomplished in their employment throughout the theater of operations. Timely disposition of the more or less immobile means must be provided. Vigorous searching for the armored foe, tenaciously holding on to his flanks, pursuing and destroying him at every turn, summarize the action of mobile antitank weapons.

CONCLUSIONS

The struggle in future warfare, as in the past, will be to deny or restrict maneuver to the opponent, while retaining full freedom of action or a higher degree of mobility for our own forces.

Tanks and airplanes have not deprived *infantry* and *artillery* of their former supremacy, but *have* greatly accelerated the methods, changed techniques, and provided supplementary means for maneuver or denial of maneuver.

Air superiority or air superiority disputed, is absolutely necessary to insure the success of offensive and defensive operations involving large armored forces. We can and *will* dispute that superiority with our own air force.

The tank itself (or tank chaser) is the primary defensive weapon against tanks. Other antitank means, active and passive, create conditions, such as disruption, delay, casualties and canalization, which favor the employment of the tank units.

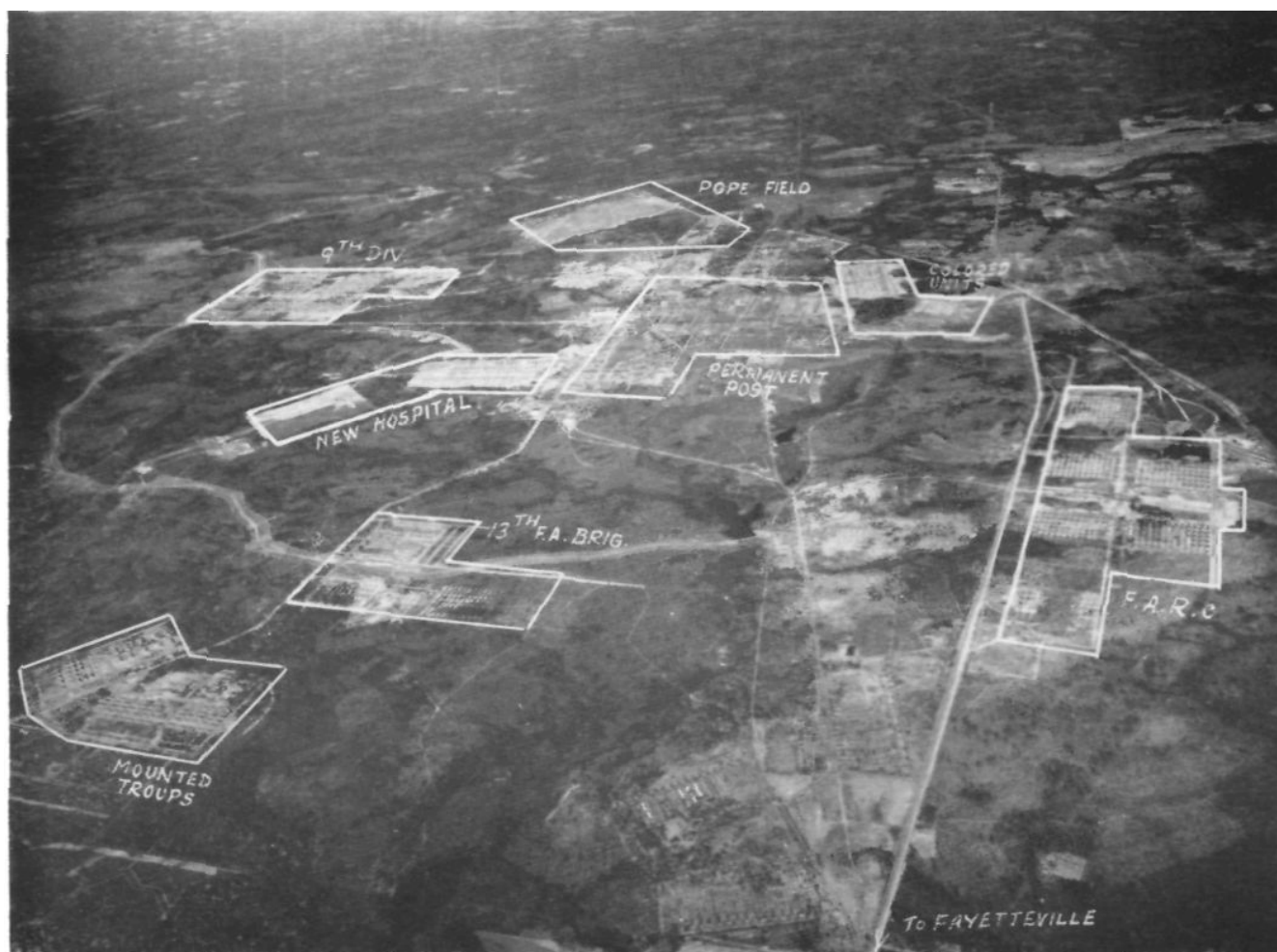
Modern armies are in the preliminary stages of a transition caused by the adaptation of the motor to the battlefield. Wars will accelerate the changes. Horse-cavalry reconnaissance may be performed by airplanes, armored cars, and motorized patrols. Artillery itself may become armored and certain artillery roles may be assumed by bombing planes. Infantry will be transported in armored carriers and airplanes.

An outstanding military authority of Europe said to the author in 1937: "Armor will enshroud war machines operating on the ground and in the air. Improved mobility, more effective and universally used armor, increased radii of operation, greater destruction and shock power may be expected."

The moral stamina of the fighting man, sound strategic concepts and adroit leadership will always be fundamental. Given these attributes, it still remains that "God is with the biggest battalions"—and the modern interpretation of "biggest battalions" means vast numbers of *airplanes* and *armored vehicles*. American ingenuity, tremendous resources and unity of purpose must be fully exploited to meet this "challenge."

¹²Although the Germans were reported, in the spring of 1940, to have an aircraft superiority over England of 5 or 6 to 1, the British established local air superiority over Dunkirk for a sufficient length of time to prevent the annihilation of the B.E.F.

Progress at the Fort Bragg Replacement Training Center



Air photo of Fort Bragg in 1941, showing new construction

THEY START TO ROLL

By Lt. Colonel Edwin P. Parker, FA.

Fort Bragg has 2,562 new buildings, 93 miles of paved roads, 75 miles of water mains, 60 miles of sewer lines, an 8,000,000 gallon (per day) water system, 60 miles of electric power lines, and when complete will be the third largest city in North Carolina.—F.A.R.C. News.

By the time you read this article, the Field Artillery Replacement Center at Fort Bragg will be rolling at top speed. Its five huge regiments will be filled with over 400 officers, 2,200 in cadres, and 14,000 trainees. Outnumbering a triangular division, they will strain the capacity of 528 buildings which have suddenly appeared in the pines.

About the middle of July, the first product will begin to reach your outfit. It is the purpose of those directing the Replacement Center to send you a group of men who first of all are completely imbued with that true discipline which begets the highest form of teamwork, and who secondly are well trained to fill particular places in your military team. Once the Replacement Centers begin to deliver the men, you should be able to sleep at night. Those nightmare calls for cadres, cadres, cadres should cease to plague you. Batteries which have had

the last proficient cook and gunner pulled out like wisdom teeth will not have to begin the uphill task of training recruits. They will receive complements of trained soldiers who know their soldier jobs.

Anyone who begins to describe anything in terms of the Fort Bragg of today ("third largest city in the State") soon finds that if his reader knows the Fort Bragg of 1939, both the describer and the describee grow more and more confused. Accordingly we shall rest with the statement that the Replacement Center fills the relatively small slice of the reservation which lies east of the Fayetteville road. "Fills" is a carefully-chosen word. With parade grounds and buildings for five regiments, little acreage is left over. Efforts are being made to rent a tract of 700 acres which adjoins the center in order to spread out the training areas without having to cross the main highway so frequently. As your Fort Bragg confidants have undoubtedly advised you, moving troops across the Fayetteville Road these days is a good deal like moving them across New York City.

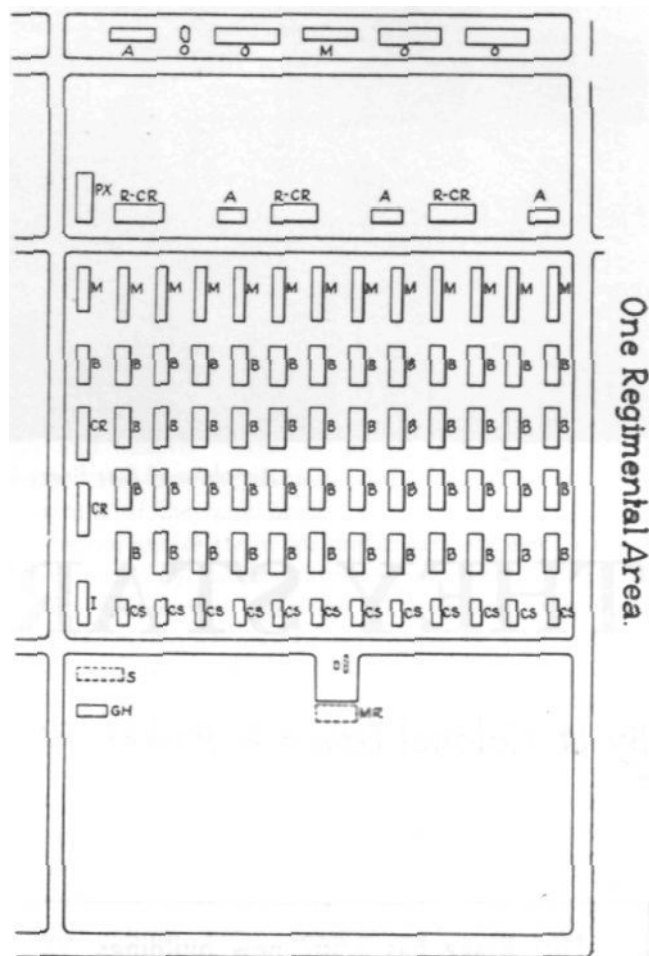
A brief description of the Replacement Center gives some idea of the size of the organization and the administrative task of keeping it going. The Center overhead has, besides its barracks and officers' quarters, three headquarters buildings, a telephone and telegraph office, a dental clinic, a post office, a main exchange, a service club, and a guest house. There are also three theaters, three fire engine houses, and a warehouse and utilities area. On a special railroad siding in the Center, troop trains unload the trainees a few minutes' walk from their barracks. In this way much motor traffic is eliminated.

The compact regimental area deserves a brief description. As built, it contains 91 buildings, to which two or three more will be added. Each battery has a combined office and supply building, a messhall, and four of the standard 63-man barracks, making a close fit for its 250 men. Each battalion has a headquarters building and a combined recreation hall and school building of good size. The regiment has two school buildings, a branch exchange, a dispensary, and a barrack for regimental and battalion headquarters personnel. Between these buildings and the officers' line stretches a parade ground, 100 yards wide and 360 yards long. In the officers' line are the regimental headquarters building, a small house for the colonel, three two-story dormitories, and a mess.

Possibly the most pleasing feature of the plant is an excellent layout of paved roads. The main roads have four lanes of pavement, the secondary roads have two.

Like most of the New Army, this brand-new organization was delayed in starting. It was hoped that the trainees could begin their training on March 15th. The delay of only ten days, until March 25th, was not very important. Most of the cadres arrived on February 15th as planned. Of the 402 officers, 154 were on hand in time to meet the cadres; 113 more came from the B.O. 5 Class at Fort Sill about March 10th; and the remainder have been coming in at odd times.

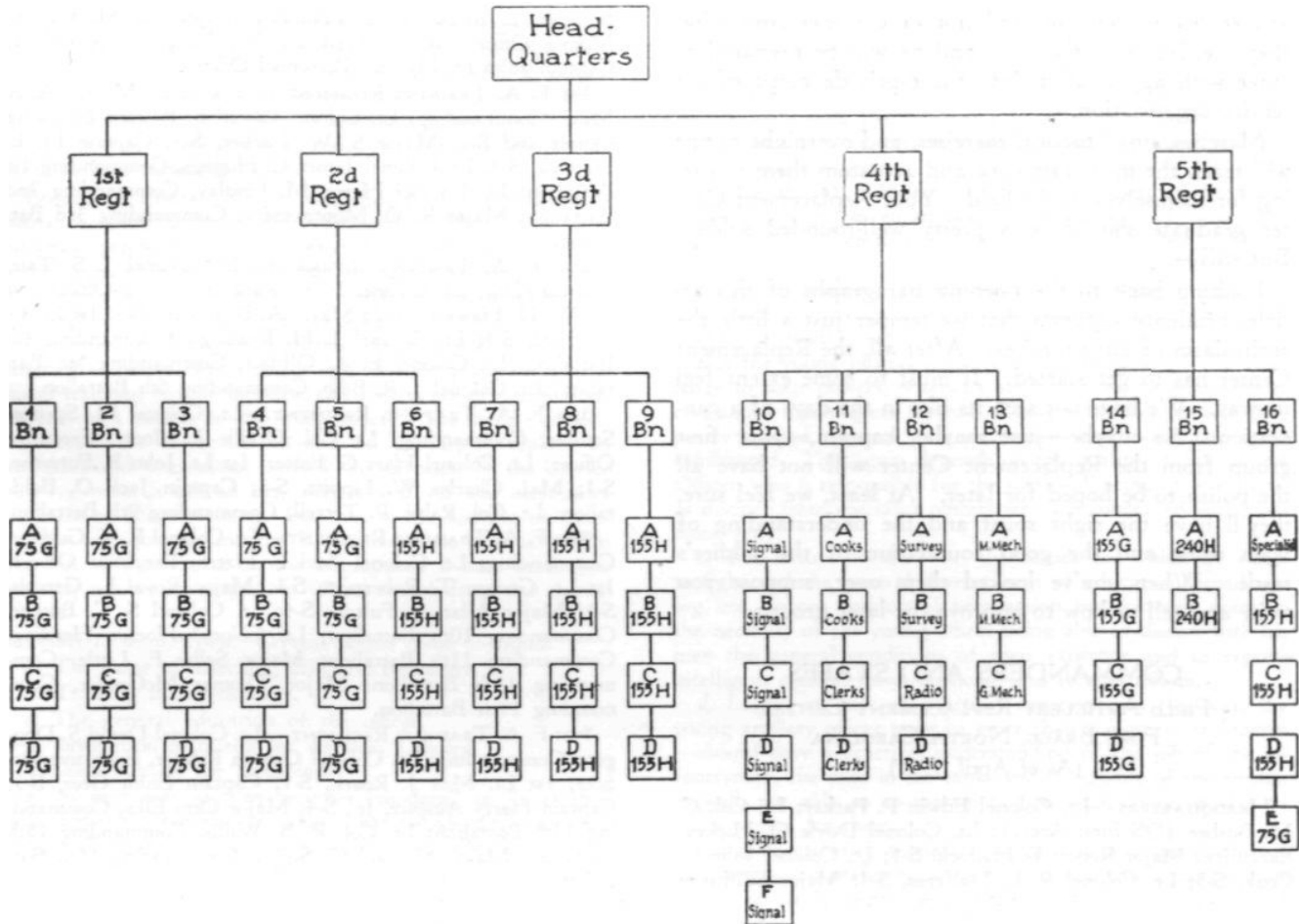
Fortunately, one regimental area was ready for occupancy on February 15th. Intensive training of officers and enlisted men began immediately. The objective set for them was to obtain the greatest possible perfection in their duties as instructors. All ranks pitched in together to help each other to improve. There were the usual difficulties. Equipment was scarce at first, and then it came in tons and tons, a heavy load for the cadres alone. Outfits settled down, and then had to move as new regimental areas were ready. New drills and new weapons had to be studied. Rifles were issued, and artillerymen gazed on each other with a wild surmise—except those whose artillery ancestors had carried rifles at Chapultepec and San Miguel de Mayuma; they knew it was not a novelty.



One Regimental Area.

- Legend:-
- A Regtl or Bn Hqrs
 - B Barracks
 - CR Class Room
 - CS Btry Hqrs & Store
 - GH Gas Station
 - I Infirmery
 - M Mess
 - MR Motor Shop
 - O Officers Qtrs
 - PX Post Exchange
 - Q Regt. C.O. Qtrs
 - R Recreation
 - S Regtl Supply

Ground plan of a regimental area



Organization diagram to include batteries, showing weapon or specialty of each battery

By March 25th, they were ready for the trainees. The Replacement Center Headquarters has a headquarters battery and band. The five training regiments contain a total of sixteen battalions. Each battalion contains four training batteries, making a total of 64 batteries. Each battery contains 250 men, of which 31 are the cadre and 219 are trainees.

It is not too early to praise these soldiers. Professional and trainee have met with a remarkable understanding for each other. The instructors had something which the trainees have been eager to learn. The whole atmosphere has been willingness, cooperation, and patience on both sides. Much can be said in praise of the officers who have worked so hard to bring about this result. But the spirit of the Service in the cadres, and the cheerful acceptance of duty by the trainees, have been an inspiration. It is fair to say that all ranks have met in a common cause and are smoothing the way together.

The organization diagram gives an idea of the completeness with which the Fort Bragg Replacement Center will serve the Field Artillery. Cannoneers and drivers will be trained for 75-mm. gun, 155-mm., both howitzer and gun, and 240-mm. howitzer batteries. This is

the only Center training with the 240-mm. howitzer. The specialist batteries include units of cooks, clerks, signalmen, radiomen, instrument and survey men, general mechanics, gun mechanics, and motor mechanics.

Of course, not all of the equipment promised by the TBA has appeared. The Replacement Center, like everybody else, has had to improvise gadgets to fill gaps in the equipment.

Firing will include both subcaliber and service ammunition for all of the types of cannon. Every man will also fire the Springfield, .30 caliber rifle. A certain proportion will be specially trained with .50 caliber machine guns and 37-mm. antitank guns. Experimental training is planned with 75-mm. antitank units. The trainees will *not* be trained with the pistol.

The scale of motorized instruction is indicated by the allotment to the Center of 1,726 military motor vehicles.

The Replacement Center affords an opportunity to establish a uniform standard of instruction in secondary but important subjects: sex hygiene, first aid, chemical defense, camouflage.

It is particularly planned to give very thorough instruction in military customs and courtesies. When a

soldier leaves here, he will not only understand what they are, but why they are, and he will be prepared to enter with appreciation into the esprit de corps of his service organization.

Marches, small tactical exercises, and overnight camps will teach the men teamwork and accustom them to caring for themselves in the field. Your Replacement Center graduate should be a pretty well-rounded soldier. But still—

Looking back to the opening paragraphs of this article, prudence suggests that we temper just a little the enthusiasm of our promises. After all, the Replacement Center has to get started. It must to some extent feel its way. We have not seen its like in the days of a generation. So maybe—just maybe, captain,—your first group from the Replacement Center will not have all the polish to be hoped for later. At least, we feel sure, they'll have the right spirit and the understanding of team work and the good foundation of the soldier's trade. When you've looked them over, suppose you write and tell us how to improve the later groups.

COMMANDERS AND STAFFS

FIELD ARTILLERY REPLACEMENT CENTER
FORT BRAGG, NORTH CAROLINA
(As of April, 1941)

HEADQUARTERS.—Lt. Colonel Edwin P. Parker; Lt. Col. C. M. Busbee (DS First Army); Lt. Colonel Doyle O. Hickey, Executive; Major Robert F. Hallock, S-1; Lt. Colonel John C. Cook, S-3; Lt. Colonel R. L. Dalferes, S-4; Major Williston B. Palmer, Inspector of Training; Major H. M. Cooper, Morale Officer; Major Frederick W. Long, Police Officer; Captain John H. Hyland, Personnel Officer.

1ST F. A. TRAINING REGIMENT.—Lt. Colonel Marcus A. S. Ming, Commanding; Lt. Colonel Lowell F. Bowers,

Executive Officer and S-1; Major S. W. Fischer, S-3; Captain H. E. Hallock, S-4; Lt. Colonel James C. Hughes, Commanding 1st Battalion; Lt. Colonel Harris M. Findlay, Commanding 2nd Battalion; Major R. O. Montgomery, Commanding 3rd Battalion.

2ND F. A. TRAINING REGIMENT.—Lt. Colonel J. S. Tate, Commanding; Lt. Colonel E. K. Kane, Executive Officer; 1st Lt. W. D. Hawkins, S-1; Major A. B. Powell, S-3; 1st Lt. G. P. Bilbe, S-4; Lt. Colonel J. H. Keatings, Commanding 4th Battalion; Lt. Colonel E. A. O'Hair, Commanding 5th Battalion; Lt. Colonel J. R. Bibb, Commanding 6th Battalion.

3RD F. A. TRAINING REGIMENT.—Lt. Colonel H. Spencer Struble, Commanding; Lt. Col. Orville J. Moore, Executive Officer; Lt. Colonel Hart G. Foster; 1st Lt. John R. Forsythe, S-1; Maj. Charles W. Lippitt, S-3; Captain Jack O. Baldtalion; Lt. Col. Ralph P. Terrell, Commanding 9th Battalion.

4TH F. A. TRAINING REGIMENT.—Lt. Colonel R. T. Guthrie, Commanding; Lt. Colonel Azel F. Hatch, Executive Officer; 1st Lt. George T. Robertson, S-1; Major Royal L. Gervais, S-3; Major Allan P. Fulton, S-4; Lt. Colonel S. C. Butner, Commanding 10th Battalion; Lt. Colonel Horace Harding, Commanding 11th Battalion; Major Selby F. Little, Commanding 12th Battalion; Major Thomas McGregor, Commanding 13th Battalion.

5TH F. A. TRAINING REGIMENT.—Lt. Colonel David S. Doggett, Commanding; Lt. Colonel Osborn Palmer, Executive Officer; 1st Lt. Max J. Roark, S-1; Captain Elihu Geer, S-3; Captain Harry Auspitz, Jr., S-4; Major Otto Ellis, Commanding 14th Battalion; Lt. Col. R. B. Willis, Commanding 15th Battalion; Major Michael G. Smith, Commanding 16th Battalion.

CENTRALIZED TRAINING

BY LIEUT. COL. J. V. DELAHAYE, D.S.O., M.C., R.A.

Practical experiences of the commander of a British Officers' Cadet Training Unit

The benefits of centralizing overheads of all kinds are obvious, and in an instructional unit overheads are apt to be particularly high. Under overheads I include the staff officers and the "employed" men of all grades whether specialist, instructional, administrative or domestic not in charge of "batches."

Centralization also facilitates organization of sports and such amenities as debates, concerts, or provision of front rank lecturers on outside subjects.

Quality of Instructors. But it is not only on grounds of economy that one is in favor of centralization. There is an even more important aspect—the difficulty of finding a sufficiency of really first class men. My own view is that of all the factors we are apt to regard of paramount importance to efficiency in battle, perhaps the junior officer is really the most predominant. We ought to be able to provide enough generals to conceive wise plans, and an adequacy of trained staff officers to work out details. We all know that N.C.O.'s are the backbone of the army, but for myself I believe that we should concentrate in the officer training establishments the very best instructors that we can find—the best in personal quality. Personality and knowledge are often closely linked, yet I believe it is the rarer personal quality

rather than the more common technical skill or instructional capacity that is the more important. Basically the teaching of military leadership involves changing people, not just training them in efficient technique. We learn by example, somewhat intangibly and only to a limited extent by the written or spoken word. Nor can maintenance of real discipline be imparted either by punishment or lectures on military codes. It must be demonstrated. Morale and initiative are spread by contagion not by lecture. Enthusiasm cannot be compelled, only transmitted. Hence the importance of the Troop Officer who is directly in contact with cadets. Instructors and commanders who possess these infectious characteristics are not easy to find, and their Regiments part with their services only under compulsion. When found, their influence should be spread as widely as possible and this is why centralization on the whole is the better plan.

Commanders. Or take again the question of command. I would say from practical experience that a C.O. of a cadet unit can exercise a personal influence by speech, interview, and occasional direct contact with his cadets (provided he is really free of administrative duties) up to a number of six to eight hundred. I believe a Commandant or General i/c of a Group

of such Wings or cadet units could impart his views, influence and command to, say, four or five such units through their C.O.'s and by his inspections and contacts with a certain amount of effectiveness. Above that, influence becomes somewhat dispersed. Thus if there is anything in my line of argument it is that a central school could not deal with more than three to four thousand cadets.

Length of Course. Quite independent of the number of hours necessary to cover any particular syllabus, there is a minimum period in which your ex-civilian must live, not merely within a military atmosphere but, in so far as we can make it so, one that is conducive to the best traditions of leadership. Although it does not figure in the syllabus, much thought and energy needs to be devoted to this. It should determine the selection of officer instructors, it underlies the plans for recreational training, outside lectures, and the system of personal interview with cadets by the troop officer. The need for self-sacrifice, to be exemplary on and off parade, to replace an individualized commercial outlook by devotion to the service and regiment, is not an easy matter and yet this constitutes the basis of officer training. For this, to say nothing of training his physique, six months is the minimum necessary. On this sort of figure, and on the assumptions I have made you can only achieve an output of 500 per month from one central school.

Points to be Stressed. Certain points come to mind:

- a. The value of marching drill and ceremony.
- b. Training in self-mastery.
- c. The general education of the officer.
- d. Instruction in tactics for Artillery Officers.

To elaborate on the foregoing:

a. As each war in turn becomes "modern" or "scientific" there appears a tendency to argue that parade drill and spit-and-polish is irrelevant and a waste of time. One finds, however, that it is an essential part of the process of transformation, of the process of training the whole man. It is the best drilled batches of cadets that excel at other work and the best drilled regiments that stand up best in battle. The

more conscious cadets, too, become aware of an inner satisfaction, a pride in reaching a high standard for themselves and the group; they realize that drill in mass and automatic obedience fits in well with their training in intelligent individual initiative and is a matter of inward mastery of mind and not mere bodily conformity.

b. We should, I think, pay respect to German insistence on self-discipline in endurance (and take note of their criticisms of effete, comfort-seeking bourgeois liberalism). Deliberately and more severely than heretofore, we should practice our men in "proofing" themselves to cold, fatigue, hunger and long hours, breaking away when possible from the steady routine of meals, sleep and class room studies.

But the young officers must be made conscious of this challenge to their powers, otherwise such training becomes drudgery, and a meaningless fatigue. Those who have been so purposely trained respond with enthusiasm and indeed are quite exhilarated. This again depends on the quality of the Course Officer, who is responsible for the total well-being of his cadets, as distinct from specialist officers who are concerned with class room only.

c. The nature of this war, the causes for which we claim to fight and the general development of education, broadcasting, etc., to say nothing of preparation for post-war, point to the necessity of the young officer being able to discuss with his men the general conditions of their existence and to express intelligent general views on home and foreign affairs.

d. Lastly, in view of practical experience in this war, the young artillery officer must be more than a gunnery technician—should have a practical understanding of the job of the infantryman, the man in the tank, and if possible of the airman as well, not only to co-operate but on occasion to be able to make a plan for them.

All these essential desiderata, of course, take time, which is why one would prefer eight months to six. Institutions cannot be too hurriedly improvised, instructors have to be discovered and trained.



British 25-pounder in action

FIRE



DIRECTION

SECTION I

TACTICAL ASPECT OF FIRE DIRECTION

1. GENERAL.—Fire direction is that tactical function, exercised by an artillery commander, whereby the fire of one or more units is brought to bear on the most appropriate target at the most opportune time with the highest degree of surprise and demoralizing density. Since the influence of field artillery is exercised solely through fire action, it follows that the effectiveness of the arm will depend largely on the ability of artillery commanders as fire directors to—

a. Deliver fire on the most appropriate target; this requires skill in the maintenance of observation and liaison.

b. Deliver fire at the most opportune time; this requires adequate and reliable communication systems.

c. Obtain surprise; this requires the fire to be delivered without warning and completed in the shortest possible time. To facilitate surprise, the target should not be used as an adjusting point.

d. Obtain demoralization; this requires that the proper volume of fire be delivered with accuracy and speed. Skill in the employment of gunnery technique and the different types of weapons and ammunition is essential to its accomplishment.

e. Exercise the fire-direction function intelligently; this requires that the artillery commander concerned be comprehensively informed as to the tactical situation, in order to appraise properly the purpose of the fire of his unit and its contribution to the general plan of action.

2. CONTROL.—a. *General.*—Centralized control is essential to the delivery of massed fires. This control should never be lost so long as the artillery commander can maintain the essential communications and his subordinate units are capable of mutually reinforcing each other. To insure timely and appropriate action on the part of subordinate units, they are assigned missions in direct support, general support, reinforcing, counterbattery, or other specific roles, within specified zones of action, called normal zones.

b. *Control within the battalion.*—(1) The essence of fire direction lies in the battalion, since it is the smallest artillery unit capable of delivering massed fires. The battalion commander is the fire director and personally acts in this important capacity, except when other essential duties temporarily require his attention elsewhere. When unable to act as fire director, the battalion commander designates a competent staff officer, preferably the executive, to act in his stead. With properly trained personnel, the battalion fire-direction center can prepare firing data, apply necessary corrections thereto, conduct adjustments, and synchronize the fires of all the batteries with much greater

speed and accuracy than can be accomplished by decentralizing these functions to battery commanders.

(2) The organization for fire direction within the battalion must be flexible in order to enable the battalion commander to delegate fire-direction functions to battery commanders and regain them at will. This is provided for by using battery personnel in the system of observation, particularly as forward observers, and also in the signal-communication system, and linking them to the fire-direction center. Delaying actions on a broad front and rapid changes of dispositions are examples of situations requiring the need for this flexibility.

c. *Control by higher units.*—Commanders of higher units exercise general control by allocating reinforcing artillery, by organizing the artillery for combat, by assigning normal and contingent zones, by specifying the locality or localities where units must be prepared to mass their fires, by providing for the issue of maps, map substitutes, and air photos, by coordinating the surveys, and by procuring and coordinating air observation. Such specific instructions as may be necessary are issued concerning communications, methods of target designation, registrations, and fires to be prepared. In order to concentrate effective fire on important targets, higher commanders endeavor by their control measures to insure that an adequate number of battalions are prepared to fire promptly and accurately in critical areas, and that the assignment of targets to subordinate units can be made instantly and unmistakably, by reference to maps, map substitutes, air photos, or concentrations for which data have been prepared.

3. ZONE OF FIRE.—a. *Zones.*—The zone of fire of an artillery unit is the field within which it is capable of placing its fire. That portion of the zone of fire within which the fire of a unit is normally delivered is termed *normal zone*. The remaining portions of the zone of fire of a unit are termed *contingent zones*. An artillery unit is assigned only one normal zone; it may be assigned several contingent zones.

b. *Assignment of zones.*—(1) The lateral limits of the normal zone of an artillery unit in direct support correspond with those of the zone of action or sector of the unit it supports, unless otherwise specified. For a unit in general support, or for one to which a reinforcing or counterbattery mission has been assigned, lateral limits are assigned, usually to coincide with those of the zone of action, or sector, of an infantry regiment, brigade, or division. For a unit assigned a special mission, the lateral limits of its normal zone are designated so as to include the hostile elements upon which it is to fire. Lateral limits of contingent zones are specified within the limits of the zone of fire, by the next superior fire director, in order to indicate the areas into which he may wish to concentrate fire.

*These notes on fire direction were prepared at the Field Artillery School and are used at the School as instruction memorandum GT 3. They represent current thought and recent developments.

(2) Normal zones may be limited in depth so as to give more definite responsibilities to subordinate units for designated types of fire. Thus in an area included between the front line of the friendly troops and a line (usually designated XX) drawn within the enemy position, generally parallel to the front line, all interdiction and harassing fire missions and fire on targets of opportunity would be the responsibility of the division artillery; similarly, fires of these types between this line and a line (usually designated as ZZ) farther within the enemy position, generally parallel to the front, would be executed by corps artillery; and fire beyond the latter line would be executed by army artillery. Occasionally, when a long-range tactical unit is formed in the corps artillery, the corps zone is divided in depth by a line (usually designated as YY) parallel to the front; this line is used to divide the responsibility in depth between other tactical units and the long-range units.

(3) When no contingent zones are prescribed, each unit assumes the remainder of its zone of fire to be its contingent zones.

(4) In the battalion, each battery takes the battalion normal zone as its normal zone, unless directed otherwise.

4. OBSERVATION.—The commander of each artillery unit must provide for detailed observation of the normal zone of his unit. Higher commanders utilize special units, such as the observation battalions (flash and sound), radio intelligence units, airplanes, and balloons, to supplement the observation systems of the battalions. Battalion and battery commanders establish observation posts at points best suited for general observation of their respective normal and contingent zones. There are modifications to this practice in units employing extremely long ranges. The commanders of direct-support and reinforcing battalions must provide for detailed observation of the immediate foreground in front of the infantry (cavalry)

(armored units). This requires that the observers be sent forward to supplement the general observation. Sometimes these forward observers will provide the only observation available. All observers within a battalion report their findings to the fire-direction center by the most direct means. All must be able to adjust fire or execute surveillance at the instance of the fire director. To further intensify observation, battalion commanders should assign each battery a portion of the battalion normal zone to observe, called *zone* of observation. To provide flexibility in the observation system, in accompaniment with that of the fire-direction center, battery personnel should be employed as forward observers.

SECTION II

COMMUNICATION FOR FIRE DIRECTION WITHIN THE BATTALION

5. GENERAL.—The communication system for fire direction within the battalion must provide for rapid transmission of target locations and sensings from observers to the fire-direction center and of fire commands from the fire-direction center to the gun position. Electrical means of communication will best provide this type of communication; the illustrated systems (wire, Fig. 1; radio, Fig. 2) are designed to accomplish this purpose. Visual means have limited application, but are often effective when conditions are favorable. Messenger communication is valuable in case of scheduled fires.

6. USE OF SYSTEMS.—While either system illustrated may accomplish the purpose of fire direction, usually a combination of both will be used. Wire communication to forward observers is difficult of installation and maintenance, owing both to the fire-swept area through which it must operate and to the frequent movement of the observers. Radio communication will be most applicable from observer to fire-direction center

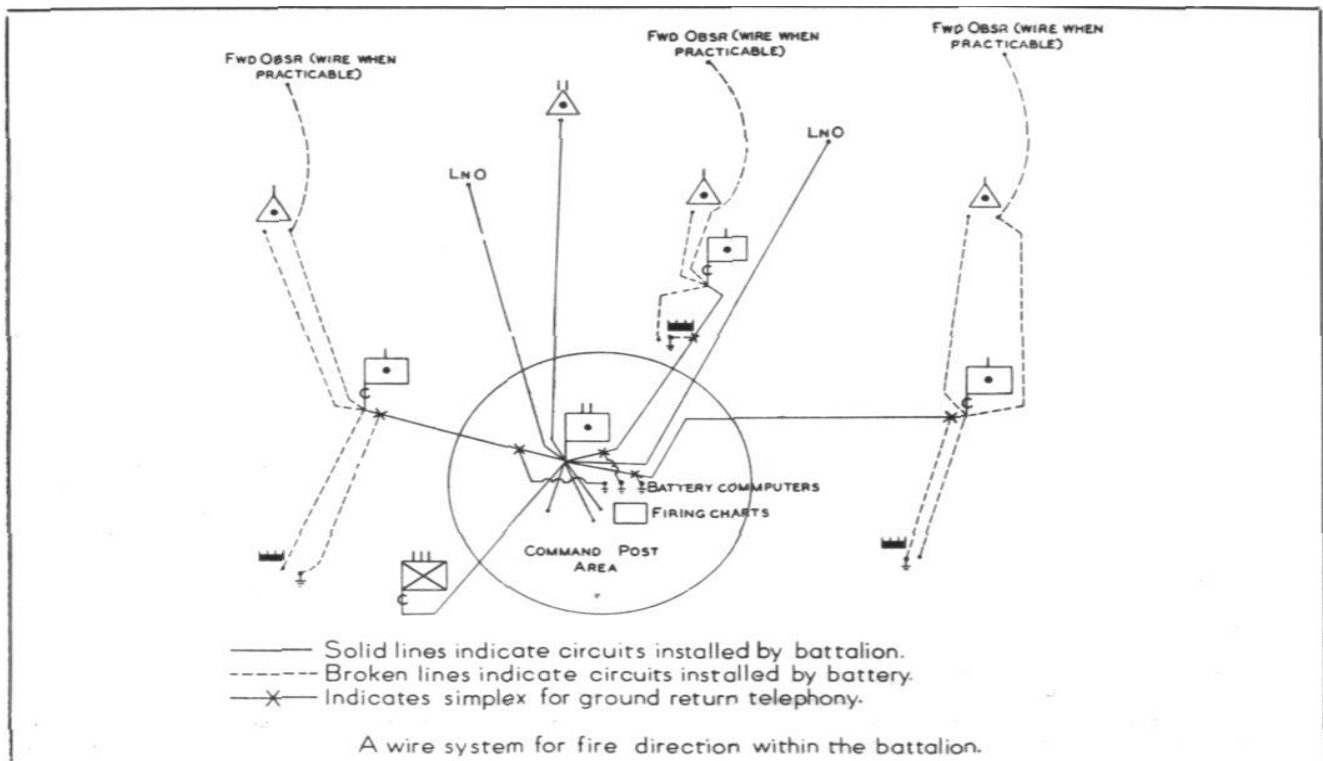


Figure 1

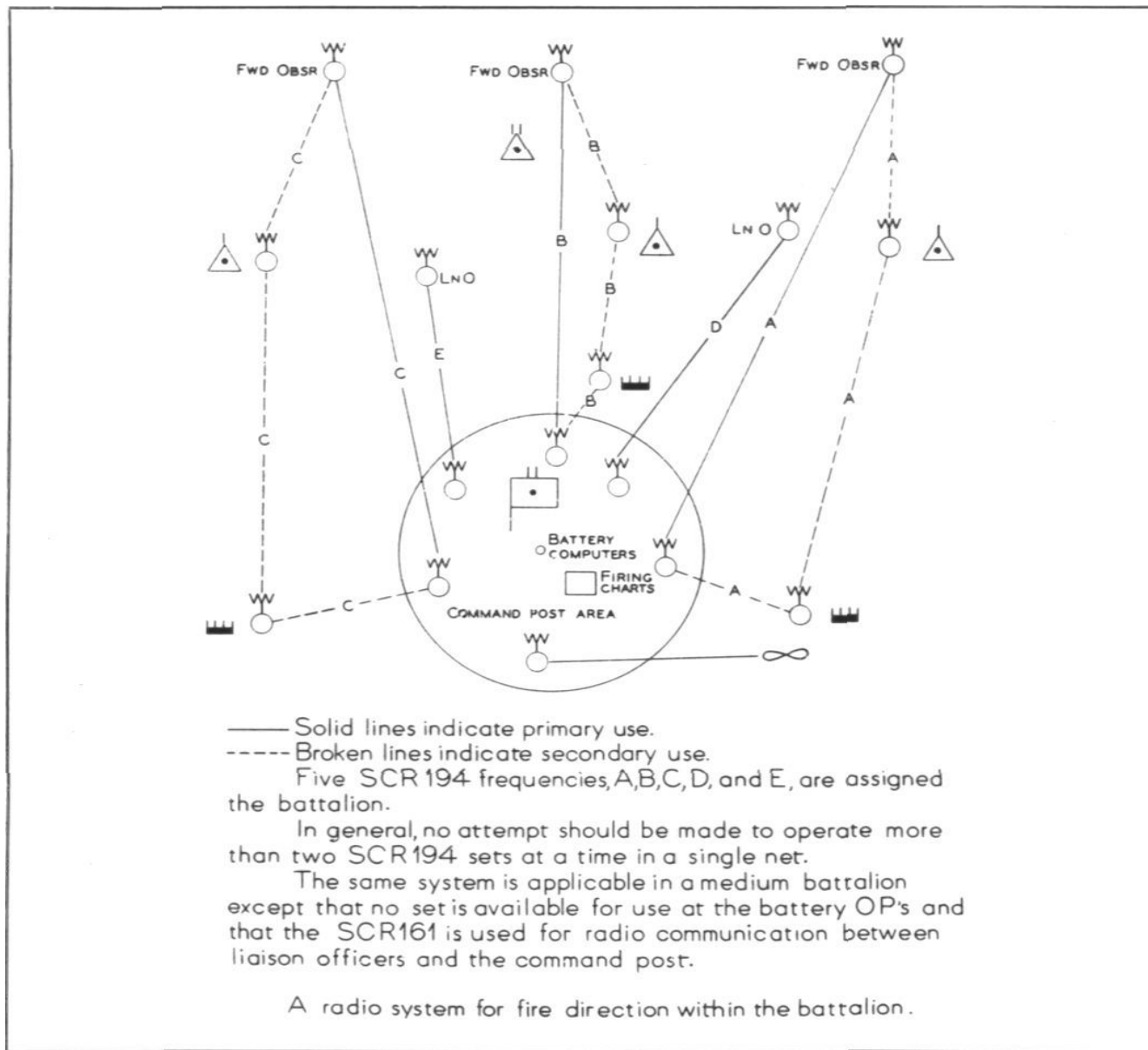


Figure 2

and simplex telephony from fire-direction center to the gun positions.

7. **COMMANDS.**—Uniformity in sequence of commands and the use of set phrases in transmissions make for both accuracy and speed. Constant drilling of all communication personnel of the batteries and the battalion as a team should be habitual.

8. **COMMAND POSTS.**—Command posts should be selected so as to simplify the communication problems. In general, battalion command posts should be well forward. Arrangement of installations within the command post should be such that the telephones and radios used for fire direction are grouped as close to the firing charts as is consistent with safety. Other command-post installations should be removed from the immediate vicinity of the fire-direction center.

9. **DISPLACEMENTS.**—Communication for fire direction during displacements presents many communication problems. These problems may be minimized by having a set plan, understood by all concerned, to take care of a standard displacement. Variations to meet special situations may be readily introduced without loss of flexibility.

SECTION III

TECHNIQUE OF BATTALION FIRE DIRECTION

10. **GENERAL.**—The battalion habitually functions as the fire unit. The training and methods employed should permit the battalion commander to maneuver the fire of his batteries

with the same relative efficiency that a battery commander maneuvers the fire of his pieces. To increase the speed and accuracy of preparation of unobserved fires, the battalion prepares the data for these missions and transmits the data to batteries in the form of fire commands. In observed fires, the battalion may prepare the initial data, which is customary when using forward-observation methods, or it may designate the target to the battery commander who conducts the fire. In either case the battalion is prepared to fire battalion concentrations based on the adjustment of one battery. The foregoing methods permit facility and flexibility in the maneuvering of the fires of the battalion and should be employed when conditions permit. At times, however, it will be necessary to decentralize fire direction and preparation of fire to batteries. Therefore batteries should be trained in the preparation of data for all types of missions.

11. FIRE-DIRECTION FUNCTIONS OF THE BATTALION COMMANDER.—The battalion commander's initial plan for fire direction includes the allotment of zones of observation and responsibilities therefor, the survey to be executed, and the liaison and communications to be established. The availability of suitable maps or map substitutes is an important consideration in the development of his plan. His preparations should look toward the translation of the more general plans of higher commanders and the fires requested by supported-unit commanders into specific fire missions. During the action he decides which targets are to be fired on, the amount of ammunition per target, and the depth to be covered. He executes the fires in such manner as to produce the greatest effect. Full use is made of massed fires. In order to effect surprise, methods are changed from time to time. His duties at the fire-direction center are delegated to subordinates only when his presence is required elsewhere.

PERSONNEL OF THE FIRE-DIRECTION GROUP AND THEIR DUTIES

12. S-3.—The S-3 is the gunnery officer of the battalion. The prompt and accurate preparation of fires and the supervision of their conduct are his duties during combat. Their preparation and delivery accord with the instructions issued by the battalion commander. Prior to the time of opening fire, he closely supervises the concurrent preliminary work being performed by the subordinate members of the fire-direction group. Immediately prior to and during combat his fire-direction duties normally require his entire attention.

13. HCO.—The horizontal-control operator (HCO) prepares the firing charts* (or observed-fire chart), plotting thereon the battery positions, base point, base lines, check points, centers of impact, own front lines, zones of supported units, and targets as they are assigned. He measures and announces chart ranges and base deflection shifts. He reads and announces the corrections indicated by the weather-correction diagram.

14. VCO.—The vertical-control operator (VCO) determines and announces sites for the batteries which are to fire. As a chart he uses a copy of the same map or map substitute that is being used as the firing chart. On it are plotted the battery positions, base point, check points, base lines, and altitudes of batteries. If the contoured map is the firing chart, the VCO reads target altitudes as he plots the targets. With uncounted maps or map substitutes, the vertical-control chart should contain numerous points whose altitudes have

*The firing chart is a map, map substitute, or grid sheet showing the true relative positions of batteries, base point, check point, targets, etc., as determined by survey. The observed-fire chart is a special chart constructed without survey but with data obtained by registration (adjusted compasses and adjusted ranges).

been determined and noted. These are determined by calculation based on site readings and distance measurements. In case the chart is a wide-angle photo or mosaic, further study by the VCO, using a stereoscope and available single vertical photos, will furnish additional altitudes. When a target is reported the VCO plots it, studies its location with respect to points of known altitude, and estimates its altitude. He then determines and announces the site for each battery. Frequently the sites for all batteries will be the same. When the altitudes of the batteries differ materially, the site for one battery is computed and sites for the others are determined by the offset method. Speed may be gained by use of tables showing sites at 200-yard range intervals for targets 5, 10, 15, 20, etc., yards above or below the base battery.

15. BATTERY COMPUTERS.—*a.* When a fire mission is ordered, battery computers receive from the S-3 general instructions as to the type of fire, manner of firing, and ammunition allotted. From the data received from the HCO and VCO, they prepare and send fire commands to the batteries. These may be sent by telephone or radio or, when a series of fires is prepared in advance, the fire commands, less data corrections, may be entered on command sheets and be sent to the batteries by messenger. In the latter case the final corrections are dispatched at the appropriate time. The computers should be well trained in the usual gunnery methods of changing sensings to commands in observed fires and in converting chart data to firing commands. In the latter operation, the commands for range may be obtained by use of the firing tables and making corrections for *K* or MDC and for site. By the use of a graphical firing table in the form of a slide rule (the adoption of which probably will be recommended by the school) the computer gains considerable speed. Although the procedure followed by the computer varies slightly with the type of mission, generally speaking his sequence of operations is as follows:

- (1) Alerts the firing battery.
- (2) Receives from HCO the chart range and the base deflection shift to place the right gun on the center of the target.
- (3) Records shift to right to center the sheaf.
- (4) Receives direction and range corrections read from weather-correction diagram by HCO.
- (5) Receives site from VCO.
- (6) Having entered the above data on the computer's record as received or calculated, converts the data to firing commands.

b. Each computer maintains a file record of missions fired (computer's record) and keeps a running account of the ammunition status of the battery he is handling.

c. It is good practice to have one of the computers in general charge of the other computers. One or two of the computers should be officers; qualified enlisted men may be substituted for the officers.

d. To facilitate decentralization to batteries, should the occasion arise when one or more batteries must act alone, or to use in case the other firing charts are destroyed by hostile action, at least one extra firing chart with battery locations, base point, check points, etc., plotted thereon should be prepared at the first opportunity.

MISSIONS

16. TYPES.—The fires which are possible of execution depend upon available observation, the progress of the survey, the map or map substitute furnished for fire control, the availability of metro data, and the practicability of registration. The extent of the use of the various types of fire will vary greatly in different situations. In some situations observed fires will offer the most effective support, in others the battalion will be forced to resort almost exclusively to unobserved fires. The fire-direction group should be prepared to execute all types of

missions possible of execution, and it should be trained to change promptly from one type of fire to another, such as from map data corrected to transfers or from unobserved fire to observed fires. For example, one battery may be firing an observed mission in one area while two are firing a concentration in another area using MDC.

17. SOURCES.—Missions may come from a higher headquarters either in the form of general localities shown by overlay or as specific targets to be fired on at once or at a given time. They may be decided upon as a result of conferences with the supported-unit commander or from a study of the terrain. They may come from supported-unit commanders via liaison officers. They may come from forward or air observers.

18. STANDARDS TO BE SOUGHT IN DELIVERY OF FIRE.—*a.* The time required for the delivery of fires is as follows:

(1) *Map data corrected.*—A battalion concentration should be opened in less than three minutes after the mission reaches the fire-direction center.

(2) *Transfers.*—same as map data corrected.

(3) *Observed fires.*—Speed of adjustment by air or ground observers is sought by accurate initial data. When one battery has adjusted, the remaining batteries should open fire within one to two minutes after the adjustment is completed.

b. When these standards are realized and communications can be maintained there will be little need for "call" missions on which data have been prepared and sent to batteries. The reason is that fires can be prepared as fast as batteries can deliver them.

EQUIPMENT

19. GENERAL.—During the initial period of training of the fire-direction group, it is advisable to employ the ordinary equipment consisting of range-deflection fan, plotting equipment, firing tables, and some type of weather-correction diagram. The following applies to the use of the normal equipment and to the employment of certain special equipment to gain speed and reduce the probability of blunders.

20. COORDINATE PLOTTING SCALE (1:20,000). — A target location having been announced as *Jig Option 42-27* (photo coordinates, indicating square JO 420 yards right and 270 yards

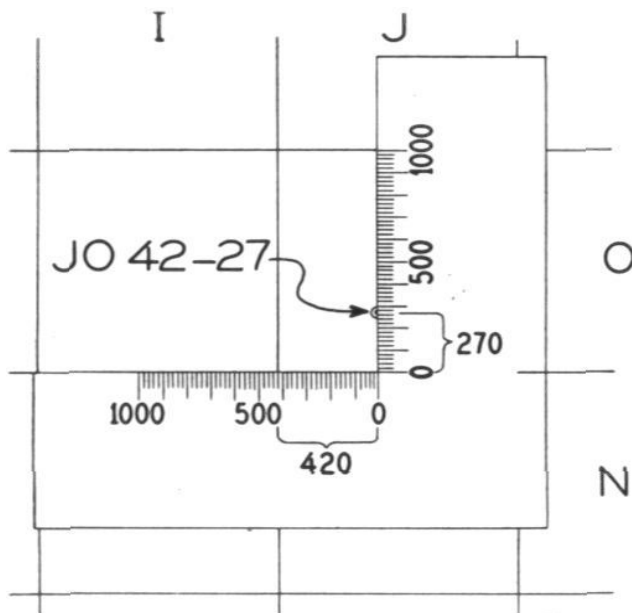


Figure 3

up), the HCO and VCO plot the point by using the scale as shown in Figure 3. The same method applies to any 1:20,000 grid or arbitrary grid using 1.8 inch squares.

21. RANGE-DEFLECTION FAN.—Fans should be checked for accuracy. Inferior workmanship in trimming edges and in the construction of the hole at the center of the rays results in inaccurate measurements. Present tables of basic allowances allow four per battalion headquarters battery. Those being issued to troops at Fort Sill are manufactured by Keuffel and Esser and are accurate except that the hole is much too large for the ordinary plotting pin, hence ranges are erroneous and also, to some extent, deflections. Accuracy can be obtained with this fan by changing the hole, using liquid solder or some similar substance.

22. WEATHER-CORRECTION DIAGRAM.—*a.* The HCO uses this diagram to read weather corrections by visual interpolation. Issue tracing paper is not sufficiently transparent to use on wide-angle photographs or mosaics. Diagrams traced on transparent celluloid are satisfactory. Celluloid diagrams whose surface is such that it will not take pencil or ink marks can be used if small squares are scraped at the line intersections with a sharp knife or razor blade. Two types of diagram have been tested. One of transparent celluloid, similar to the issue type, is tacked to and rolled over the firing chart in the manner shown in Figure 4. Unless the batteries are widely dispersed, the diagram can be oriented to the chart with its center in the center of the battalion area before being pinned down. After the corrections for all batteries have been read, it will automatically roll back like a window shade. When it is expected that more than one charge will be used, diagrams for additional charges can be tacked to the sides of the chart as shown.

b. A second type of diagram is made of celluloid of thickness comparable to that used in the range-deflection fan. This type, shown in Figure 5, is notched so that it can be quickly oriented to the firing chart by placing the notches against two pins. Diagrams for other charges are identical in design so that they can be oriented by means of the same two pins.

c. A battalion will not usually have to employ more than three charges in the execution of its missions from a given position.

d. When a unit is operating in an area where gridded maps or map substitutes showing the Y-north are not furnished, the artillery battalions must be informed of the base direction used by the metro section in establishing wind direction; this direction is needed to orient the weather-correction diagrams. A base direction, such as true north or an arbitrarily established direction, must be used and the battalions notified to that effect.

e. The corrections on the weather-correction diagram normally include, in addition to the usual elements, corrections for drift and, in case the scale of a wide-angle photograph or mosaic is not exactly 1:20,000, the range corrections for variation from 1:20,000 range measurements.

f. In cases where, at the beginning of an action, map data corrected have been prepared and subsequent registration discloses errors, the diagram may be corrected to compensate for such errors.

g. Where no metro message is available and correction factors are obtained by registration, the direction corrections may be incorporated on a diagram in the manner shown in Figure 6. At check point Number 1, the adjusted base deflection was *Left 12* from the measured chart shift; at check point Number 2, it was *Left 7* from the chart shift. For the arc and ray intersection nearest each check point, determine the direction correction considering the firing table drift values. Next, considering drift differences, complete the direction correction on each of the two rays. Finally, interpolate for the other intersections.

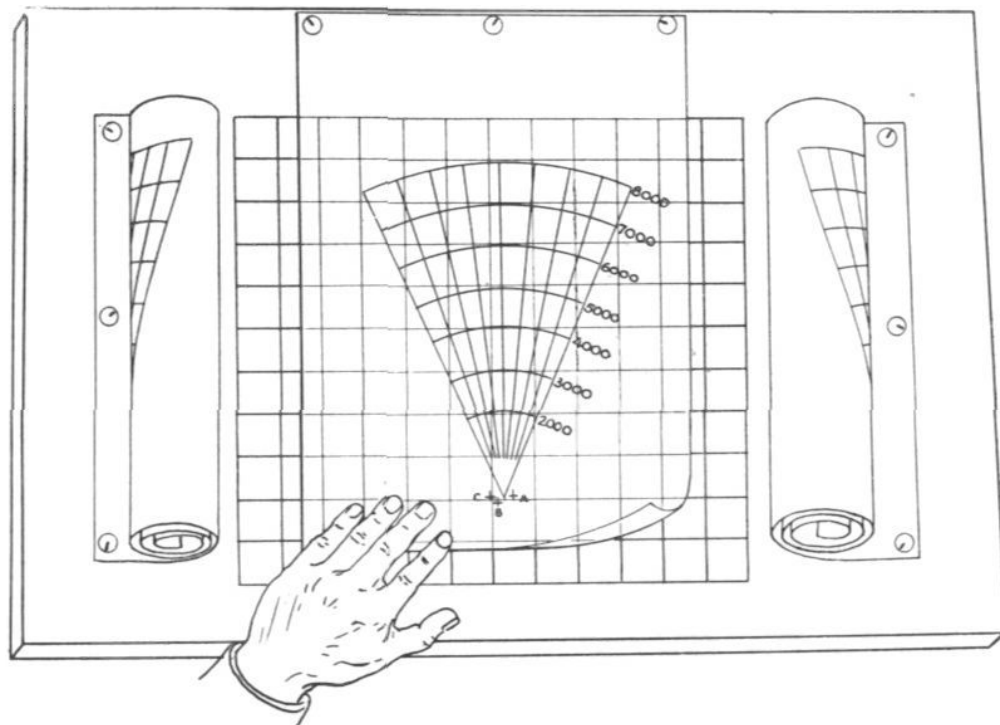


Figure 4

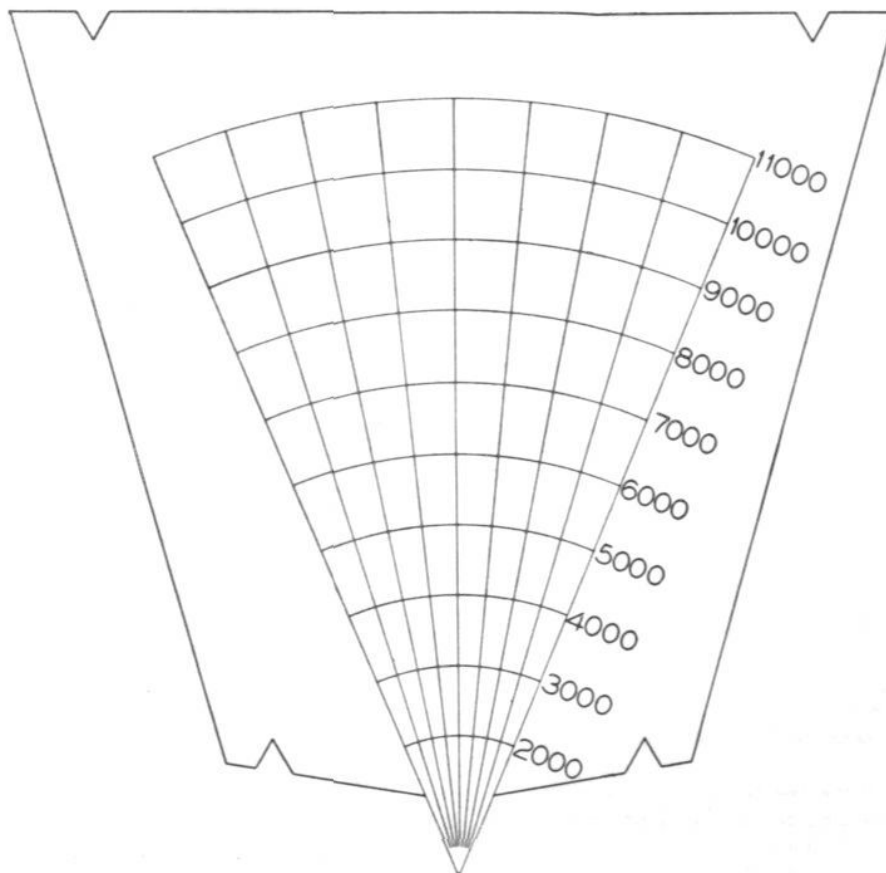


Figure 5

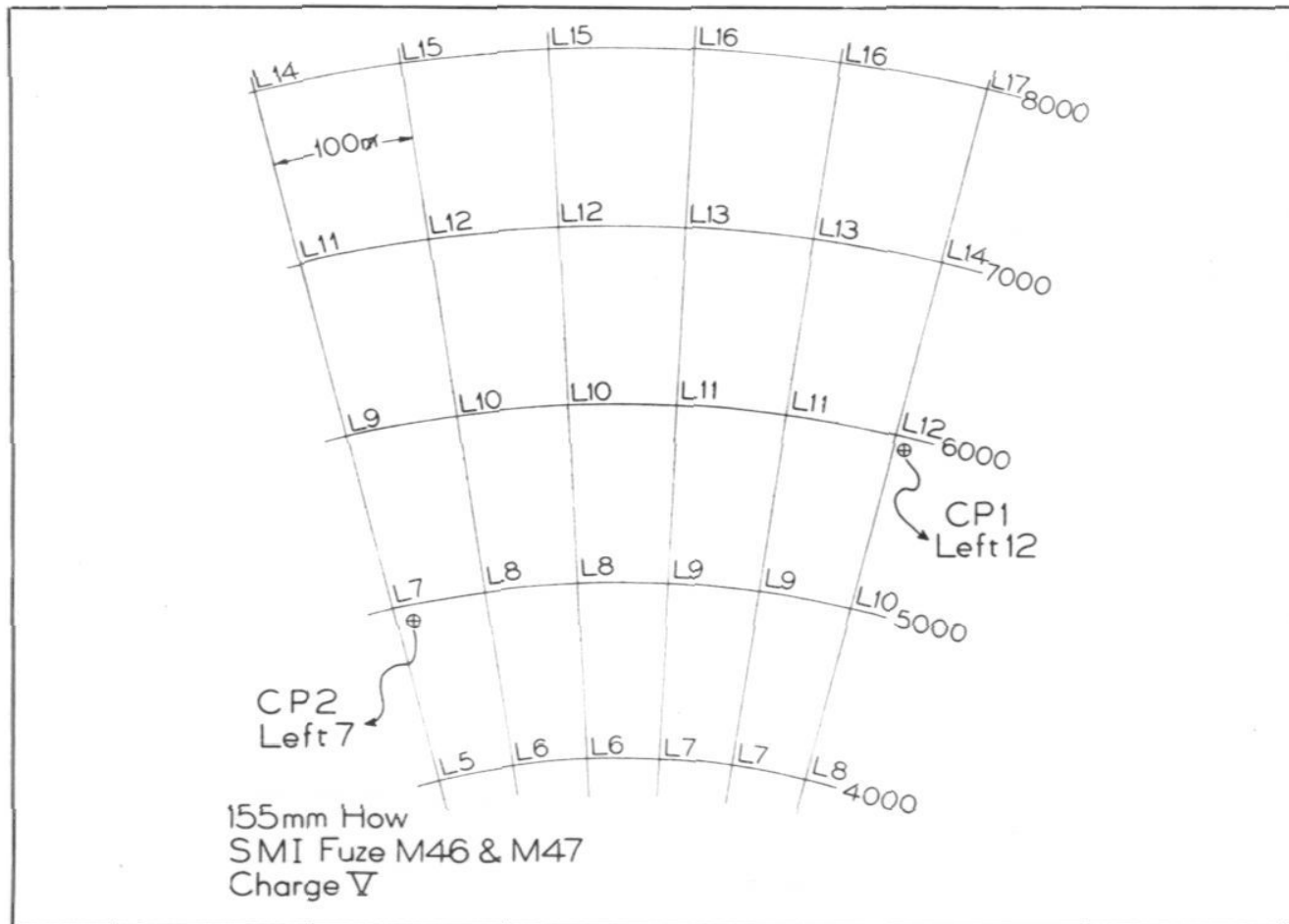


Figure 6

23. GRAPHICAL FIRING TABLE (Figs. 7-10).—The Graphical Firing Table is designed primarily to simplify and speed the work of computers at the battalion fire-direction center. It consists of: A *standing portion*, which is standard; and *slides* for the ammunition fired by the various weapons used in division artillery. The standing portion and the appropriate slide are intended to be mounted on a Mannheim-type slide rule. All scales on the slides and those on the face of the standing portion (with the exception of the gauge points on the lower left portion) are logarithmic.

STANDING PORTION.—*Reverse*.—On the reverse of the standing portion are graphic scales showing the range capabilities of each charge for various weapons. Figure 7 shows these scales. Arrows have been drawn on this figure indicating for the 155-mm. howitzer firing HE shell, Charge 7, the following:

- A is the zero range line.
- B is the maximum range.
- C is the maximum effective range.
- D is the minimum range which should normally be fired with this charge.
- E is the best range for the base point or a check point.

Face.—The upper standing portion has four lines. These are, from top to bottom, as follows:

K scale.—This line, on the upper left of the rule, indicates directly the *K* in yards per thousand, both in amount and sign.

50/R.—This line indicates the amount to shift right in order to center a 100-yard sheaf. Doubling the value read will give the

amount to shift right to center a 200-yard sheaf.

33/R.—This line indicates the amount by which to open from a converged sheaf to form a 100-yard sheaf. Doubling the value read will give the amount of opening to form a 200-yard sheaf.

Range.—This line gives the range in yards. The vertical marks between the numerals on this line indicate the limits of convergence.

The scales on the lower standing portion are gauge points to aid in the setting of the rule for individual situations.

SLIDES.—Different slides for various weapons are made up to be used interchangeably in the standing portion of the rule. Figure 8 shows the rule set to use one of the slides for the 155-mm. howitzer firing HE shell. It is set for Charge 4.

Each slide has scales for four charges. The scale in Figure 8 indicates firing-table values for Charge 4. The same scale, turned end-for-end, indicates values for Charge 5. The reverse of this particular slide is shown in Figure 9. It indicates firing-table values for Charges 6 and 7.

The scale for each charge has three lines. These are, from top to bottom, as follows:

Elevation.—This line gives the elevation, in mils.

c.—This line gives the change in elevation corresponding to a 100-yard change in range. It has been interpolated to the nearest mil.

Drift.—This line gives the drift corresponding to the range.

Figure 7

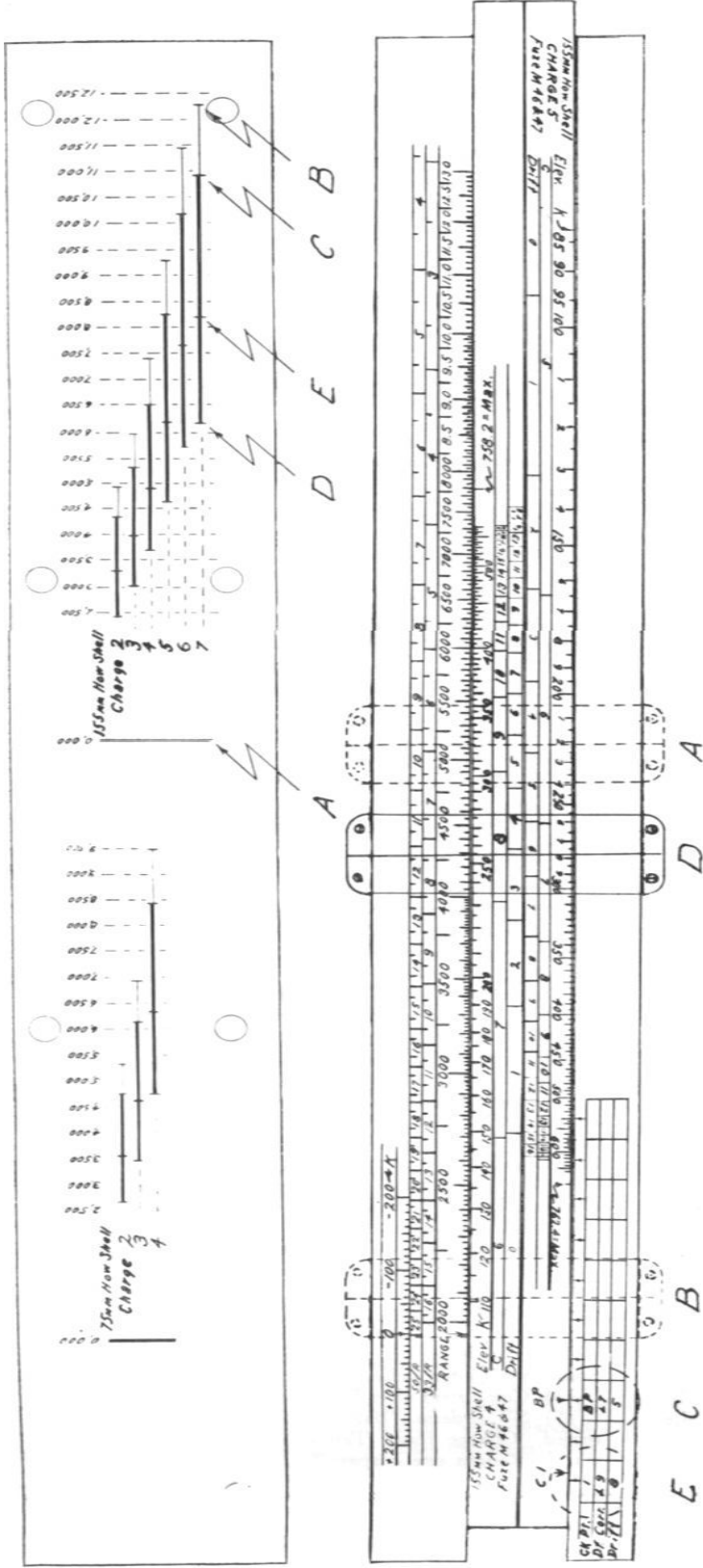


Figure 8



Figure 9

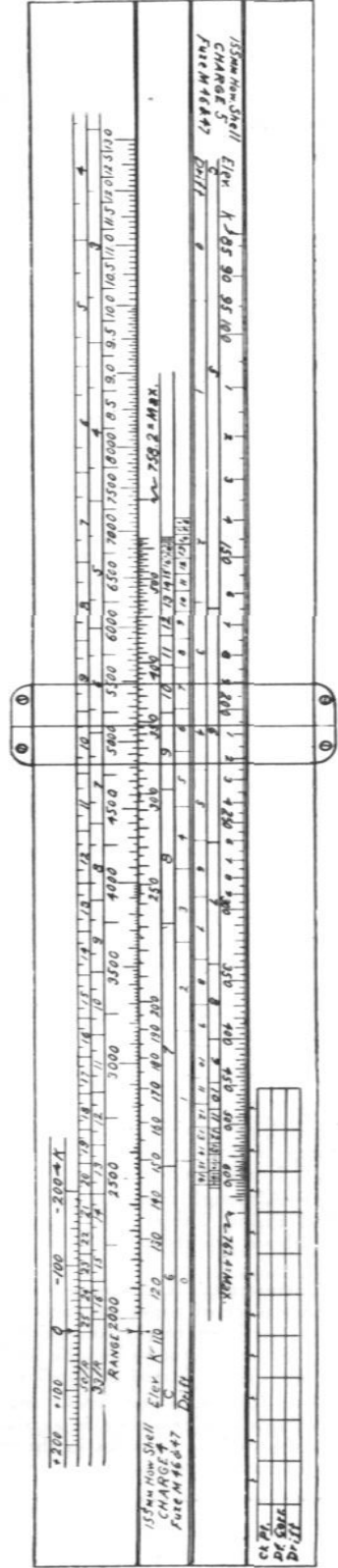


Figure 10

Example Illustrating the Use of the Graphical Firing Table

MISSION.—A 155-mm. howitzer battalion is to register on the base point with HE shell Mk I, Charge 4, fuze M46. From the firing chart, the following data have been obtained: Range to base point = 5130 yards; site to base point = minus 7 mils.

INITIAL ELEVATION AND *C* (Fig. 10).—The *K* gauge-point on the slide is set opposite the *K* gauge-point to the left of the 2,000-yard range mark on the standing portion. (The rule is now set for a *K* of zero and gives the same values as are found in the standard firing tables.) Opposite range 5130 (range to base point) the elevation (346) and the *c* (9) are read. By including the site, the initial quadrant elevation is determined to be 339 (346 + (−7)) mils.

Upon completion of the registration, the following adjusted data are reported *Base deflection left 7, Quadrant 314*.

DETERMINATION OF CORRECTION.—The site is stripped from the adjusted quadrant elevation, giving the adjusted elevation of 321 (314 − (−7)) mils. This value (321) is placed under the range of 5130 (indicator position A, Figure 8). The value of *K* may be read directly from the rule as −55 yards per thousand (indicator position B, Figure 8).

The adjusting computer announces the results of the registration as "*Deflection correction left 7*" and either "*K is minus 55*" or "*Set 321 under 5130*."

Each computer then selects any convenient gauge point (arrow) on the lower portion of the standing scale and opposite it marks a gauge point on the slide, using a pencil. (Dotted circle, Figure 8.) Also he may jot down the deflection correction, and the drift at the base-point range. (Later, similar data for Check Point No. 1 might be noted as shown in dotted circle E.)

APPLICATION OF CORRECTIONS.—The rule is now set so as to apply the *K*. Thus, if a concentration is ordered at a range of 4280 yards, the indicator is set at range 4280 (indicator position D, Figure 8). From the Graphical Firing Table the following may be determined by reading under the indicator:

Shift to right to center a 100-yard sheaf.—Opposite 50/R, read 12 (mils). (23 mils to center a 200-yard sheaf.)

Opening (from a converged sheaf) to obtain a 100-yard sheaf.—Opposite 33/R, read 8 (mils). (15 mils for a 200-yard sheaf.)

Convergence range.—4500. (Indicator is between the vertical marks on the range scale indicating 4500.)

Elevation.—Opposite 4280, read 254. (This includes correction for the *K* of minus 55 yards per thousand.)

c. Opposite *c*, read 8 (mils).

Drift.—Opposite drift, read 5. (Since the drift at the base-point range is 5, a shift of *right 2* would take care of difference in drift, if it is desired to take this into consideration.)

NOTE.—Although there are several other uses to which the Graphical Firing Table can be put advantageously, the ones outlined above are those for which the rule is primarily designed.

24. COMPUTERS' RECORDS.—Although computers can use an ordinary piece of paper for each mission, the form shown in Figure 11 has been found convenient. The records are completed by the computer to include final data, rounds fired, and battery ammunition status at conclusion of the mission.

25. SITE TABLE.—The VCO may compute the sites by usual methods. When time is available he may make a site table for the various altitudes in the zone of fire, based on the altitudes of battery positions.

COMPUTER'S RECORD

BATTERY _____ Bn. No. _____	
Fire Commands	Notes and Computations
Battery Adjust	
Base Deflection _____	
Converge at _____	
On No. 1 Open _____	
Shell Mark _____	
Charge _____	
Fuze _____	
Battery _____	
Subsequent Commands	

Figure 11

PROCEDURE IN EXECUTING MISSIONS

26. GENERAL.—Elevations habitually are used. Short battalion concentrations, with each battery firing at a single range and covering the maximum front without sweeping, will be frequently employed. All batteries may be ordered to fire so many volleys at the computed range to the center, in which case the beaten zone may be considered to have a depth of 100 yards; or they may be ordered to vary their ranges by 1 *c* or ½ *c*, in which case, by standard procedure, one battery fires at the center, one at 1 *c* (½ *c*) greater range and one at 1 *c* (½ *c*) less range. When more than one battalion is to fire simultaneously on a target, all batteries usually fire at the center range. Where survey has been completed and map fires by time schedule or on call are prepared, the methods set forth in FM 6-40 apply generally with the following exceptions:

- a. Overlays and graphical time schedules are not used by battalions to assign fire missions to batteries. Missions arrive at batteries by voice (telephone, radio) or by command sheet.
- b. Base deflection, once having been determined and set on the pieces, is not changed following registration, but corrections are carried to apply to targets in the vicinity of the point registered on.
- c. The preparation of the work sheet is unnecessary and is eliminated.

27. MAP DATA CORRECTED. — a. The following example illustrates the procedure when firing with map data corrected.

- (1) A liaison officer, designating the target by photo coordinates, reports: "King prep 18-17 infantry assembling request battalion cannot observe."
- (2) HCO and VCO plot the point.
- (3) The battalion commander directs that the target be fired on with ten volleys per battery and depth of 200 yards.
- (4) Computers alert batteries.
- (5) S-3 orders: "Battalion concentration Map data corrected Charge four Ten volleys per battery At my command Ranges one c apart."

(6) HCO announces:

Baker	440	Left	151
Affirm	4360	Left	133
Cast	4280	Left	168

HCO saves time by reading the range first. Computers, when using graphical firing tables, set the range first. All shifts are from base deflection; therefore the words *base deflection* are omitted. While awaiting the announcement of weather corrections, computers write down the shift to center the sheaf and the opening from convergence.

(7) HCO announces: Corrections all batteries

Left	11	Plus	3
------	----	------	---

Computers apply these corrections to the shifts and elevations already entered on the computers' records. The computers know as a matter of routine the battery to fire with the long and short ranges.

(8) VCO announces as computers request site:

Site	Baker	Plus	4
	Affirm	Plus	2
	Cast	Plus	6

(9) Computers now enter the corrected elevations and complete the sending of data to batteries. The first batteries to receive data should delay the sending of range until the slowest battery is about ready, so that powder temperatures will not be raised. When all batteries have reported that they are ready, S-3 gives the command to fire.

b. As previously indicated, the weather-correction diagram may include the range correction due to the photo's being off-scale. In the example shown above, the *K* for scale could instead be set on the graphical firing table.

c. Accurate initial data in an observed-fire mission is taken from the same firing chart and in the same manner as shown in this example.

28. *K-TRANSFERS.*—*a.* Assume that registrations have been made, using charge IV, on check points 1 and 2, which are 400 to 500 mils apart in direction. The correction factors obtained in each registration apply to areas adjacent to each check point. The range and deflection limits of these areas are prescribed in FM 6-40. The computers are furnished with the deflection correction, *K*, and charge for each check point. These can be recorded on a sketch maintained by each computer or they may be recorded by markings on the standing portion of the graphical firing table. Assume that the target designated in paragraph 27 falls in the area around check point 2, that the corrections determined for this check point were Left 10, *K*-20, and that the drift at check-point range is L 5.

b. The following example illustrates the procedure:

(1) S-3 orders: Battalion concentration *K*-transfer
Charge four Ten volleys per battery
At my command Ranges one *c* apart.

(2) HCO announces: Check point 2

Baker	440	Left	151
Affirm	4360	Left	133
Cast	4280	Left	168

(3) VCO announces, as computers request site:

Site	Baker	+4
	Affirm	+2
	Cast	+6

(4) Computer C, for example, adds to the announced shift the deflection correction obtained by registration, the difference in drift between check-point range and target range (assumed to be Left 3), and the shift to center his sheaf ($50/4.3 = R 12$), or $L 168 + L 10 + L 3 + R 12 = L 169$. This is his base deflection shift. To determine the elevation, he applies the *K* and takes out of the firing tables the corresponding elevation. With the graphical firing tables this

elevation is read directly when *K* of —20 is set opposite the index. He adds the announced site to this elevation and applies 1 *c* to the sum in order to comply with instructions as to depth of the concentration.

c. If a correction diagram similar to that shown in Figure 4 had been prepared, the direction corrections obtained in registration and changed to compensate for difference in drift (i.e. L 13) would have been announced by the HCO. Obviously the elevation corrections corresponding to the *K* correction could be included in the above-mentioned diagram.

d. Accurate initial data in observed-fire missions are obtained in exactly the same manner as in unobserved missions.

e. A nonregistering battalion can deliver fires by *K*-transfer based on registration data furnished by another battalion of the same caliber, provided the two battalions are tied together by survey. The data furnished by the registering battalion must include:

- The chart direction of fire.
- The deflection correction.
- The type of ammunition used.
- The range to the registration point.
- The *K* obtained.

The nonregistering battalion uses the corrections as though they had been obtained by one of its own guns.

29. *SURVEILLANCE FIRES.*—When the data can be prepared with accuracy, the observer may execute surveillance of fires instead of adjustment. The fire is prepared with the most accurate data available. The observer reports the errors promptly; the necessary corrections are applied, and the fire is continued.

30. *OBSERVED FIRE.*—*a. Initial data.*—The target habitually is plotted in accordance with the designation. Chart data, including known corrections, are announced to the computers, priority being given to the computer of the adjusting battery. All computers apply corrections and center the sheafs. The computer of the adjusting battery proceeds with the adjustment while other computers send their commands, except for range, to their batteries. They make note of their elevations, calculated for the target location as initially reported.

b. Adjusted data.—When the adjustment is completed, the computer of the adjusting battery announces the changes made from the initial deflection and range; for example, *R 18, plus 6*.

c. Final corrections for nonadjusting batteries.—The computers of the nonadjusting batteries, having laid their batteries in the identical manner in which the adjusting battery was laid and having noted their appropriate elevations, now apply the corrections, *R 18, plus 6*, and complete their fire commands.

d. Replot on the firing chart.—The corrections, *R 18, plus 6*, furnish the information for replotting the target on the chart. The HCO and VCO apply these corrections to the initial plot and number the target. Thereafter the ground location of the target and its plotted location on the charts permit its use as a reference point for the designation of other targets. If two battalions in the same general area are tied together by accurate survey, the replotted target may be used in bringing in the fire of the nonadjusting battalion.

31. *OBSERVED-FIRE CHART.*—When, because of lack of suitable maps or map substitutes or because the situation is changing too rapidly to permit survey, use of the observed-fire chart is necessary, it is constructed and operated as described in FM 6-40.

32. *AUXILIARY TARGET.*—In case the observer wishes to gain surprise in the delivery of fire for effect, his designation of the target location may correspond to a terrain feature in the vicinity of the actual target. After obtaining an adjustment on this auxiliary target he senses the last salvo with respect to the actual target and calls for fire for effect.

The Value of Artillery in Modern War

The German viewpoint, as expressed in Information Bulletin No. 160, the German Embassy, Santiago, Chile, January 9, 1941.

Impressed by the great successes of the Air Force, especially the dive bombers, in gaining the decision in ground combats, many persons have formed the belief that in the present war the importance of the field artillery has greatly diminished, and that some of its functions—for example, long-range firing—should be executed by bombardment from the air.

In reality the situation is very different. The artillery is, as it has always been, one of the principal and indispensable arms in attaining that great objective: preparing the road for the victory of the infantry. In Germany the opinion was never accepted that the artillery must conquer and the infantry simply occupy the ground won by the artillery. Rather it was held, and with reason, that the decision could be gained only by the infantry. Movement and intense fire are the two mediums by which the artillery fills its role; it knows no others. Germany has laid greater stress on the accuracy of each round fired rather than using a great quantity of rapid-fire light artillery to produce a huge volume of fire, much of which was inefficient. In this we have been different from many foreign armies; and for this reason we have replaced the old 75-mm. of the World War with the 105-mm. of the present.

Nevertheless German artillery knows the importance of bringing a concentration of fire to bear on important objectives. This has been emphasized in training; and the flexibility of the modern carriage—both in range and in traverse—has been put to good use in producing fire of an efficiency not possible with World War materiel. Efficient fire direction and mobility are the prime characteristics of the employment of German artillery today. These methods of combat have proved their worth, to the sorrow of the enemy in this war. As in the case of the infantry, the German artillery has its center of gravity (makes its main effort) where the going is easiest, in accordance with the variable conditions of combat. Normally the artillery is employed in mass against the concealed hostile positions. Many modern means facilitate this. The introduction of radio permits greater freedom in selecting OPs and in executing fire control. Observation and aerial reconnaissance have improved, as has the employment



German artillery advancing through Holland

of observation battalions. The latter, using flash and sound ranging and captive balloons, quickly locate the hostile artillery and facilitate its early destruction.

In addition to the normal supporting role of artillery, the present war has shown the employment of many field pieces pushed well up to the very front in undefiladed positions, and in far greater numbers than was known during the last war in connection with accompanying batteries. In attacks on river lines, and in other similar combat, cannon have been used in this manner (close to the targets, using direct fire), greatly aiding the infantry and tanks to gain their objectives in spite of strong defensive fire. When fortifications were attacked, artillery was used in the same manner, at close range, to permit the assault troops to occupy the bunkers quickly. In these activities the artilleryman has again become a front-line observer and fighter. This increased fighting spirit, after so long a period of combat in which firing was conducted from hidden positions, where the men did not see the enemy.

In moving these individual sections of artillery up to the front, great mobility was demonstrated. But the artillery has shown its efficiency in other ways. Although the duration of ordinary long-range firing has been shortened owing to the necessity for frequent change of position, the artillery has occupied itself with keeping close to the infantry. Not only with the infantry, but the armored units has the artillery maintained the rhythm of advance. This was expedited by motorization. Even animal traction maintained, in that part of the artillery where used, adequate mobility, especially for the light howitzer. Under these conditions (and as great care has been taken to insure ammunition supply), the German artillery has constantly been in a position to cooperate with the infantry. It never had the opportunity, because of the speed of combat, to dedicate itself to the defense of large areas as in the last war. But it was ready to do so had the need been present.

In no way has the importance of artillery diminished in this war. The question as to whether victory is won by artillery or dive bombers makes no sense. Both act together in modern war. In the excellent coordination of these two arms in performing their tasks, do we find the reason for success.

An Artilleryman's Impression of Service in

TOPSY - TURVY LAND

Theodore Roosevelt has written in his autobiography: "By far the most important action I took in foreign affairs during the time I was President related to the Panama Canal." He was keenly aware that a one-ocean Navy would be sorely tried if called upon to do a two-ocean job. He made the building of the Canal an American enterprise because he knew we had almost a life-or-death interest at stake.

The integrity of the Canal is vital to Hemisphere—and possibly to National—defense. Thus the importance of the station and the traditions of Panama give the Field Artillery units of this Department an especial morale. And, all serious considerations aside, Panama is highly diverting, for Panama is topsy-turvy land.

Because the Isthmus forms an S, the sun rises in the Pacific and sets in the Atlantic. On maneuvers it is always a struggle to keep any sense of direction.

From a plane one looks down on Atlantic and Pacific Oceans at the same time, and sees ocean liners in the jungle.

Because of trade winds, it is cooler in the dry season than it is during the rains. Along the Canal one sleeps without blankets the year around. Yet it is never as hot as New York City in August.

One drives on the left-hand side of the road. The police are O.D. instead of white.

The dress uniform is white instead of O.D. Even our equipment (pack howitzers and 1916

75's) is unexpected. We wear no white gloves at ceremonies (they are too hot); but do in the jungle to keep off anopheles and stygonia mosquitoes. A soldier in the "bosky" usually looks like a bee-keeper gone berserk, with a green gauze headnet over his face and sun helmet, and a great bolo or machete in his hand. Despite the steamy heat, woolen shirts are always worn in the jungle. Both wool and

cotton become wringing wet in no time, but evaporation is much quicker from cotton; one who does not wear wool easily catches severe tropical colds at halts.

The Canal, with the cosmopolitan cities of Panama and Colon at either end, is the "Cross-Roads of the Western World"—and

dense jungle hems it in. Panama is topsy-turvy land.

RECONNAISSANCE

The Field Artillery units of the Panama Department are the 2nd FA,* of Fort Clayton (Pacific side), equipped with 75-mm. pack howitzers; and the 87th FA of Fort Davis (Atlantic side), which will have 75-mm. field howitzers, but now has American split-trail 75-mm. guns, M-1916, with high-speed carriages, and is a motorized unit. Both belong to the Panama Mobile Force, which has approximately the strength of a division.

*Their recent crossing of the Isthmus has been graphically described by Major Gildart in the September-October issue of the JOURNAL.

By Lieut. Edward A. Raymond,
87th FA





Photo by H. L. Brazeal

A reconnaissance in the jungle

As soon as practicable after their arrival in the Department, Mobile Force officers are sent off for a week's reconnaissance of the country on the Pacific side of the Canal and towards Central America.

The Canal Zone itself is covered with a dense jungle growth, has few good trails, and is not deemed suitable for the maneuvering of large forces. The infantry maneuvers with a view to keeping raiding parties from landing on the Atlantic coast and penetrating to the Canal, but artillery would probably be of little use in such terrain. East of the Canal, the jungle growth continues into Colombia. Much of the Isthmus is swamp land, in which men and mules flounder to the waist and are soon exhausted. Rock is found only in the hills; even the best of the jungle trails are always muddy. In the jungle are large trees—cualpas, many-trunked banyans, cypress, and occasional mahoganies. There are many species of palms, including tania, which, when cut with a bolo, squirts out a juice containing minute parasitic worms. The juice itself stings like sulphuric acid. And there is the cocorite, with a stem covered by a fuzz of spikes three to six inches long, each spike ending in a fine point which breaks off under the skin. Any scratch or abrasion which, at the halts, attracts

screw worms, becomes a bad sore. There are trees with thorns paired like the horns of a miniature steer; fire ants congregate on these. There are saw-grasses and sword bushes, and all manner of poison fruit. The whole inhospitable mass is woven densely with innumerable tough, resilient vines. The terrain, sharply accented, contains numerous streams. Trails grow over so fast that it is normal to have to cut one's way with the bolo. The jungle is a real obstacle, and it is not surprising that for many years it was considered a barrier to movement by military forces.

The great chain of mountains which runs from Cape Horn to Alaska, "the backbone of the Continent," only pauses on the Isthmus. West of the Canal, after about twenty miles of jungle country, it rises and goes on. It becomes the great Continental Divide and its volcanic foothills. Vegetation thins out and the Panamanian provinces of Los Santos, Herrera, Veraguas and Cocle contain wide, open prairies.

The military rather than topographical aspect of the reconnaissance by a newly-arrived officer deals with two problems: The defense of the close-in beaches, which will not be discussed here, and mountain defense. Spurs of the Divide parallel the Canal and run into tidal

swamps on the coast. Above them are the plains, accessible from forty miles of as fine a beach as can be found. If an enemy had air and naval supremacy it is conceivable that he could assemble a good-sized force above the excellent defensive positions just mentioned. To disregard the strength offered by the mountains would be folly; but then, too, the Liddell Hart theory of Sitzkrieg, or defensive warfare, has been pretty well exploded during the past year in Europe. General Daniel Van Voorhis, commander of the Department, was one of the first protagonists in our Army of large mechanized forces and the fluid front. No underground pool rooms are being built in the Panamanian defensive positions.

The reconnaissance terminates at Rio Hato, the Department Training Center. Here there is a gunnery camp for the field artillery. The guns fire into the foothills of the Divide. Piled-up volcanic rills make a joke of Large-T factors. The Air Corps also makes extensive use of Rio Hato for machine gunning and bombing. In a number of B-18 bombers, officers on the reconnaissance review their week's work, covering in four hours the ground they had traversed so laboriously by truck and on foot. Later on, some of the same officers will be fortunate enough to go on other, more extended flights into Central and South America.

HUNTING

Officers are encouraged to go into the jungles and learn to take care of themselves there. They never go alone, and until they are experienced always take along a "jungle rat" or skilled guide. A soldier of the Fifth Infantry once went out alone from Camp Paraiso and nearly paid with his life; a boa-constrictor five inches thick wrapped itself around the man and his rifle, which was held at the carry. The soldier was able to work his rifle against the boa's body and break its back with a bullet before his own gave way. The bushmaster, or twenty-minute snake, is more feared than the boa. Fortunately, both are relatively rare.

The king of game in Panama is the crocodile. While both crocodiles and alligators are found, most of the so-called alligators are really crocodiles. They are chiefly hunted up the Rio Chepo and the Rio Chagres. There is some hunting of tapir and of conejo—a beast somewhat resembling a rat, but the size of a jack rabbit. Iguanas grow four feet long and, although poisonous looking enough, taste much like chicken. Armadillos, sloths and ant eaters are not hunted. Game includes small deer and wild pigs. The pigs, or collared peccaries, could be hunted on the plains of La Chorrera in the way described by Churchill when he wrote of pig sticking in India, in



Contact with the home station

H. L. Brazeal



H. L. Brazeal

Panamanian village

his "A Roving Commission." Also, at the jungle's edge, are duck, dove, snipe, quail and native turkeys.

FISHING

There is deep sea and river fishing in abundance. Marlin and sailfish are to be taken on the Pacific side. On the Atlantic side are tarpon and barracuda. During February the tarpon spawn in the Chagres as far up as the Gatun Spillway. Although a license is required from the Republic of Panama, there is no legal limit and no season. It really is perfectly feasible to catch a 150-lb. fish, and the Tarpon Club at Gatun has many members who have done so.

An infantryman and an artilleryman went out recently in an outboard craft. They intended to fish all Saturday night and come back at dawn. They left the boathouse on the Canal and went down to Limon Bay. They started up the coast to the Chagres mouth. As they hit the rough patch where fresh water meets salt, their gas line clogged. Unable to keep the head of the boat into the rollers, they shipped one and capsized. Weighed down by the motor, the boat sank some eighteen feet to the bottom. There were triangular fins cutting the water here and there, showing where sharks awaited tidbits brought down by the river. Nevertheless, the fishermen wanted to float the craft, so dived down and unbolted the motor, attaching fish lines to it as they did so. The rough water hammered them against the gunwales as the boat rose to the surface, and cracked one man's rib. Much tackle and a gun were lost, but they reached a mud flat at the Chagres mouth with boat and motor too, unmolested by sharks or barracuda. It was growing too dark to attempt the fourteen miles back through the jungle, so they tried to sleep on the mud bank.

Sandflies filled the air with red hot needles. And then a mosquito took the artilleryman by one ear. Another took him by the other. Then the mosquitoes started to argue. Would they take him back to show to the gang? No, they had better not, for if they did the big ones would get him.

CIVILIZATION

In the jungles and on islands in the lakes are isolated antiaircraft posts. Between the jungles and full civilization is a halfway country containing temporary structures for recent additions to the garrison. The buglers are awakened in the morning by flocks of parrakeets flying noisily across the clearings from the jungle. Wild monkeys, and even an ocelot, are soldiers' pets, coming up to their masters for food at regular hours.

The temporary buildings are of wood, with corrugated iron roofs. The buildings are raised up from the ground on creosoted uprights, set in concrete basins. These are filled with crude oil, and discourage snakes, scorpions and dry-land leeches. Dead termites (which are not ants, but a species of borer) are removed from these basins and fresh oil is added at frequent intervals. Why the termites do not use the oil as an aperitif and keep going, this writer can not explain. He has seen a pile of tarpaulins entirely ruined by them. The buildings, when completed, have all necessary conveniences, including electrically heated closets for clothing, leather, books and papers. These items become mouldy and tend to disintegrate in the extreme dampness unless kept in such closets all the time. Firearms, business machines, watches, and so forth, must also be kept heated when not in use.

Copper screens take the place of windows and usually extend all the way around a building. It is a standing

quip in the 87th FA that enemy planes attacking the Canal would certainly mistake our cantonments for warehouses. There are a good many cement walks, which are lifelines in the heavy rains. In the United States it is only during the heaviest summer thunderstorms that rain reaches the intensity which it maintains here for four or five days at a time. It is as though millions of shower nozzles were turned on full and left running. There are floods in all directions. People do not bother with raincoats or rubber boots; it is as bad to get wringing wet from the inside out as from the outside in, and the rains do not bring cool weather.

Back of the semi-civilized belt comes the line of established posts. These have been cared for over a period of twenty years and are delightful. Tall palms shade the walks. The white buildings are tile roofed and built of masonry. In a country where fence posts sprout when struck into the ground, gardens and decorative plantings luxuriate and give a park-like atmosphere to all the older stations.

Athletic facilities abound. There are five golf courses, built by soldier labor and for that reason available to enlisted men as well as to officers. Most of the posts have their own swimming pools and cement tennis courts. There are stables at Fort Clayton and Fort Davis. Swimming, behind shark nets, is also excellent in both oceans, and there are many boating facilities.

One aspect of post life which greatly pleases the soldiers is the use of Indians as KPs. There are two varieties of pure-bred natives in Panama; there are Chiriquis, pronounced "Cherokees," and San Blas Islanders. The latter are very short and stocky, and sufficiently inbred to resemble one another surprisingly.

TRANSIT GUARD

A military guard is placed aboard every vessel that passes through the Canal. All line organizations take turns in furnishing the men. If a vessel carries explosives, oil or gasoline, is armed, or carries passengers, then a double (or "X") guard goes aboard. Otherwise a few men and a sergeant suffice. The Navy furnishes a helmsman and an engineman to see that the pilot's orders are obeyed and that the ship is not driven into the gates or other delicate parts of the locks. The Army guards the sailors and stands ready to prevent an armed party from landing to seize and sabotage one of the locks. The Army also guards against the dropping of a demolition charge in the locks or the approaches thereof.

A guard may be called out at nearly any hour of the twenty-four, and it takes up to twelve hours to go from one end of the Canal to the other, including three hours in the locks. An officer is never off duty during this



H. L. Brazzal

Native village in the jungle

entire period, and it is hard on the feet. However, the work is popular. It is always an interesting gamble as to whether the day will be spent on a Greek or Turkish tramp or a Grace Line cruise ship, gay with pretty tourists. Seamen are usually loquacious, and in these days the tales they tell, while steaming across Gatun Lake—tales of Finland and Norway, of Dunkerque and Malta—are endlessly interesting. Many of the captains to whom you bid farewell today go down with their torpedoed ships next week or the week after.

At times the feet are forgotten. It is hard to keep the relief off guard away from the galley; and there is always the danger of a friendly little discussion with members of a foreign crew becoming too warm. Hints of more serious trouble crop up from time to time. This writer can well remember the prickly sensation he experienced shortly after the Nazi-Japanese Alliance had been signed. He was aboard a Japanese explosives ship. As he entered Culebra Cut and was passing the famous Cucaracha Slide, another vessel approached from the other direction. On her side was painted a large red disk in a white field. Had "The Day" arrived?

NEIGHBORS

No talk of Panama service would seem natural without mention of the enormous Air Corps installations here. Mobile Force officers are given frequent opportunities to fly, and all work is done against the humming, droning or roaring of planes.

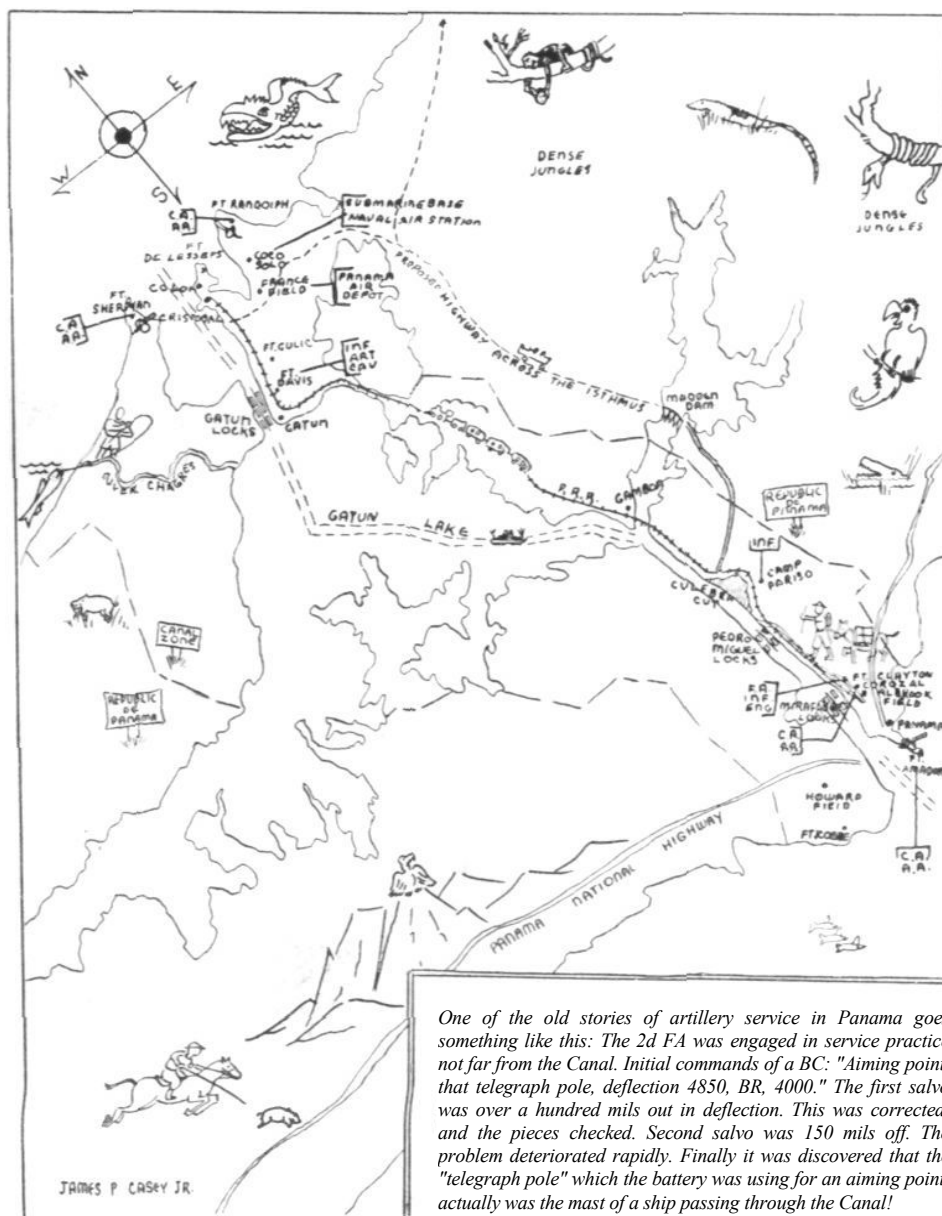
Submarine, destroyer and Naval Air bases also help to make the Zone an armed camp, alive with endlessly varied and impressive activities. At a post in the United States one realizes more or less vaguely that other arms and the other services exist, and that coordination will be necessary in time of war; in Panama they are part of the picture all the time. Most officers have friends on all other posts on their side of the Isthmus, naval as well as military.

Relations between Panama and the United States are generally good.

Officers are encouraged and in some organizations are required to learn Spanish and to appear at such public functions as the Inauguration Ball.

EL FIN

It is safe to say that if the United States were ever to send armed aid to a South American country, a regiment with a background of Panama service would be well fitted for the job. Such a regiment ought to be good elsewhere, for that matter; it is used to strenuous service and stiff standards, and if its men have learned anything in Panama, they have learned adaptability. They have learned the value of discipline in strange, bizarre and difficult situations in the jungles and the cities of the Isthmus. They can keep both feet on the ground, even in Topsy-Turvy Land



One of the old stories of artillery service in Panama goes something like this: The 2d FA was engaged in service practice not far from the Canal. Initial commands of a BC: "Aiming point, that telegraph pole, deflection 4850, BR, 4000." The first salvo was over a hundred miles out in deflection. This was corrected, and the pieces checked. Second salvo was 150 miles off. The problem deteriorated rapidly. Finally it was discovered that the "telegraph pole" which the battery was using for an aiming point, actually was the mast of a ship passing through the Canal!

An Eighteenth Century Spanish Military Camp in Panama

By Ralph Z. Kirkpatrick

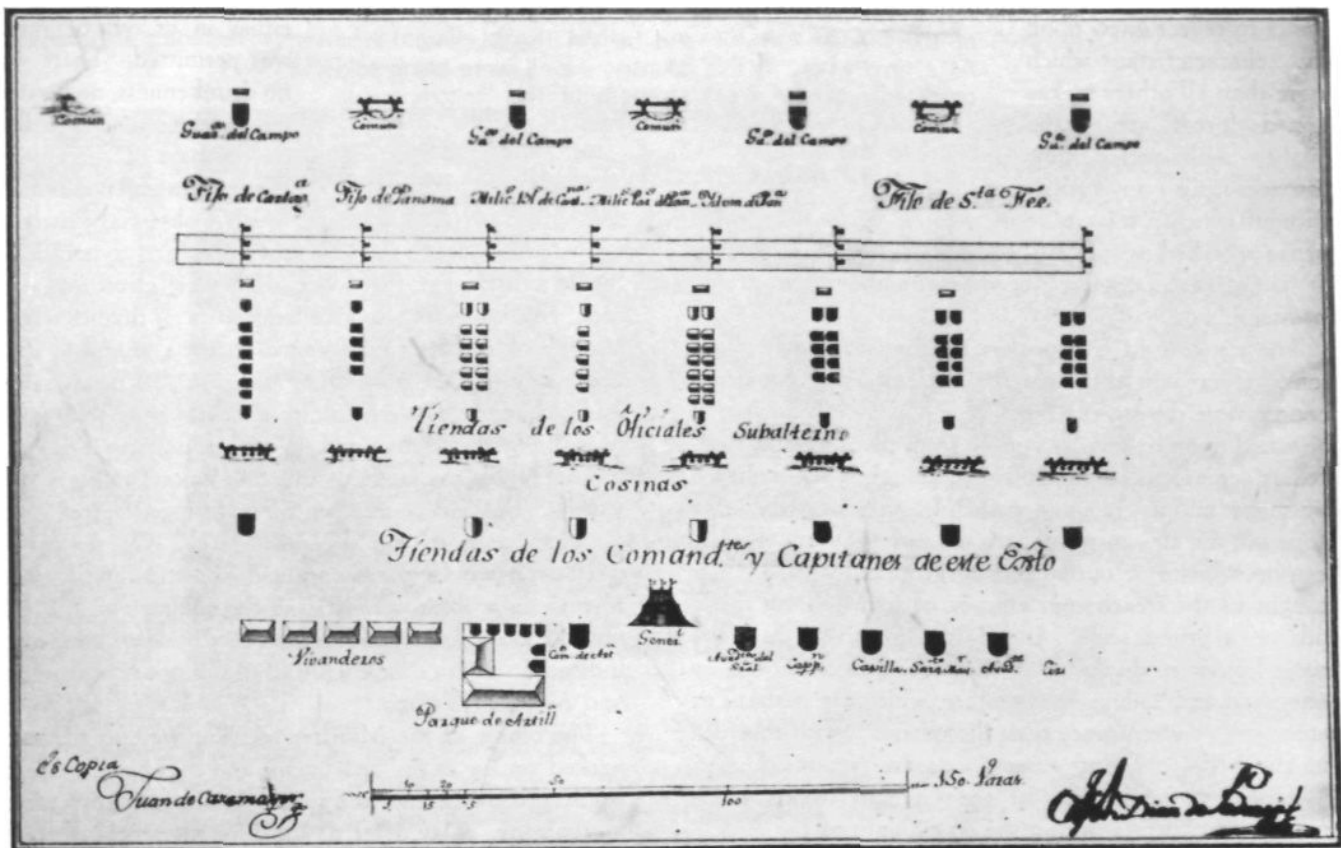
It is unfortunate that during their two-year tours in Panama so few Army men interest themselves in the locally engrossing historical research possible, with visits to the sites of the nearby points of past world events. For, from Balboa's 16th century exploratory conquests in Darien (eastern Panama) and the usually successful forays of English buccaneers like Drake, Hawkins, Morgan, Damphier and Sharp, there were three centuries of sporadic military activities in what is now the environs of the Canal Zone.

Perhaps none of these equalled the spectacular exploits of Cortez, Pizarro or Alvarado in Mexico, Peru, or Guatemala, respectively, in that those conquerors virtually destroyed ancient civilizations and seized unprecedented loot. Nevertheless there must have been most difficult defense and offense problems in tactics, supply, logistics and morale. The Panama campaigns involved battles against fortified towns, open warfare, and jungle guerrilla-like raids on commercial or military packtrains along the transisthmian routes.

There were also punitive campaigns against loosely organized groups of Indians and Cimerones. The latter were escaped African slaves, uniquely adapted for hit-and-run jungle warfare by their native backgrounds and

hatreds generated from their recent cruel treatment. Their ambushes often ruined the military prestige of many overage generals fresh from very different continental conditions in the Moorish wars.

Generally speaking the local Spanish military system consisted of a few regulares and many *Filos* (local militia) under the supreme command of a Governor who had usually been appointed by the Crown as a reward for military services elsewhere; the Governor in turn appointed relatives or political favorites to the various commands of the militia units. If not destroyed in the recent Spanish Civil War, the national archives at Seville still contain some musty but interesting documents, i.e., the official reports and recommendations of Viceroys, Governor Generals, Commanding Generals, Special Investigators for the Crown, and Bishops of the Spanish-American colonial period. The photograph below was recently made from a copy in the National Archives in Panama City; it had been photographed by a Panamanian historian from a war diary in the old Seville records. At about the time of our Revolution the Indians



Spanish military camp in Darien, Panama, 1785

of Darien Province were also in revolt. The base camp of the punitive expedition shows similarities to our own army's up to a few years ago. Again there's little new under the sun; it is evident that our military forebears borrowed heavily from the service regulations of the continental armies of their time.

Translating and reading from the rear of the camp and from left to right on the photograph we have:

The *Comun* or latrine is the pole on forked sticks, a familiar place that would certainly draw frowns from a modern medico because of its nearness to the *Guardias del Campo* or sentries; then come the standards of the various militia units or *Filos* from far off *Cartao* (Cartagena) and *Santa Fee* (Bogota) as well as *Panama*, all then a part of New Granada (now Colombia); to the front of the company rows are the *Tiendas de los Oficiales Subalternos* or non-coms; the *Cosinas* or company cooks with their cooking

pots on poles would be known in any language; the *Tiendas de los Comandantes y Capitanes de este exto.* or Company Officers are next (evidently the small unit headed by a sergeant is the Hq and Service Company); the *General* has his staff nearby, consisting of: Chief of Staff, Sergeant Major, Adjutant, Surgeon, etc., and nearby is the *Parque de Artill.* or Field Artillery Park with its officer in command (presumably the park includes the picketlines for the horses and mules — doubtless giving the ranking officers and cooks more flies than the sentries were fighting near the latrines); the *Vivanderos* or Subsistence Stores are close in under the General's scrutiny; the plan is a *copia* or certified copy attested by *Juan Casamayor* and its graphical scale is in *varas* or about 33 inches. The authorizing official signed so illegibly one cannot read his signature, often likewise the case these modern days.

What Makes an Army?

On the eve of the creation in America of the greatest armed force which has ever challenged a possible aggressor in this hemisphere it seems appropriate to reflect anew upon the characteristic which more than all others makes armed forces great: the quality with which they can accomplish any task—without which a multitude

of men whether of students, workers, or soldiers becomes a mob. That quality is discipline.

The struggle in Europe has taught us important lessons. It has taught us that the static defense considered impregnable during the First World War can no longer be relied upon to save a country from invasion and ruin. It has demonstrated conclusively, though it was believed by many military men in principle, that overwhelming forces in the air can so prepare the way that any obstacle can be overrun or outflanked by ground forces. It has taught us the treacherous efficacy of fifth-column methods on a grand scale. In addition to these there are basic lessons in discipline to be learned from success on one hand and failure on the other, which are perhaps of even greater importance than the others. With this idea in mind the following observations are recounted.

A systematic scrutiny of the German troops which moved into Vienna during the tragic days of the Anschluss in March, 1938, convinced me that their discipline was excellent. Their dress and appearance even after the strenuous march from Germany was creditable.

By Lieut. Col. L. M. Riley, GSC (FA).

Editor's note Lt. Col. Riley, who spent several years in Europe as military attache, had an unusual opportunity to compare the condition of the various armies there. He was in France during the winter of 1939, and saw much of the French Army in and behind the Maginot Lines. At a time when, in this country, we all were being told repeatedly of the great strength of the "incomparable army of Gamelin's," Col. Riley made significant observations to the contrary. One cannot but speculate as to what might have occurred in 1940, if the reports of objective realists had been given more attention.

Their conduct during the month that followed indicated that nothing unseemly on the part of individuals either in or out of ranks was permitted.

There was no drunkenness, no boisterous conduct, no discourtesy on the part of the troops. Their arms and equipment, which I observed closely as they

prepared to parade on the fourth day of the occupation, were clean and well cared for, indicating an excellence of performance which, in spite of reports to the contrary, they appear to have had. Saluting was invariable and punctilious. A salute was exchanged between soldier and soldier as well as between the enlisted man and the officer, making it in truth the honorable exchange of greeting among military men which is the best conception of its "raison d'etre."

Being "on post" in Prague in March, 1939, I stayed a week after the Germans occupied Bohemia, and later returned for a three-week stay in the summer of '39. My observations of the conduct and discipline of the troops indicated the same excellence of training and behavior I had noted in Vienna.

The offices of the Ministry of War were in the same parked square as my apartment, and night and morning I observed the reveille and guard mount formations from my balcony. Day after day a different sergeant of the guard marched his men out of the main gate with the same precision of command and execution which I was

later to witness daily at the Brandenburger Gates in Berlin. I saw them at their daily work of drill and training in the Hracin Palace area as I drove through frequently en route from home to the Legation. Other formations witnessed, including the review of hundreds of troops and tanks, indicated an impressive efficiency.

On the other side of frontiers where intensive war preparations were being made, I had less opportunity to view the troops at close hand. I saw parades of French troops on the Champs Elysee and the Rue Royale; the marching of the troops as well as their appearance was splendid. A Chasseur regiment passed in review at Romaine on Armistice Day, 1939, and the peculiar little quick-step which they took up as they passed the reviewing stand was inspiring indeed and likewise indicated a high degree of training and discipline. A visit to a hill fort in the Maginot Line disclosed a garrison of a thousand regular officers and men whose attitude and conduct appeared to promise an impregnable defense on that part of the line.

But during this same period I made a tour of inspection of the area in which the Germans made, six months later, their main effort in the attack on France. Earthworks were being dug and observation posts prepared in what appeared to be a half-hearted way. Town after town through which we passed was filled with French troops badly and carelessly dressed, coats unbuttoned and caps askew, unshaven faces behind dirty muffers wound 'round and 'round with ends trailing carelessly off behind. Equipment

appeared generally dirty, and horses ungroomed and poor in flesh from under feeding or under care. Saluting was perfunctory or lacking. Other rules of military courtesy were carelessly observed. A great deal of idleness was apparent; the men looked uninterested or entirely bored. True, most of these were reserve troops, but a number of them were the troops who met the Germans six months later. I commented to friends about the apparent lack of discipline, and was told that French troops had a "particular kind of discipline."

An eyewitness description of some of the events which took place in northern France in the middle of May, 1940, states that the day the German troops arrived in Amiens there were no French soldiers guarding the bridges over the Somme at that place, and no French forces to be seen.

In this connection it is interesting to note a recent general order published by General Huntziger, the Minister of War in France, to the French armistice army, calling for "absolute discipline and impeccable decorum" on the part of the remaining French Army.

We send observers abroad so that we may learn from their observations what in foreign armies is good and what is bad; how we can apply what is good to our methods and training; and how we can avoid or eliminate from our army what is bad. Regardless of how one feels about the political side of the present situation, it is the business of the soldier to regard the results of military actions in a cold analytical light and to make the most of the experience of others.



German pioneers bridging mine crater in street of Belgian town

There were many factors which contributed to the French defeat. Among them were the relative size of the French and German land and air armies; staff work; morale; and the comparative efficiency of the details of preparation. The basic concept of the manner in which France was to be defended certainly had its part, and the observations which I have recounted lead me to the belief that defective discipline was a contributing cause.

There are degrees of discipline in a man and in an organization, which depend upon the kind and amount of training which they have received; and the extent to which there has been installed in them a high sense of duty and infallibility of conduct in any and all circumstances. But there is no such thing as a "particular kind of discipline," as some would have us believe. There is in an organization "good discipline" or "bad discipline" and every officer of experience knows what that means.

The new terror of air bombardment and blitzkrieg makes it more important than ever that the standard should be high and the training expert. The comparative freedom of thought and action which our young men have enjoyed, especially in the past twenty years, makes it imperative that they be brought in their military training to a point where devotion to duty and determination to give their best under all circumstances is uppermost in their minds. They must be made proud and happy to be soldiers. They must be made to feel the satisfaction which comes to the soldier who has attained the necessary qualities; the self respect which accompanies self reliance, courage, teamwork and discipline. (All the military attributes are part and parcel of the latter quality.)

The standard of discipline in our forces is that which has been built up over a period of many years beginning with the efforts of Washington to bring order out of chaos in the Continental Army. Our service academies and the excellent colleges and schools modeled after them have had a large part in its conception and execution. This standard is based upon the principle of absolute impartiality. It demands prompt, willing and invariable obedience to orders. It is made effective by hard work in training and practice, and a system of example and eternal vigilance on the part of commanders which allows not the slightest infraction of regulations and conduct to go unnoticed and uncorrected. It is fostered by a system of healthy competition which makes every man strive to do the best that is in him. Its standard is contained in the motto of the Military Academy, "Duty, Honor, Country," and all that it implies, which should be the guiding principle not only of cadets but, more and more, of the corps of officers, both regular and reserve, which has been built up, and through them permeate all ranks.

Let us see how in detail this standard is to be applied to our new and growing army. It begins in an organization with the senior officer, who must instill in the officers

under him a sense of "noblesse oblige" and an obligation to know and do their jobs. He must instruct them himself or satisfy himself that they have been instructed in every phase of the work they are called upon to do. In every branch of military activity he must demand a standard of excellence which is satisfied only by the best. As this is being progressively accomplished he must be seen among his officers and men suggesting, correcting, demanding better and better conformance to the standards in work and discipline which has been set for them. He must insure the progress to be made by schedules of planned instruction, and also by a system of officers' and NCO's schools and conferences. These precede instruction and demonstrate by oral or written test the ability of officers to impart the instruction and exact the discipline desired. After this knowledge has been transmitted to the troops it is followed by inspections to assure accomplishment and as a check on what is lacking.

As to the officers of company grade, all must work and study unceasingly to make themselves the best-informed members of their organizations. They must become examples of conduct and appearance which will be an inspiration to their men. They must be quick to reward where work and conduct warrant it, and invariable in censuring laxity, inefficiency, and negligent ignorance. They must be impartial, uniformly just, and loyal to a degree. These qualities in a commander of troops should be accompanied by tireless efforts to improve the condition, training and discipline of his command. The officer must avoid what is sometimes thought to be the traditional method of command—a loud, violent, and profane manner of controlling and correcting men. He must practice, rather, a quietly exacting insistence upon obedience of orders and regulations and thus furnish an inspiring example of leadership. Those are the methods to be employed. The commander must never be soft and over indulgent. Coddling never made a man, but hard work and difficult experience, successfully negotiated, have. A busy life, a full schedule, and hard work are essential.

I wondered as a young officer in France why, in 1918 when the war was apparently over and the armistice signed, we should begin an intensive training program. As I look back upon it I know that such a course was absolutely essential. Could there have been any more dangerous or unfortunate condition in an army than having thousands of men idle, without interest and without an objective? With an army as with any other organization there must be improvement, or deterioration will occur. There is no such thing as continuing the "status quo." And fortunately there is always work to be done. No unit has ever reached perfection in all the multiple activities which are the responsibility of fighting forces; and the very complexity of these activities leaves always something to be accomplished.

Gun Procurement

the French 75 millimeter gun (the "soixante quinze")

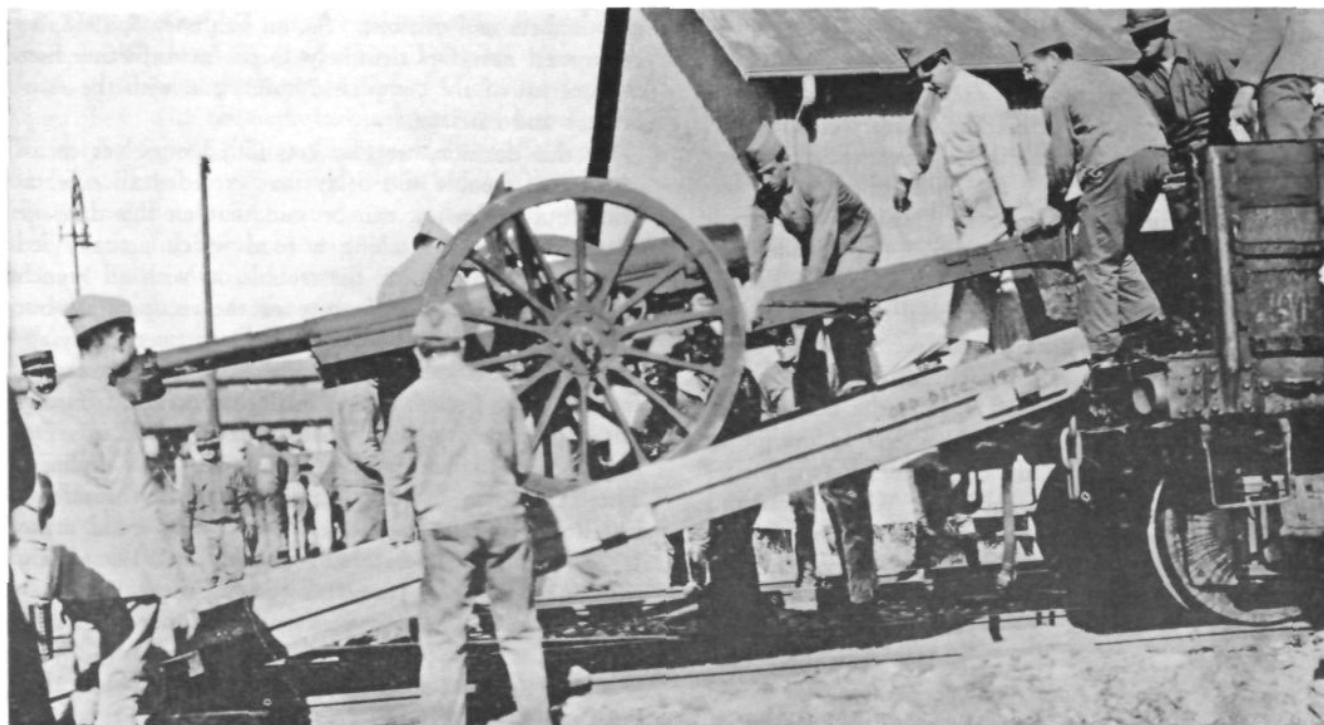
By Major General William J. Snow, USA-Ret.

On October 31, 1918, just before the Armistice, there were just 59 French 75-mm. guns with the Field Artillery in the United States. Twelve of them were at each of the four Firing Centers, and 11 were at the Fort Sill School of Fire. The latter originally had 12 also, but one had been blown up during service practice. All 60 of these guns had been brought from France. During the month of October, 1918, the Ordnance Department produced its first French 75, American made—just as the war ended.

There is a most interesting story back of the American production of this gun. The French 75-mm. was the gun with which our field artillery fought in France, it having been furnished there by purchase from the French Government. Our Government bought a total of 1,828 of these guns for the A. E. F.

It will be recalled that upon the advice of the French Mission, which came here soon after we entered the War, the United States decided to adopt the caliber 75 millimeter

in place of 3 inches for our light gun, thus making American and French ammunition interchangeable. This did not, of course, in itself, involve adopting the "soixante quinze" gun. Nor at that time had we any idea of so doing. We did, however, make a contract with France to purchase about 600 of these guns complete. However, that was regarded only as a temporary procedure, adopted for the purpose of providing General Pershing's army in France with a light gun until we could replace it with our American 75 Model 1916, which as heretofore indicated was the gun with which we proposed to fight the War. However, the Ordnance Department did secure the drawings of the French 75 recuperator. These drawings were received here in August, 1917, and a recuperator was received the next month. However, because the Ordnance Department was at that time pinning its faith on the Model 1916 gun, no use was made either of the French drawings or of the recuperator. The latter was sent to Rock Island



First French "75" to arrive at Fort Sill. Note French personnel

Morris Swett

Arsenal, the usual repository for parts of foreign guns. In addition, the drawings were not entirely complete.

As was stated in discussing the Model 1916,* doubts as to the success of this model had been creeping into the Ordnance Department even as early as the late summer of 1917; accordingly, in October of that year, two American Ordnance officers were sent to Puteaux Arsenal, France, to study the manufacturing methods of the recuperator. Or it may be they were sent there in order to learn how to make repairs to the French guns with which Pershing was being equipped. Anyhow, whatever the object may have been, while this Ordnance party was making its study, affairs with the manufacture of the Model 1916 got worse, so much so that, on January 16, 1918, Colonel E. S. Hughes, whom I have previously mentioned and who was Chief of the Artillery Section of the Procurement Division of the Ordnance Department in Washington, recommended in a written memorandum to his Chief that the contract with the Willys-Overland Company for 2,927 carriages, Model 1916 (without recuperators), be cancelled and a contract with the same Company be made for an equal number of French 75-mm. carriages also without recuperator. No action was taken on this memorandum at the time. Instead, a meeting was held on January 31st to discuss the matter, at which no decision was announced.

On February 18, the Willys-Overland Company was informed that the suggested switch in contracts would be made, and they were authorized to purchase materiel and equipment to make the French 75-mm. carriage (without recuperator). From then to April 17th, when the contract was signed, the Ordnance Department in conjunction with the Willys-Overland people were engaged in checking and rechecking drawings, preparing assembly drawings, changes to facilitate production, etc. This contract provided for carriages (less recuperators). I may add that the first carriage came through in September, 5 months later.

In the meantime, the Ordnance Department, here in the United States, began, on January 14, 1918, the transcription of the drawings of the recuperator of the French "75" I have mentioned as having been received the previous August. This work was completed on February 19, 1918. From then until March 2d, these new drawings and figures were checked against the actual recuperator received the previous September. In the meantime, late in January, 1918, the contractors for the Model 1916 carriage had been assembled in Washington and had thrown up their hands. So, here we were, nine months after we entered the war, without a gun program.

We had cancelled the Willys-Overland contract for three-fourths of all the Model 1916 carriages we had contemplated making, while for the remaining one-fourth we had not yet gotten a recuperator that would work. Until we got a satisfactory recuperator, none of this comparatively small number of carriages still remaining

under contract could be used. We were waiting for the report of the test of the single gun and carriage of Model 1916 that had been sent to France to be fitted with a French design of recuperator, the St. Chamond. If that recuperator worked there was still to be made a field test of gun, carriage, and recuperator. And if the field test proved satisfactory (which in reality it did not), there was still ahead of us the making and installation of machinery with which to manufacture the St. Chamond. The machinery once installed, there remained the actual manufacture of the recuperator itself and the assembly of the recuperators on the carriages. Hence, all hope of carrying out our original idea of fighting the war with the "Model 1916" was dead. It was a case of what some man once described as "a beautiful theory murdered by a brutal mob of facts."

Under these circumstances, the Acting Chief of Ordnance, on January 30, 1918, cabled Pershing as follows:

"Paragraph 3. If we find it desirable to place orders in this country for French 75 millimeter field guns and carriages to augment production, will 1897 Model be satisfactory?"

In reply Pershing cabled, on February 6, 1918, as follows:

"Paragraph 6. For Chief of Ordnance. With reference to paragraph 3 your cablegram, 714, manufacture of French 75 millimeter materiel of the 1897 Model will be satisfactory."

This settled the matter, for on February 8, 1918, the Control Bureau of the Ordnance Department directed the Procurement Division to purchase 2,927 French 75-mm. carriages from the Willys-Overland Company, without recuperators; to buy recuperators from Rock Island and the French government; and to buy the necessary limbers and caissons. So, on February 8, 1918, we committed ourselves definitely to the manufacture here in America of the complete 75-mm. gun with the recuperator and carriage.

By this decision, we also committed ourselves to an amount of trouble and delay that exceeded all expectations; but at least it can be said that on this date we were finally started along a road which actually led somewhere. Of course, the trouble, as with all French guns, was in the manufacture of the recuperator; but when we adopted it, the Ordnance Department fully appreciated that it was a very, very difficult device to manufacture. The French officers in this country had frankly stated that they doubted whether we could do it. Ten large American manufacturing companies flatly declined. Three Canadian and one American company considered it. Rock Island Arsenal sent word they could make 1,750 Puteaux recuperators by January 1, 1919, starting with one per day in June and working up to 9 per day in December. The only concern that really wanted to make it was the New York Air Brake Company. With reference to that company, the thought was present that the company would be especially pleased to get rid of the contract for making the Model 1916, and the company was anxious to be a producing plant instead of "an experimental laboratory for the Model 1916," as one of

*See FA Journal, April, 1941.

their officers phrased it. In addition, they were, as I have stated, the only plant in this country equipped to proceed at once with the manufacture of the recuperator. Just what the compelling reasons were that kept this plant on the Model 1916 instead of putting it on the Puteaux recuperator, I do not know.

France is a nation of hand workers. All their recuperators were so made, just as certain high-priced automobiles abroad are largely of hand work. This kind of work is characteristic of the genius of the French people. The American system of production is the reverse of this. It is quantity production. In this, all the separate parts of a machine are made separately by machinery, each piece being given just the right amount of "tolerance" so that all the parts will fit together and work when assembled. Until the United States undertook to make these recuperators, no nation except France had made them. Germany had captured quantities of French 75's, but did not even consider making them. England, an ally of France, had the opportunity to make them, but also would not consider the idea. The United States alone was rash enough to undertake the manufacture, and to do it by quantity production methods. Certainly, it was the finest and most delicately accurate piece of manufacture ever undertaken up to that time by quantity production methods, and the successful manufacture of it was the crowning achievement of American industry during the War.

Now I want to invite attention to a peculiar chain of circumstances. It will be recalled that I was verbally detailed as Chief of Field Artillery on February 6th, the day Pershing cabled his decision about the French 75 gun from France, and that the printed order announcing my appointment as Chief was dated February 10th. Between these dates, the Acting Chief of Ordnance decided to go ahead with the manufacture of this gun complete. It is probably true that at the time he made the decision he did not know of the existence of a Chief of Field Artillery and therefore no charge of neglect can well lie against him for failure to consult me. But as a matter of fact I was vitally interested, of course, in this gun question, and was at the time actually on duty in the War Department; but I knew nothing about these cablegrams and it was many months later before I learned of their existence. When I did find out about them, I naturally felt that when the Acting Chief of Ordnance learned of the existence of a Chief of Field Artillery he should have mentioned the fact that he had recently taken this momentous and far-reaching decision. But he did not. I remained wholly ignorant of this exchange of messages with General Pershing and of the fact that the adoption of the French 75 had been made after I became Chief of Field Artillery.

For months afterward I labored under the impression that the manufacture of this gun, complete with recuperator and carriage, had been decided on in the summer of 1917. This error on my part was due to one of those peculiar misunderstandings that are constantly occurring in every-

day life. It arose in this way: Contracts were made by the Ordnance Department as early as August 29, 1917, for the French 75 gun. In the Field Artillery, the term "gun" means a complete unit (gun, recuperator, and carriage), ready to fire. When, therefore, early in my inquiries of the Ordnance Department I was told of these contracts made in 1917 for the manufacture of the French 75 gun, I assumed they were contracts for complete units according to the Field Artillery use of the term. Consequently, I thought that by the summer of 1917, we had already adopted this gun complete. This error was somewhat strengthened in my mind when I was told the contracts were coming along satisfactorily. This was, indeed, a cheering thought while it lasted. A little later, however, it developed that these 1917 contracts were for gun tubes only (no recuperator or carriage) and that the guns were to go to France in part payment for complete units that were being furnished the A. E. F. This was far from a cheering thought.

I learned that these 1917 contracts were for guns only in a rather peculiar way. I had, of course, by the latter part of February or early in March, learned of the confusion in the Ordnance Department, but was still under the illusion that the 1917 contracts were for complete units, when Major Bacon, of my office, who was doing yeoman service for me with the Ordnance Department, walked into my room one day and said, "The plans for the French recuperator have been found." I naturally asked him what he was talking about. He then gave me the disagreeable information that the 1917 contracts were for gun tubes *only* and that no contracts whatever had yet been made for recuperators or carriages. We were then well into the month of March. Major Bacon then went on to state that the Ordnance officers who had been in France several months (this was the first I learned of that also) had returned to Washington early in February with the drawings of the recuperator, drawings of the special tools to make it, etc., and that the one in charge had immediately left the city, and that only now, over a month later, had the drawings been found in his desk.

I told Major Bacon he must be mistaken. Such a thing could not happen! It was silly and sounded like a lurid book, a dime novel, or some sort of a joke. But he insisted he was right as to the main facts. I had great difficulty in crediting his statements, notwithstanding my absolute confidence in him.

We had been in the war eleven months. We had produced no guns. The "Model 1916" was dead, or at least I thought it was. We could not win the war without guns. Were we only now just starting to make them? Had we not yet gotten even to the contract stage? And after contracts were made would factories and machinery have to be made? And after that would still more months elapse before production started? It looked fantastic and hopeless. However, the thing to do was to investigate and find out whether these alleged facts were actually true or whether they were merely some of the

war-time rumors that were prevalent in Washington at that time. Accordingly, an investigation was made which disclosed that, in so far as contracts were concerned, none had been made for recuperators and only recently had the first contract been made for carriages, the Willys-Overland contract.

In so far as "losing" the drawings was concerned, it was not true. Partly due to the French insisting on "secrecy" (of which more later on) and partly due to other causes, the drawings, etc., were carefully guarded in the Engineering Bureau of the Ordnance Department—too carefully guarded. In the meantime some other bureau of the Ordnance Department which wanted these plans could not get them; hence the rumor that they were "lost."

A factor lending credence to the "lost" rumor was that a lieutenant named Hughes who had been in France at the Puteaux works studying the manufacture of the recuperator and who had brought the drawings to the United States, entered the hospital shortly after his arrival in Washington. He was there several weeks. He had evidently been strongly impressed by the French with the idea of secrecy and had probably transmitted the idea, undiluted, to the Engineering Bureau of the Ordnance Department here when he gave them the plans.

The result was secrecy with a vengeance. And in the meantime Colonel Hughes, who wanted and needed these plans, was unable to get hold of them. Finally, on March 13th, after several unsuccessful attempts to get them, he wrote a memorandum which succeeded in prying the drawings from the Engineering Division where they had been so carefully guarded. Hence the "found" rumor.

One unfortunate circumstance connected with the "lost and found" rumor was that these officers both of whom were named "Hughes" became confused in the minds of associates as "Colonel Hughes" only and as the one whom rumor charged with having both "lost and found" the drawings. This was a great injustice to him. He was the one officer who, by camping continuously on the trail of the drawings, finally, as I have stated, pried them out so that they could be used. Too much credit cannot be given him for his persistence. I doubt if there was another officer in the whole Ordnance Department more anxious than he to get the drawings, for he had to procure the actual recuperators and manifestly his hands were tied until he could get them. He was (and is) a highly talented officer, and the field artillery is under great obligations to him for his superior work.

There is another sidelight on the recuperator. On February 26, 1918, Professor Edward B. Reed, of Yale University, whom I knew personally, in a letter congratulating me upon being appointed Chief of Field Artillery, mentioned that Yale University had 4 French 75-mm. guns that had been obtained from France as they were too badly worn for further firing. Yale had a field artillery regiment and was using these old guns for training.

Professor Reed appealed to me for copies of the A.E.F. translation of the drill regulations for this gun. I told him I had received only one copy of this translation but was having it printed and would send him a supply as soon as they came from the printer. The fact that Yale had 4 French guns then passed out of my mind for a couple of weeks until Major Bacon gave me the information I have narrated. It then occurred to me that if we were now just beginning the manufacture of the French carriage and recuperator it would be of considerable help to get hold of the ones at Yale. I talked this over with Ordnance Department officers, who were quite anxious to get the Yale guns. I thereupon wrote Doctor Hadley, President of Yale, explained to him our desperate straits, and offered to trade him at once for his French guns, a battery of British 75's, these to be replaced by a new battery of American made French 75's when we could spare them. In a letter which cordially expressed a wonderfully cooperative spirit, he agreed. The Ordnance Department then sent men to Yale to secure the guns and to bring one recuperator to Washington, in order that it might be torn down, the "secret" which France had protected for years disclosed, and engineering data and measurements of parts obtained. I was invited by the Ordnance Department to come over and watch the recuperator being taken apart but of course I had no time to go, much as I so desired. After the disassembly was completed the Ordnance Department telephoned me that the "secret" was merely an indescribably close fitting piston. This particular recuperator incident is simply illustrative of the delays and accidents and differences of opinion that constantly occurred.

At times during the war it seemed to me as though there was almost a conspiracy of the fates to prevent prompt action. At the time we got the recuperator from Yale, arrangements for their manufacture were being completed by the Ordnance Department with the Singer Manufacturing Company. The officers of the Production Division of the Ordnance Department thought that the recuperator should go direct from Yale to the Singer people so as to assist them in designing and laying out their tools, jigs, and fixtures and so that the tool makers could see the actual parts of the product for which they were to design and make the tools. The Production Division said it would do no good for these tool makers to come to Washington, look at a part, and then go back and design a tool to make such a part. Or, they said, if the recuperator were not to be kept in Washington but were ultimately to go to the Singer people, why not send it at once? The Engineering Bureau of the Ordnance Department, however, directed that the recuperator be brought to Washington and disassembled here. They were controlled by the secrecy insisted upon by the French.

On the ground that I had obtained the recuperator for the Ordnance Department in the first place, certain officers in the Production Division then appealed to me for help. This was decidedly embarrassing. The recuperator,

however, was brought to Washington and disassembled here, and an agreement was reached on March 18th to give the Singer people all the drawings except one. That one was to be split up into four pieces, manufacture of these parts was to be by some other concerns and assembly of all parts was to be according to some scheme to be later worked out. Now, let us get to the actual disassembling of the recuperator. Here occurred another and characteristic delay that seems amusing, in looking back at it now, though it was far from so at the time. Everybody has heard the old joke about the plumber who after arriving at a house to which he had been sent to repair a leaking pipe sent his helper back to the shop for the tools. Well, a French mechanic arrived in Washington about March 25th, having been sent all the way from Rock Island Arsenal, Illinois, to disassemble this recuperator—and he arrived without his tools!

However, on March 26, 1918, the Singer Manufacturing Company took a contract to make 2,500 recuperators at the rate of 17 per day. But the first one was not produced until about a year later (1919). On the 16th April, 1918, and a little over a year after we entered the war, Rock Island Arsenal was given a contract for 1,000 recuperators. They produced the first one at just about the time of the Armistice. There was talk about giving Ingersoll-Rand a contract for 1,000, but if this were done the contract was cancelled shortly after it was made, and doubtless on account of the Armistice. I believe the French government was given a contract for 15 a day, but none of these came to the United States.

There was another appeal made to me about this recuperator when we adopted it. It will be recalled that the New York Air Brake Company had a plant erected at Government expense to make the "Model 1916," and that in this plant they were still struggling valiantly but unsuccessfully to produce the 1916 carriage. The Production Division wanted to get this plant diverted to making the recently adopted French recuperator. It was stated that if this plant shipped to Rock Island all its Model 1916 parts, it could then start immediately on the French recuperator and turn out 8 of them per day, production to begin within 2½ months. It was further stated that this was the only plant in the United States equipped to start production at once. As it was known to all of us that the recuperator would be the limiting time factor, 8 recuperators meant 8 complete carriages. So it came down to 8 complete French carriages per day vs. continuing experimental and development work in trying to make an uncertain number of the Model 1916. I agreed with the Production Division that such development work on the Model 1916 should be confined to a government arsenal and that the New York Air Brake Company should make French recuperators. I thought, as a result of our combined efforts, we had finally succeeded in getting this done; but months later I found that I was wrong. The Model 1916 still held forth in this plant and continued to do so right up to the Armistice.

Continuing this plant on the Model 1916 up to the Armistice was a grave mistake. By November, 1918, the New York Air Brake Company had completed only 33 of the carriages on their contract to make 400, and I am under the impression that these 33 did not have recuperators. In March, 1918, when the question first arose of diverting this plant from the questionable Model 1916 to the French recuperator, the Ordnance Department inspected the plant and reported it well equipped to do the proposed work. It was known that while the Singer Manufacturing Company was an excellent concern, some considerable time would necessarily elapse before its equipment to make recuperators could be supplied; and, of course, this meant still more time before a finished recuperator could be produced. It was expected that when the Singer plant got under way it would produce in large quantities, but until that time the New York Air Brake Company would fill in the gap with its 8 per day. It should be borne in mind that this was the only plant in the United States equipped for early production, hence the anxiety of the Production Division to divert it to this class of work. The only plant in the United States! But the Control Bureau said "no." So, in place of probably a large number of French carriages that would work because they had stood the crucial test of some years of warfare on the Western Front in France, we got 33 carriages of a very questionable model. After the War, several Regular Army Field Artillery Regiments were equipped with the Model 1916 gun and carriage in order to test it thoroughly. At one post, it came to be quite a joke among the cannoneers as to who would carry the basket in which to place the parts of the carriage, as they fell off or broke off during drill and maneuvers.

As soon as the new Chief of Ordnance, General Williams, got around to the light gun question he immediately began to push the French 75-mm. production. Having recently return from France, where he had made most of the arrangements with the French government to furnish Pershing with this gun until we could come into production, and being familiar with it, he fully realized that the recuperator was the troublesome and time-consuming factor. At that time the Ordnance Department had concluded a contract with the Singer Manufacturing Company for 2,500 and with Rock Island Arsenal for 1,000. General Williams directed that a third source of supply be opened up. As arrangements were pending with the French government to make recuperators for us, General Williams in reality was after a fourth source of supply. After some difficulty, it was thought that this fourth source had been found in the Ingersoll-Rand Company, and this Company was either given an order for 1,000 or same was contemplated. Some officers in the Ordnance Department, after this reported contract, rather anticipated so many recuperators shortly as to be embarrassing, but they were spared that feeling! I think the Ingersoll-Rand contract, if made, was shortly cancelled.

One of the French 75's having burst at Fort Sill, as

I have stated, the recuperator was sawed through lengthwise so as to give a sectional view of it, and it was used for instruction purposes at the School. The French officers on duty with the School said this was the first time they had ever seen "the inside of the works," and they must have promptly informed the French Mission in Washington. The latter, of course, promptly appeared at my office, protesting exposure of the "secret."

M. Tardieu, who was then in Washington, took up with the Ordnance Department the maintenance of the "secret." General Williams, Chief of Ordnance, and I both tried to negotiate with him some relaxation of the delaying restrictions that he insisted on with reference to the manufacture of these recuperators. He was a hard man with whom to do business, as were most of the French for that matter.

Late in August, 1918, Mr. Stettinius, who had gone abroad for the purpose of coordinating and speeding up the deliveries of supplies, cabled a suggestion that certain finished parts of the French carriage and recuperator be shipped to France, and that the French would give us complete units in exchange. But there were strings tied to this offer. While the French thus furnished the skilled labor, we were to send over to them considerable numbers of other workmen to assist in handling the work. In addition we were to furnish certain raw materials, which would have resulted in shutting down some American plants which were just coming into production. We wisely declined. How much of this offer was altruism on the part of the French and how much was good business to keep their factories going, I, of course, do not know. Anyhow, we were not ready to throw up our hands in despair and accept the French proposition.

It is thus seen that after we had been in the war for about a year we found out we could not make the gun and carriage with which we had expected to fight the war (Model 1916). It is also seen that at this time, and I repeat it was about a year after we entered the war, we made our first contract to build a different gun and carriage (a foreign gun, the French 75) with which to fight the war. A volume could be written on the dangers of such a procedure.

It has always been a source of wonder to me why the French were so secretive about this recuperator; but they were. Even the Field Artillery officers of the French Army knew nothing about the "secret," or, if they did, they concealed their knowledge well. One American Ordnance officer, who was trying to speed up the production of the recuperator here in the United States, made the remark, in all seriousness, that he thought the French would rather lose the war than make public the secret of the soixante quinze. While this was, of course, an exaggeration, yet it conveys some idea of the strength of the insistence. The French carried it to a degree that seriously delayed our production; and even after the war one American Ordnance officer did not hesitate to say that the French had hindered more than they had helped us in making the French 75-mm.

The polishing by machinery of the interior of the recuperator cylinders to a perfect mirror surface was a hard task. Also, there were no "tolerances" on the drawings, the French officials explaining that their workmen carried in their heads how tight things must fit. There was used in packing a particular kind of grease that gave trouble, and there was used in the cylinders a particular kind of oil that also gave trouble. Of course we analyzed some of the oil gotten from France, but even so we had trouble in producing it. The Texas Company made some that functioned perfectly during the summer, but it would not work when cold weather came. At one time, we were reduced to five gallons as the total reserve supply in the United States. Finally, when a recuperator was finished and looked perfect, it would not work. Then it had to be torn apart and worked over some more. The Ordnance Department built a dustless factory at the Rock Island Arsenal, with filtered air which was maintained at a certain constant temperature and of a certain constant degree of humidity, in which to do the final work on the recuperators; and it was not until then that success was finally attained. But of course all this had taken time, months and months, with the result that the war was over before one complete gun and carriage could be delivered to the Field Artillery. Later, they came through rapidly.

While freely admitting the magnificent work accomplished by the Ordnance Department in solving the many difficulties involved in making this recuperator, I think the saying attributed to Bismarck that a special Providence watches over the United States must be true.

We started out to equip our Army for the war with the "American 75, Model 1916" gun. After almost a year of effort we had to abandon it. We then adopted the French 75 and made a new start, after losing a year in war. The war was over before we produced this gun. It may be said, then, that we could not and did not equip our Army with artillery during the War. It is of course true that our Army in France had guns during the war. We bought them from the French and the British; otherwise, there would have been no American Army, for these guns certainly could not have been obtained from American manufacturers. Had there been no American Army there would have been no Allied victory. Therefore, had we depended on our own manufacturing facilities and followed the plan we did with the different models, we and our associates probably would have lost the war. That is a strong statement to make, but the reader must remember that the World War was sometimes called an artillery war. About two-thirds of the casualties that occurred on both sides were inflicted by the artillery. This was the first war in all history where artillery inflicted more casualties than the small arm or musket. Thus, realizing the importance of the Field Artillery and our fiasco as far as production of our adopted guns goes, one can appreciate our precarious situation from the day we entered the war to the signing of the Armistice.

INCIDENTS FROM THE BATTLE OF FRANCE

Artillery in Action on the Aisne on June 9

Translated by CAPT. P. W. THOMPSON, Corps of Engineers

The battery position for days, morning, came "Change 6:00 AM the hitched to the the ammunition stacked near the was reloaded. training were times we had very operation winter. In a short was ready to

At the the battery unobserved by About 12:00 taking cover in woods, out of air. At 6:00 PM order: "Battery up survey

The new firing battery OP were during the night. Chemindes short time later, firing positions The battery went action. The OP light telephone out immediately, Vassogne and site of the OP, relieved certain comrades. Wire between OP and was established

The OP was camouflaged. It wonderful view valley of the

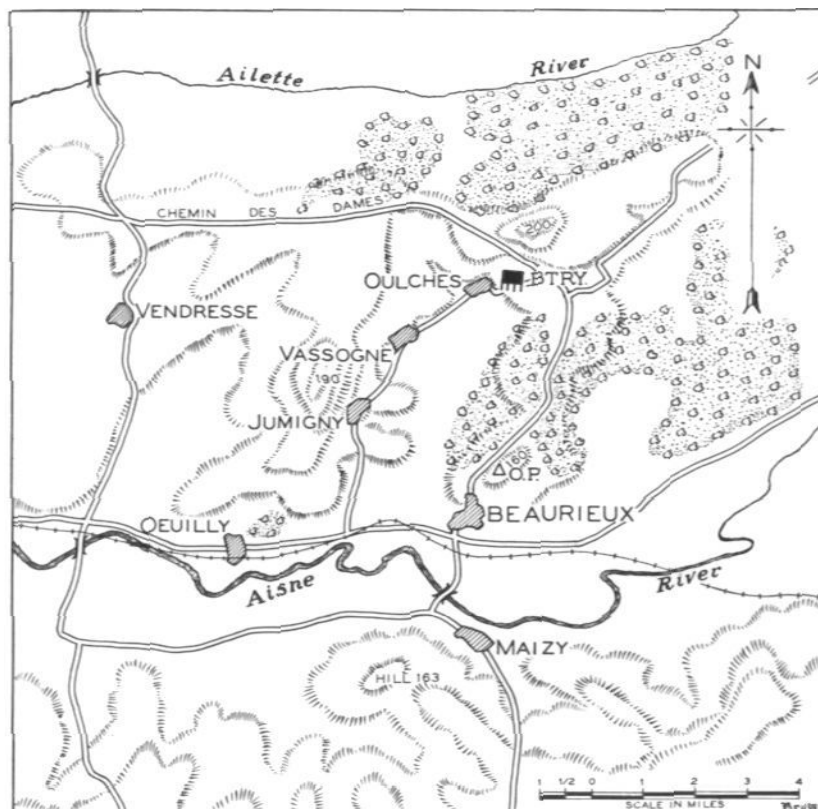
By June 9, 1940, the Germans had completed the destruction of the Allied armies in the Low Countries; the British Expeditionary Force had withdrawn through Dunkirk to England. Weygand, appointed generalissimo in a last-minute effort to stave off disaster, was attempting to create a defensive cordon along the Aisne. The Germans, repeating their strategy of May, had been making strong feints in the Abbeville area, thus enticing the remaining French strategic reserves toward the western part of the line. Once again the center was insufficiently protected.

The Germans were now ready to launch their final blow to eliminate France from the war. Again it was to be a penetration, with the main effort in the historic Laon-Sedan area—toward the southeast this time, instead of toward the Channel. Von Rundstedt's army group was to make the assault, in which infantry divisions supported by 300 batteries of artillery were to crack the line. The armored divisions were held thirty miles in rear, ready to exploit the breakthrough.

At daylight on June 9 the artillery, including many heavy batteries, commenced an intense one-hour preparation. The fire was directed mainly against the dominating French observation on the high ground below the Aisne. Then the infantry moved forward. Finally, after what the Germans describe as the heaviest fighting of the war, the armored divisions were thrown against the French, and continued their dash south toward the rear of the Maginot Line.

Herein we present a brief eyewitness account of the artillery phase of this great battle.

From *Militarwissenschaftliche Rundschau*, November, 1940



had been in when, early one the order: positions!" By limbers had been guns. Noiselessly which had been firing positions The results of our evident; many practiced this during the past time the battery march.

designated time moved out, enemy aircraft. noon we halted, the edge of a sight from the came another on the alert; load equipment."

positions and the to be occupied We reached the Dames, and, a the site of the near Oulches.

headquarters energetically into section and the wagon moved passing over Jumigny to the where we

Austrian connection firing positions without delay.

well commanded a over the entire Aisne, the

villages of Beaurieux and Maizy, and the bluffs on the other side of the river.

The following days passed in relative quiet. However, certain individual buildings in our vicinity were shelled regularly each day. Our battery had the immediate mission of determining the size and disposition of the enemy opposite us.

Within a few days we began to see officers of other arms, whereupon we knew that the attack must be coming very soon. We redoubled our caution. Anyone who visited our positions by day was forced to crawl the last 200 yards. We ate our lunch at midnight.

The preparations for the attack continued. Battery after battery arrived and went into position, many of them near us. Firing positions were staked out in readiness for batteries which would arrive during the night before the attack. Observation was intensified. Enemy positions were reported as soon as located. Many infantry officers, passing through the vicinity, inquired as to whether sufficient artillery was at hand.

The CP of the infantry assault regiment was established nearby, but still there was no indication as to the exact time of the attack. Enemy artillery at first had been active; however, as our artillery remained silent, the activity of the

enemy slowly subsided. Our plan was to obtain complete surprise.

Thus, the evening of June 8 arrived. By midday, the enemy artillery fire had become heavy, and so many shells fell near us that we believed our positions had been located. At 8:00 PM the enemy fire increased in intensity. It was moved systematically over the entire area, disrupting our communications net. At this point, our battery commander told us of his World War experiences. He reminded us of the terrific bombardment which had preceded the French General Nivelle's attempt to break through in the spring of 1917—a bombardment which General Nivelle thought would destroy every living thing, but which did not prevent the Germans from repulsing the infantry attack which followed. In the present case, the violent French bombardment failed to affect seriously the German positions.

The great attack was scheduled for June 9. The zero hour was to be 5:00 AM. As dawn broke, we saw that it was to be a fine summer day. Already, German dive-bombers were flying overhead, dropping their deadly loads on the enemy. Our own tension mounted as the zero hour approached. Now only a few minutes remained. Once more everything was tested and all settings



German 15-cm. howitzer in position ready to fire across the Aisne.

were checked. There was a last word of caution and cheer. Then the roar of a shell leaving one of our guns broke the momentary stillness. The attack was on!

From the edges of woods and from behind rows of bushes the German guns were firing. Slowly the barrage rolled away from the bluffs on the near bank, toward the enemy. The entire valley was filled with smoke, so that our observation was only partly effective. In the face of heavy fire, our engineers were rushing forward with their assault boats, and were ferrying the infantry across the river. A bitter fight over the crossing of the river and the canal was

under way. However, by 12:00 noon, our infantry had gained the heights on the opposite side, this despite desperate resistance on the part of the French.

Now, the advance had gone beyond range of our OP. Meanwhile, our advance observers with both radio sets had gone forward with the infantry during the morning, and were keeping us advised as to developments. During the afternoon came the order for change of positions. The day now was hot. Soon we had reached the Aisne, and soon a new OP had been established on Hill 163. The final phase of the Battle of France was under way.

ADVENTURE AT JUSSEY

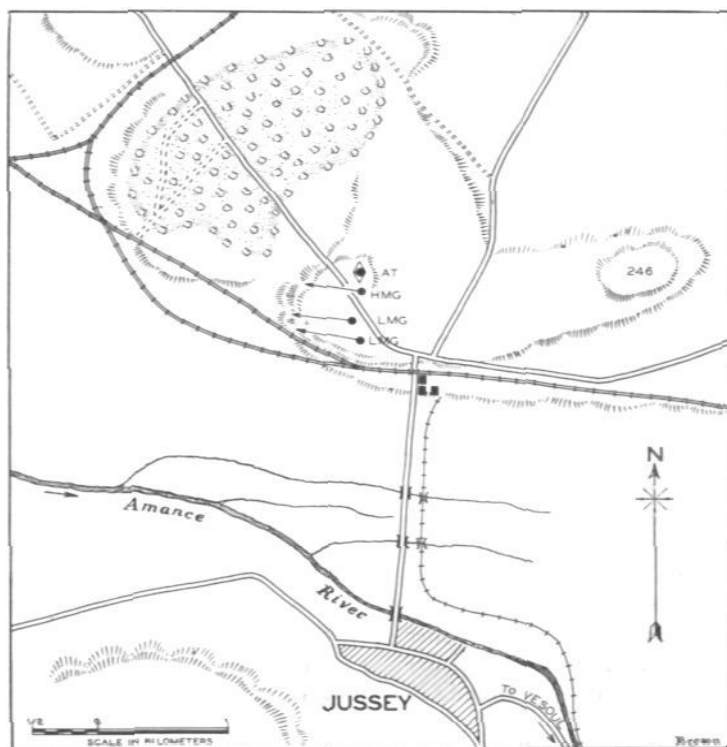
Motorcycle Infantry and Antitank Guns in Combat at the Railway Station



By Corporal Schwolbe, in
Militar-Wochenblatt, 22
November 1940
Translated by Capt. C. T.
Schmidt, Inf.

During the advance Vesoul on June 16, reconnaissance mission of protecting division and patrolling enemy retreating toward had to be held up. The detachment to the east Jussey was very wide so elements had to be motorcycle infantry guns and heavy command of the was sent to take Jussey. anything in particular, sudden halt made us all shooting in front of us. machine gun was made to report to my He, however, was northward up the road On the right side of the squads of the were following. The left the heavy machine gun, protective fire. Along truck after truck of a column. The completely

The action described herein took place as the 19th and 22nd Armored Corps swept down behind the Maginot Line after breaking through on the Aisne. This unit was part of the 7th Army which cracked the Maginot Line just above Belfort.



of our division on 1940, our detachment had the the north flank of the toward the north. The the west and southwest sector assigned to our and west of the town of that the individual widely dispersed. A column with antitank machine guns, under company commander, Without experiencing we reached the town. A listen. There was At once my heavy ready and I ran forward company commander. running, rifle in hand, to the railway station. road the individual motorcycle column side was reserved for which was to give the whole road we saw French transport surprised column only

realized what was happening when our machine gun sent a hail of bullets after it. Already the first trucks were reached, but we went on without halting. Nobody paid any attention to the poilus who were standing by their trucks with hands raised. Nobody paid any attention to the bullets that were being fired at us. Only forward, for we must reach the railway station and take it—so read our order. The infantrymen with machine guns ready ran along the column shooting here and there. The mad rush went on and on.

Finally we reached the station, in front of which we had to prepare for defense. Behind us stood the French column with valuable material. Thirty vehicles with all their occupants fell into our hands. At the station the squads assembled. The motorcycles were pulled along after us. Orders were issued by the company commander to the squad leaders and the antitank leaders. Suddenly we heard the piping of a locomotive. Everybody looked in that direction. A freight train wanted to come into the station. A man yelled, "give the signal for arrival!" Immediately, one man jumped on the signal station. There was a clatter inside the station. Everybody was waiting with bated breath. Quick orders were given, the machine guns were immediately put into position. But the train stopped. "Now the train is moving!" shouted someone. Yes, but it was moving backwards, and disappeared even before we were able to fire on it. Clearly, French troops had noticed our presence. However, it was not long before we could hear motors on the road leading to the northwest. There they came, automobiles and tanks. Again, a short fight and the vehicles were in our possession. Then the squads went into their designated defensive positions 500 meters to the north of the station. There is a little ridge there running from east to west. There, the platoon, my machine gun, and the antitank gun were to take position. As we reached the height, we saw a motorized column which the French had left behind. The motorcycle infantry platoon was to take position on the left side of the road, and I, with the heavy machine gun, on the right side. The antitank guns remained on the height with a good field of fire on all sides.

Now, we thought, we would be able to rest a bit. But nothing of the kind. The motorcycle infantrymen were ordered to come back to the railway station. Likewise, the squad attached to us was recalled.

"Now you are all alone and must depend upon yourself," I thought. I got in touch with the leader of the antitank gun and we talked in detail about what we would do if the enemy attacked. And that was just our luck, for once again we heard the piping of a locomotive. A freight train with a lot of passenger cars came out of the woods lying to our left front. What to do?

"Don't shoot," I shouted to the antitank gun commander. For I saw behind the advancing train another passenger train. Quickly we agreed that we should fire on the passenger train. My machine gun was already in position.

Riflemen were dug in. Every nerve was strained. My aimer was already aiming at the train.

He reported, "Machine gun loaded with tracer and armor-piercing bullets, and ready for fire."

"Good," I said. "We must wait on the antitank gun."

At the same moment the antitank gun fired for the first time. I looked. The shot went right through the middle of the locomotive of the passenger train. The poilus who were leaning out of the windows and admiring their beautiful country jumped back all at once into the compartments. The antitank gun fired round after round.

My time had not yet arrived. One glance at my aimer was enough. I looked him in the eyes and he laughed as if we were on maneuver rather than on French soil. Now I saw the whole terrain.

"Fire at will," I called to the machine-gunner. A hail of fire burst from its muzzle like a chain of pearls. The tracer bullets streamed toward the train. The aim was good. A great confusion broke out in the train. We could see, at a distance of 400 meters, the Frenchmen jumping out of the train and crouching in the ditches. Now the train stopped. There was a tremendous crowding at the doors.

"Belt finished," called out No. 2. This little pause was enough to give the Frenchmen time to take positions. At the next moment there was a torrent of bullets falling upon us.

"Take cover," I shouted to the men. I myself had to crawl back to the road, for I had not dug out a hole for myself. Now the Frenchmen really began to fire. The antitank gun still was firing. Then I saw one of the crew collapse, seriously wounded. The French began to attack. To raise one's head was perhaps to invite death. But it had to be risked. The machine gun in any case had to change its position. A quick order and the men crept up like snakes, each one with his rifle. They were quite pale; only their eyes gleamed. I was very happy that all of them were safe and sound around me. But we had no time to think about things. Just there, the road was like a protective wall, and this enabled me to move to the rear. But we had to stop the enemy, no matter what it might cost. A hedge was useful to us. Again we crept like cats into position. Our machine gun hammered once more. Its fire fell in the midst of the Frenchmen. They stopped, turned around and ran into the nearby wood, which gave them good protection.

I ran to the company commander to tell him about the situation and to ask for reinforcement. But all squads were already in position and engaged. The company commander told me that we had to hold until the end, so I knew what was what. I ran back to the machine gun and told them what the company commander had ordered. Each one knew what was before him if there were another attack.

I looked over the ground in front of us. Nothing was to be seen of the enemy. So we had some time to rest.

The carbines were lying ready for fire beside the men. Another piping from a locomotive made us listen. We saw that two more passenger trains were carefully pushing forward out of the woods.

Then came the order, "Change position to the rear." At double time we ran back 500 meters. The fire of the French whistled over our heads. I looked for a suitable position from which I could survey the whole terrain along the railway. To my right there were a number of houses in which I had to find cover. But I did not have one single man available. As if by accident, the munitions motorcycle came up just then. At once I detailed the driver as right-flank security. He went into a ditch pointed out to him and immediately a rain of bullets hit around him.

"You won't see him again," I thought, and wanted to call him back. I saw that he was standing and firing round after round with his rifle. Then I lay down.

Again, a passenger train came rolling along. An antitank gun on the railway platform fired on the train. A hail of bullets from all machine guns fell on it. Within the train itself not a man was to be seen. The train went past the station and the antitank gun which fired after it. A terrible explosion shook the earth. A bridge went up in the air. Quite by accident an antitank gun had hit the explosives that had been prepared for destruction of the bridge. Several of the railway cars fell into the stream with the bridge. But nobody climbed out.

Was this a bluff on the part of the Frenchmen? In those moments of tremendous excitement a fourth train rolled up. Frenchmen looked out of all the cracks in the cattle cars. What now? There was our antitank gun firing again. A light mortar had come into position and was now firing heavily. At the same time there was a second explosion. Shell after shell exploded. All around us flew fragments of iron with a horrible howling. I heard a lieutenant shout, "Look out, explosion!" Immediately, everybody threw himself on the ground. Again, a terrific noise and a shower of fragments. And now a deathly silence. The tracks were blown up. The train continued to roll on and then stop.

I looked at every car. Everywhere Frenchmen. If they attack us, we are lost, I thought. But a miracle happened. On the other side of the railway platform I saw the company commander, big as life, walking towards the train. A cold sweat broke out all over me. What does he want there? Now a lot of firing by the Frenchmen; but on our side everything was still. Over on my left a light

machine gun went into position. Then there was a shouting in French. Questions and answers followed. Through my field glasses I could see the company commander conversing with the French officer. The whole train surrendered. A French battalion surrendered to a reinforced motorcycle infantry platoon. At once the soldiers were hauled out of the train, and what did we see there? Women and children refugees among soldiers. Then a stone dropped from our hearts, for we saw our detachment commander, cigar in mouth, on the railway platform.

Now the armored reconnaissance cars must be coming up. And there they came to the station. Now, we were no longer alone. The rear cars had not yet been searched. A squad went forward to do this job. A tank went along with the squad for protection, discovering that there were still four or five cars occupied. The French soldiers defended themselves but the tank fired on the cars. Finally, they surrendered. I myself went on the other platform to help search the cars.

Suddenly I heard shooting. I looked out of the car and saw my munition carriers standing and firing at fleeing soldiers. The Frenchmen fired back. I wanted to get to the machine gun and crawled up to it. At that moment, the roar of motors. Several planes! Somehow I had an unpleasant feeling, for we had not had time to lay out ground markers. Well, this can be bad!

"Take full cover," I ordered my men; just then we heard a terrible howling above us. And I saw on the other platform how Frenchmen and Germans were throwing themselves together on the ground. Somebody fired a flare, but it was too late. The howl of the bombs became louder. We fell in the ditches, our faces pressed to the ground.

Everyone counted and thought, "Now they must hit!" But where? Now a terrible explosion and bursting, and it is still again. And again—quite nearby. Then another bomb was seen hurtling right down upon us. But nothing happened. Deathly silence. Finally, everybody began breathing again. It was a dud, only 50 meters from us. One of our aviators, thinking we were all French troops being detained, had thrown several bombs at us.

That was the last fight we had that day. The enemy in the woods did not attempt another attack. Our mission to prevent any penetration by the enemy into the north flank of the division had been fulfilled. About 1,000 prisoners were taken, together with a great many tanks and other vehicles.

One of the commanders of National Guard field artillery brigades has worked out a morale-boosting scheme which is worthy of consideration by other commanders: His three regiments hail from three different states. Instead of forming the brigade headquarters battery and brigade headquarters all from one locality, he has drawn them from the three states which supply personnel for the regiments. Thus he has formed a miniature "rainbow battery," in which the officers and men of all the component regiments feel that they have a part and interest. Everyone feels that he has a friend in court. The plan makes for good teamwork.

CONDUCT OF FIRE

Chapter 1—General

SECTION I—GENERAL

1. DEFINITIONS.

a. Conduct of fire.—Conduct of fire is the technique of placing artillery fire upon the selected target.

b. Observed and unobserved fires.—When fire on the target can be observed, it is adjusted to conform to the target. When fire cannot be observed, accurate data, usually based on topographical survey, are prepared; fire is then placed on a larger area in order to increase the chances of including the target.

c. Adjustment and fire for effect.—Observed fire consists of *adjustment* and *fire for effect*. The object of adjustment is to determine, from the

observed positions of the burst and target, data with which to begin fire for effect. The object of fire for effect is to place fire on the target. Adjustment should continue throughout.

2. SCOPE.—This text covers those observed fires for which the fire commands are given by the observer direct to the battery. The following types of observed fires are not included:

- a.* Time fire.
- b.* Fire with smoke shell.
- c.* Fire conducted by air observers and forward observers.
- d.* Fire with direct laying on rapidly moving targets, such as tanks.
- e.* Surveillance of fires.

3. SENSING.

a. A positive sensing is the determination, from observation of burst and target, whether the range or deflection is *short*, *over*, or *correct*. One positive sensing is

The following notes on Conduct of Observed Fires were prepared at the Field Artillery School as Instruction Memorandum G-7. Although at present they can only be said to represent methods and trends now being tested at the School it is expected that later they will be incorporated in a revision of FM 6-40. The methods contained herein depart from those of the current edition of FM 6-40 in brief as follows:

a. PRECISION.

(1) In light and medium artillery, except when special accuracy is desired, the *c* is used instead of the fork.

(2) Deviations are measured (when they are to be acted upon) but are not announced aloud.

(3) In lateral adjustments, small deviations are not computed to the line. Usually when sensings are obtained the deviation need not be considered.

b. BRACKET.

(1) There is no set rule for bringing in the battery. To save ammunition or to assist in obtaining surprise, the adjustment may be conducted with one gun as desired. Unless there is some reason to open with one gun, the adjustment is commenced with a battery salvo.

(2) The 100-yard sheaf is used for adjustment of all calibers. (The same sheaf is used for forward observation and air adjustment.)

(3) In axial, fire for effect is opened at the center of the bracket except when the target is moving.

(4) In general, the sheaf is considered as a group of bursts. The burst center is moved to the desired point.

(5) In small-T, deflection is not sensed until effect is started; On going into effect the effort is to place the burst center on the observing line.

(6) Deviations are measured (when they are to be acted upon) but are not announced aloud.



sufficient to establish a limit of a bracket. A burst should not be sensed positively unless the observer is sure the sensing is correct. An erroneous sensing prevents a prompt and effective adjustment. Bursts which cannot be sensed positively are sensed *doubtful* or *lost*. A sensing of *lost over* or *lost short* may be made when there is accurate knowledge of the terrain and the deflection is known to be reasonably correct. Lost rounds are brought into view by a change of data.

b. Sensing must be made promptly except when necessary to take advantage of drifting smoke. The observer must base his sensings on what he sees while it is

before his eyes, and not on his recollections.

c. (1) Positive sensings are usually made on shots in line with the target. When the terrain near the target is known, positive sensings for deflection and range may often be obtained from shots not in line with the target. These sensings are termed *terrain sensings*.

(2) If the target is clearly defined against the burst, the burst is *over*. If the target is obscured by the burst, the burst is *short*. If the target is obscured, then immediately silhouetted by smoke or dust, or vice versa, the burst is close to the target. If the burst is near the observing line and below the target, the burst is *short*; if on impact above the target, the burst is *over*. Range or deflection sensings on bursts wide from the target should be made with caution. When sensings are made on drifting smoke or on shadows, the direction of the wind or the position of the sun must be considered.

(3) Because of the difficulty in average terrain of estimating

the amount of error of a burst, the methods outlined herein are based on the assumption that a bracket or a target hit is necessary before starting fire for effect. This is usually true; but under favorable observing conditions the distance from the burst to the target may at times be apparent. If a burst is obviously very close to the target, a sensing of *range (deflection) approximately correct* should be made and fire for effect should be started at once with the same data or with a small appropriate change. Usually a sensing of range or deflection approximately correct is possible only if the observation post is considerably higher than the target, if the target is on a forward slope, or if the observer is close to the target. As indicated in the preceding sub-paragraph, smoke, dust, or shadow may occasionally give definite information that the burst is very close to the target.

4. APPEARANCE OF BURST.

a. HE shell.

(1) *Burst on impact*.—The smoke of the burst of HE shell is black. On wet soil, only the smoke is visible. On dry soil, dust is mingled with the smoke; the burst is discolored and larger. There is little difference in appearance between bursts with the quick fuze and those with the delay fuze. An incomplete detonation, called a *low-order burst*, gives a lighter colored smoke.

(2) *Ricochet*.—When the angle of impact is small, the projectile may ricochet. With a quick fuze, the detonation usually takes place at the point of impact; there is no ricochet unless the fuze fails to function. With a delay fuze, a shell which ricochets usually bursts about 10 or 15 yards beyond the point of impact; if the fuze is inertial, the projectile seldom fails to burst, but if the fuze is point detonating only, the projectile may ricochet on first impact as a dud. Fire against personnel with ricochet bursts, properly controlled, is very effective.

(3) *Air bursts*.—Air bursts are black. The point of burst is at the center of the smoke ball. The main effect of the shell fragments is underneath the burst.

b. *Chemical shell*.—Bursts of chemical shell vary widely in appearance. The bursts of smoke shell are easy to observe; those of mustard gas shell are difficult.

SECTION II—TYPES OF FIRE

5. GENERAL.—Fire is classified as precision fire and bracket fire.

6. PRECISION FIRE.—The object of precision fire is to place the center of impact at the target. It consists of a precision adjustment and precision fire for effect. It is appropriate for destruction.

7. BRACKET FIRE.—Bracket fire consists of a bracket adjustment and zone fire for effect; the object of the former is to inclose the target in a suitable bracket; of the latter, to cover the bracketed area with fire. Bracket fire should be delivered with surprise, rapidity, and adequate density.

8. REGISTRATION.—Registration is an adjustment on

a selected point in the target area to determine data for use in subsequent firing. Depending on the time and ammunition available and the accuracy desired, registration may be by a bracket or a precision adjustment. Because of its greater accuracy, a precision registration usually is made.

SECTION III—TARGETS

9. TYPES.—The targets considered in this text are of two types: Fixed, inanimate objects; and stationary or slowly moving targets involving personnel. For the first type, precision fire for destruction is normal; HE shell with a delay fuze generally is used. For the second type, bracket fire is necessary using HE shell and a quick fuze to give better fragmentation. Chemical shell may also be used.

10. ASSIGNMENT.—Targets usually are assigned by the battalion commander, or his representative, exercising fire direction. When the battery is operating alone or when there is no communication with the fire-direction center, the battery commander, or his observer, exercises fire direction. A battery observer may conduct fire on a target in his normal zone on his own responsibility, within the restrictions imposed by the battalion commander. Normally, however, when any observer discovers a target, he reports its nature and location to the fire-direction center. For the type of conduct of fire described in this text, the observer should have telephone or radio communication direct to the battery.

11. ATTACK OF TARGETS.

a. *Destruction*.—Because of dispersion, fire for destruction requires much ammunition. Medium and heavy calibers are better for most targets; smaller calibers may be used against light structures. Speed is not essential, although firing should be conducted without delay in order to minimize the effects of atmospheric changes. When more than one piece is to fire, data obtained by the first piece to adjust may be used by the others.

b. *Personnel*.—The object of fire against personnel is to cause losses, prevent movement or action, and in general to destroy combat efficiency. Once fire has been opened, speed of adjustment is essential. In preparing the data, the priority of speed or initial accuracy must be decided in each individual case. In general, accurate initial data will produce early fire for effect by speeding the adjustment; this is often more important than speed of determining initial data. Previous registration on one or more points facilitates prompt opening of fire.

SECTION IV—MISCELLANEOUS

12. ELEMENTS TO BE ADJUSTED.—The following elements must be adjusted:

a. Direction, to determine a deflection which will cause the line of fire to pass through the target.

b. Distribution, to determine a deflection difference which will cause the sheaf to cover the desired front.

c. Height of burst, in case of time fire, to obtain a corrector or time setting which will give the desired mean height of burst.

d. Range, to determine the elevation or range setting which will produce maximum effect on the target, other elements being correct.

13. CONTROL.

a. Discipline.—Personnel and equipment at the observation post must be kept at a minimum and concealed from hostile observation. Unnecessary movements and noises are forbidden.

b. Communication.—Telephone is the usual means of communicating between the observer and the battery; radio and visual signals are other means. The operator should be close to the observer and in a good position to hear and transmit commands.

c. Commands.—Fire commands must be given clearly and at a rate which the operator can transmit without confusion. Commands are given in the terms and sequence prescribed in FM 6-40.

d. Correcting commands. — Fire commands once transmitted must not be cancelled, but any element in error must be corrected by announcing new data. An error in giving the command for deflection, deflection difference, or corrector is rectified by announcing a compensating change. If a different range is ordered after the piece is loaded, the new range will be set, but in case of time fire the fuze setting will not be altered except when friendly troops are endangered.

e. Observing instruments. — The usual instruments for observing artillery fire are the BC telescope and the field glass. Observing instruments should be used only with a definite purpose; their sustained use reduces keenness of vision. For the first round, it is well to watch for the burst with the naked eye, since a large error may put the burst outside the field of view of the instrument. When the burst is located, the observing instrument may be brought into use promptly. Each observer should note his interpupillary distance and eye-piece settings in order to adjust observing instruments promptly.

14. TERMS.

a. To avoid repetition in the discussion of methods, *c. range*, and *target* are used as general terms as follows:

(1) In precision fire, *c* indicates both *c* and *fork*.

(2) *Range* indicates both *range* and *elevation*.

(3) *Target* indicates the object or objects upon which adjustment is made.

b. Error indicates the distance from the target to a burst or the center of a group of bursts. The error may be divided into its deflection component and its range component. This use of the term *error* must not be confused with the errors of dispersion.

c. A salvo or volley is *bracketing* when bursts *over* and bursts *short* are equal in number; it is mixed when both *overs* and *shorts* are obtained, but more in one sense than in the other.

d. The *deviation* of a burst is the horizontal angle, measured at the observation post, between the burst and target. A burst on the observing line is a *line shot*.

e. The *burst center* is the center of a group of bursts.

15. ABBREVIATIONS. — The following abbreviations for commands and sensings are used herein:

A	Air (sensing)	Kr	Corrector
Adj	Adjust	L	Left
AMC	At my command	Mk	Mark
AP	Aiming point	NCh	Normal charge
B	Battery (pieces to fire)	Op	Open
BD	Base deflection	Pl	Plateau
BL	Battery left	Q	Quadrant
BR	Battery right	R	Right
CF	Cease firing	RCh	Reduced charge
Ch	Charge	Rd	Round
Cl	Close	RGM	Rounds per gun per minute
Ca	Compass	Rn	Range
Cv	Converge (at)	RS	Rounds sweeping
D	Down	SCh	Super charge
Dev	Deviation	Sh	Shell
Df	Deflection	Si	Site
Dr	Drum	T	Target (sensing)
EI	Elevation	U	Up
FD	Fuze delay	Z	Zone
FQ	Fuze quick	+	Over (sensing)
G	Graze (sensing)	—	Short (sensing)
		?	Doubtful (sensing)

Chapter 2—Axial Conduct of Fire

SECTION I—GENERAL

16. DEFINITION. — Conduct of fire is termed *axial* when the observer is on or near the line of fire, with a target offset of not more than 100 mils. Deflection errors can be determined accurately, and compensating corrections made. Range errors cannot be measured accurately.

17. SENSING.

a. Range.—Range is sensed as *short*, *over*, *target*, *range correct*, *range approximately correct*, *lost*, or *doubtful*.

b. Deviation.—Deviations are measured, but need not be announced aloud.

18. ADJUSTMENT.

a. General.—The adjustment of all elements is carried on simultaneously.

b. Direction.—The deflection correction, based on the observed deviation, usually is made in multiples of 5 mils until the deflection is close. If a cross wind is blowing, the bursts may be kept slightly to windward until the adjustment is completed.

c. Distribution.—See paragraph 24 *b*.

d. Range.—When a range sensing has been obtained, a bold range bound is made, seeking an observation in the opposite sense, in order to include the target in a bracket. The bracket is split until one of the proper depth is obtained. One sensing is sufficient for establishing a limit of a bracket.

19. RANGE BOUNDS.

a. Unit.

(1) For light and medium artillery, the unit of range

change for either a precision or a bracket adjustment is 100 yards; for a precision adjustment with heavy artillery, it is the fork. The equivalent of 100 yards in mils of elevation—known as c —may be found in the firing tables.

(2) For precision adjustments, with light and medium artillery, the fork may be used if greater accuracy is desired.

b. First bounds.—The size of the first bound made during adjustment is based on the accuracy of the initial data, except when information of the range error warrants a different bound. Based on the initial data, the following bounds should be made:

(1) One c , when using transfers or map data corrected.

(2) Two c 's, when using map data uncorrected or a properly adjusted range finder, or when making a small shift in range or deflection from a previous target.

(3) Four c 's, when using estimate data.

c. Bounds when range error is known approximately.—If, at any time during adjustment, it is possible to sense the approximate amount of a range error, the next range bound should be modified accordingly. If the range error is observed to be great, a bold range change, which gives promise of bracketing the target, should be made. If the burst is observed to be close to the target, the next bound may be decreased but normally should not be less than the bracket sought. If the burst is obviously very close to the target, *fire for effect should begin at once.*

d. Bounds close to friendly troops. — When firing close to friendly troops, fire is opened with a range which is surely over. The range is then decreased by small bounds until a short or a correct range is found.

20. USE OF r/R .

a. When r and R differ materially, the observed deviation will differ from the deflection error (Fig. 1). A burst is brought to the OT line by a deflection change equal to the deviation multiplied by r/R .

b. Examples.

(1) The value of r/R has been determined as $3/4$. The first burst was observed 40 mils left of the target. The shift necessary to put the burst on the OT line is right 30 ($3/4 \times 40$).

(2) The value of r/R has been estimated as $1/2$. The first burst was observed 50 mils left of the target. A shift of 25 mils is made and the next burst is observed 25 mils right of the target. The corrected value of r/R , determined by firing, is $25/75$ or $1/3$.

c. When the value of r/R has been determined with reasonable accuracy, it should not be changed

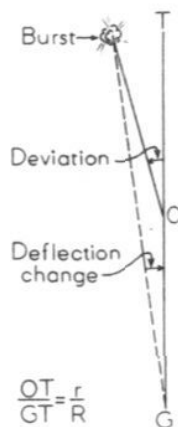


Figure 1.

unless obviously in error, and preferably as the result of a comparatively large deflection shift.

d. In a similar manner, r/R may be applied when determining the width of a sheaf.

SECTION II—PRECISION FIRE

21. GENERAL.—Fire is conducted by a single piece. The gunner's quadrant is used. Each round is sensed for range; for example, *short; over; doubtful.*

22. ADJUSTMENT.—The object of adjustment is to obtain a trial elevation; this is an elevation giving a target hit, or the center of a 1- c bracket. The method of fire is *one round*. The value of c is that corresponding to the initial quadrant elevation. To facilitate the splitting of the bracket, it is convenient, and usually sufficiently accurate, to use an even number.

23. FIRE FOR EFFECT.

a. Fire for effect is started at the trial elevation. An initial group of six sensings is desired; any shot fired during adjustment at an elevation later used for this group may be included. If the trial elevation is determined by a target hit, five additional rounds to complete the group are fired in one series. If the trial elevation is the center of a 1- c bracket, the group of six sensed rounds are fired in half groups of three. If the first half group is all in the same sense, the elevation is changed $1/2 c$ in the proper direction, and enough shots are fired to complete three sensings at this elevation; the group is then considered to have been fired at the mean of the two elevations used.

b. Adjusted elevation.—After the first group of six sensings, an *adjusted elevation* is determined. If this group gave an equal number of *overs* and *shorts*, the adjusted elevation is the one at which the group was fired; otherwise, the adjusted elevation is determined as follows: Find the difference between the number of *overs* and *shorts*, neglecting target hits. Add (subtract) this number of twelfths of c to (from) the elevation used. (The c used during adjustment is satisfactory for this computation; when using the fork, the value should be that corresponding to the quadrant elevation at which the group is fired.) With this adjusted elevation, a second group of six sensings is obtained; a new adjusted elevation is determined in a similar manner, making *one-half* the change indicated; after the third group, *one-third*; after the fourth and following groups, *one-fourth*. Precision fire for registration includes one or two groups, depending upon the accuracy desired. The above procedure is based on constant firing conditions.

EDITOR'S NOTE: Next month we will publish Section III, Percussion Bracket Fire, together with two illustrative examples.

ILLUSTRATIVE EXAMPLES

EXAMPLE 1 PRECISION, AXIAL

Target: Check point. Mission:
Registration. Materiel: 75-mm. pack howitzer.
Ammunition:
HE shell, quick fuze.
 $T = 70$; $r/R = 0.5$; $c = 6$.
Initial commands: No 1 Adj, BDL 340, Sh
M41, Ch 3, FQ, No 1 1 Rd,



Commands	Results	Sensings	Remarks
Q, 110		?	40×0.5=20.
R 20, 110		—	2-c initial range bound.
122		?	Deviation caused by small lateral displacement of battery.
L 4, 122		+	
116		+	
R 2, 3 Rds, 113		—	Increase elevation 1/2c
2 Rds, 116		+	One more sensing needed to complete a group of six.
L 2, 1 Rd, 116		—	Including last round for adjustment, there are 4 shorts and 2 overs.

In this case, one group of six rounds is considered sufficiently accurate for registration. The group was fired at a mean elevation of 114.5.

Adjusted elevation is 115.5 [$114.5 + (2/12 \times 6)$].

EXAMPLE 2 PRECISION, AXIAL

Target: An emplacement with light overhead cover on a fairly steep forward slope. Mission: Destruction. Materiel: 155-mm. howitzer. Ammunition: HE shell, delay fuze.
 $T = 80$; $r/R = 0.6$; $c = 10$.
Initial commands: No 4 Adj, BDR 145, Sh
Mk I, Ch 4, FD No 4 1 Rd,



Commands	Results	Sensings	Remarks
Q, 370		+	Smoke behind crest. 2-c initial bound.
350		—	
360		—	
R 3, 3 Rds, 365		+	
365		+	Firing may cease if target hit
		Target	accomplished mission; if not, the next group of six rounds would be fired at 362.5.
		+	[365—(3/12 × 10).]



Learning from the Engineers

The publicity given to some of the matters brought out during the course in the Technique of Assault Operations recently completed at The Engineer School, Fort Belvoir, Virginia, indicates that the aspects of the work which bear on matters of importance to the Field Artillery should be presented to the branch at large for consideration and possible experimentation or test.

As the summaries given below will show, the course actually included more than the title would indicate. In fact, the investigations made really constitute a study of the role of division engineers in combat. A consideration of this subject was especially timely in view of the developments in the campaign in Western Europe.

The student body was comprised of some thirty Engineer officers and representatives of the Armored Forces, the Chemical Warfare Service, the Air Corps, the Infantry, the Field Artillery and the Marines. The students worked in committees. The facilities of the Engineer School and the Engineer Board were placed at their disposal to the extent possible, both for research and for practical experimentation and demonstration. The Office of the Chief of Engineers cooperated by furnishing considerable information on European operations which had, up to that time, not been generally distributed.

A very brief and general summary of the principal conclusions and facts brought out in the various committee reports is given below. In each case there is appended a suggestion as to the significance of these matters for the Field Artillery. These suggestions present only the notions

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of the Field Artillery representative; they are not necessarily endorsed by the Field Artillery School or the Chief of Field Artillery.

ASSAULT OF DEFENSIVE INSTALLATIONS

The committee which investigated this subject studied foreign procedures and tested the value of flame throwers, thermite grenades, improvised bottle grenades, Molotov Cocktails and explosives in these operations. The committee determined that German methods which have proven successful in battle could be applied by our army with little or no change in organization or doctrine. It is interesting to note that the principles governing operations of this sort laid down in a new draft of FM 100-5 (FSR-Operations) are in accord with those believed by the committee to be correct. The committee felt that elaboration to the extent shown in the draft of FM 100-5 should be included in appropriate branch manuals.

Significance for Field Artillery: It is of course generally known that the Germans employed their AA and AT weapons for direct fire on the embrasures of emplacements and bunkers. Since it is likely that there will be a serious shortage of these weapons in our forces



Fig. 1—Raft with draw bay



Fig. 2—Assault-boat ferry with girder runways used as ramps

in any war in which we may be engaged within the next few years, our field artillery may be called upon to perform missions of this sort. Certain it is that we will be called upon to give continuous and close support to any units that are engaged in assault operations of this type. Increasing emphasis on pushing observation and liaison

forward and providing it with alternate means of communication as now emphasized at Fort Sill are positive essentials for success in these operations. The artillery and air force preparation which should usually precede the assault must be effective against the hostile works and against support groups which protect the blind spots



Fig. 3—Tank suspended between pontoons

of the emplacements; accuracy of fire, therefore, is of prime importance.

Tests conducted with flame throwers, bottle grenades and the like bring to mind the question of anti-mechanized defense for emplaced artillery. The Spaniards and the Finns made constant and effective use of "Molotov Cocktails" against tanks. The writer feels that instruction in the preparation and use of these weapons would be of considerable value for field artillery troops. We all know that the field artillery is one of the first targets of any mechanized attack. Normally, it is expected that the supported troops and antitank units will defend emplaced

out the lack of American equipment and training for such a task. It indicate lines for the development of mine detectors and special equipment for the removal of obstacles. The value of explosives in the latter was clearly demonstrated in exercises put on by the committee.

Significance for Field Artillery. It has long been recognized that field artillery fire is an expensive and time-consuming method of destroying obstacles such as barbed wire, abatis, and the like. Screens of fire and smoke, however, can play a vital part in protecting demolition parties engaged in removing such obstacles by other means. Our routine methods are adequate to meet the needs



Fig. 4—Light tank passing through concertina wire. No obstacle!

field pieces, or rather supplement the defense which they themselves can make. However, it would be tremendously comforting to have a few incendiary grenades around to heave at any over-zealous hostile tanker who had succeeded in getting past other troops and in evading the fire of our organic weapons. Wouldn't our cannoneers operate their guns much longer if they knew that even if their fire failed they still had an ace in the hole?

The committee recommended the development of a TNT grenade fuzed with a hand grenade type time fuze. If and when such a grenade is developed, field artillerymen should have a few of them stowed in their hip or saddle (as the case may be) pockets for emergency use against tanks. It is reported that British artillerymen who have been subjected to tank attacks indicate that these means should be available to artillery units.

PASSAGE OF OBSTACLES AND CLEARING OF MINE FIELDS

The report of the committee studying this matter pointed

of such situations.

Normally, the field artillery should expect to find mine fields and obstacles cleared, but it would appear to be sound practice to have a few key men—perhaps mechanics or scouts—trained in the use of demolitions and the passage, for emergencies, of mine fields. It also appears definite that our AA and AT platoons and AT batteries should be trained in these matters.

RIVER CROSSING TECHNIQUE INCLUDING FERRYING AND EXPEDIENTS

The work of this committee was concentrated on methods and means for speeding up river-crossing technique. Special attention was paid to providing means for getting heavy vehicles of the armored forces across streams rapidly. Some promising items included girder-type runways for ferries and bridges, ferries designed to carry vehicles partially submerged, ferries designed to

be applicable to special shore conditions, and variations in the standard procedure of bridge construction. See Figures 1, 2 and 3.

RIVER CROSSING TACTICS

The report of this committee is in fact concerned more with technique than with tactics. In so far as tactics is treated emphasis is placed on speed in crossing and in crossing on a broad front. The employment of parachute troops and air infantry was also advocated.

Significance for the Field Artillery. This observer is convinced that our general theory and doctrine on river crossings is sound. He also agrees with the contention of one of the officers on one of the committees, that "Rivers do not spring up on you unannounced"; hence that there is normally time

to make preparations and plans in advance.

However, he is convinced that actual details of organization (for river crossings) are not generally understood throughout the service. Since our troops are now to an increasing extent congregated in places where there is opportunity for combined training it would appear that exercises to cover such

matters as: organization, procedure and order of crossing; guiding; assignment to boats and details of command and liaison might well be included in training programs. It would seem that much of this training could be done even when no rivers or bridge equipment are available. Such training will promote more smoothness at maneuvers where river crossings are involved. The importance of continuous accurate artillery support, especially through many of the vital stages of a crossing, make this matter of organization of special concern to the artilleryman. He needs to get his observation, liaison and reconnaissance elements on the hostile side as early as possible and needs to know exactly when, where and how his guns are to be

crossed, so that they will be out of action the minimum amount of time. He wants to know how many (if any) guides, messengers, bridge police or laborers he will be called upon to furnish so that he can plan his other operations accordingly. No special fire technique appears to be indicated, but the problem of ammunition supply is one that may become critical.

BARRIER TACTICS

Although this committee concerned itself mostly with the "big picture" of barrier tactics, it pointed out some matters of "little picture" importance. The committee advocated the formation of special barrier units and the theory of cellular defense, i.e., the preparation and disposition of means so that a mechanized attack could be

bottled up in those areas which afforded the best

opportunities for defense. Barrier units something similar to the "reconnaissance

detachments" formerly used in problems at Leavenworth were proposed.

The committee, like others, came to the conclusion that the heavy prefabricated antitank barriers were of application

only in those situations where ample time was available. The land mine was advocated as the most effective barrier. Also emphasized was the need for the defense of all road blocks and barriers. The following was indicated as the smallest element of a barrier unit:

- 1 Engineer squad (12 men)
- 1 Truck and tools
- 50 AT mines
- 1 Lt MG with AA mount
- 1 37-mm. AT gun
- 1 Motorcycle

This unit is capable of erecting barriers and defending them.



Figure 5—Medium tanks bellied on saw-horse type obstacle.

The report warrants the attention of all field artillerymen who are charged with responsibility for training antitank units.

OBSTACLES

This committee tested various types of obstacles and agreed that the land mine was the most effective obstacle during a war of movement. It advocated the standardization of obstacle construction to a few simple types and emphasized the need for defending obstacles. It believed that the American mine should be made larger to make certain that it would destroy the crews of the heavier tanks.

various types of emplacements and the proper methods of siting them; the location of obstacles; and the proper use of supporting troops in a defensive system. The committee discovered some serious defects in our standard defensive works and proposed remedies for them.

Significance for Field Artillery. The Field Artillery is interested in several aspects of this report. First, the suggestions on the organization of defensive positions present information that will indicate the location and types of targets the artilleryman will be required to fire upon in an attack on an organized position. Second, it gives him some sort of an idea as to where to find the most vital



Fig. 6—Tetrahedrons stopping medium tank

The committee devised a method of blowing craters that is superior to the standard method prescribed in current manuals. It presented a training program in the construction of obstacles. See Figures 4 to 10.

Significance for Field Artillery. This observer feels that all AT and AA personnel in the Field Artillery should be trained in the construction of the simplest types of obstacles and in the laying of mine fields. In addition, a few men in each firing battery should have this training, because of the limited number of Engineers and antitank personnel usually available.

ORGANIZATION OF A DEFENSIVE POSITION

The report of this committee discusses the value of

needs for liaison and facilities for observation. Third, it gives him information on the technical details of the construction of defensive structures which may prove of value in determining the methods of firing upon hostile works of a similar nature.

Throughout the report the need for all-around defense by all units from the lowest echelons to the highest, the necessity for mutual fire support and the requirements of camouflage and concealment are emphasized.

DEFENSE OF AIR BASES

The report of this committee indicates that the defense of an air base should really begin when the construction of the fields and other installations comprising



Fig. 7—Tank passing through crater made by using 150 lbs. of TNT.

it is planned. It indicates methods and organizations for defense against air infantry and parachutists. The provision of a mobile force of combined arms held in readiness to counterattack any hostile force that may have gained a temporary success is recommended.

Significance for Field Artillery. The mobile force proposed contains field artillery. However, in trying to visualize the nature of the actions in which such a force might be employed there is nothing to indicate that the normal and routine field artillery methods would not prove entirely adequate.

MISSION AND TRAINING OF DIVISIONAL ENGINEERS

This committee considered the mission engineers are at present charged Field Service Regulations with a view to determining the appropriateness of those functions in the light of developments in Europe. The committee concluded (and it is believed that this conclusion is generally shared by officers of the Engineers as well as those of other branches) that the duties of division engineers should be more truly those of pioneers, with less emphasis on the engineer aspects; and that division engineers are at present charged with so many tasks that the principle of the economy of force is violated and that there is reason to believe that certain essential support in the forward parts of

the combat area can not be rendered if the present multitudinous number of tasks is to be retained. The following matters were considered as suitable for elimination; road construction, other than emergency in the forward areas; general construction; traffic control; ponton and heavy bridge construction.

The report goes into considerable detail in recommending training programs, methods and principles. It outlines some interesting tests for judging proficiency in training.

Importance for Field Artillery: This observer feels that the training suggestions and the proficiency tests might be studied with a considerable value by officers charged with the problem of preparing training programs and tests.

COMMUNICATION FOR ENGINEERS

This report was concerned only with the matter of recommending ways and means to remedy the present situation of inadequate communication facilities in engineer units. Hence it contained practically nothing of direct significance for field artillery, except to bring up the thought that in the event the engineers do become more truly pioneers and their communication facilities are increased they may well become a valuable source of information as to targets for field artillery, and may form an important element in an antitank warning service.

TRAFFIC CIRCULATION AND CONTROL

This committee was concerned primarily with the matter of traffic regulation within the division. The committee,



Fig. 8—Tank fails to pass crater made by 150 lbs. of TNT used in variation on standard method.

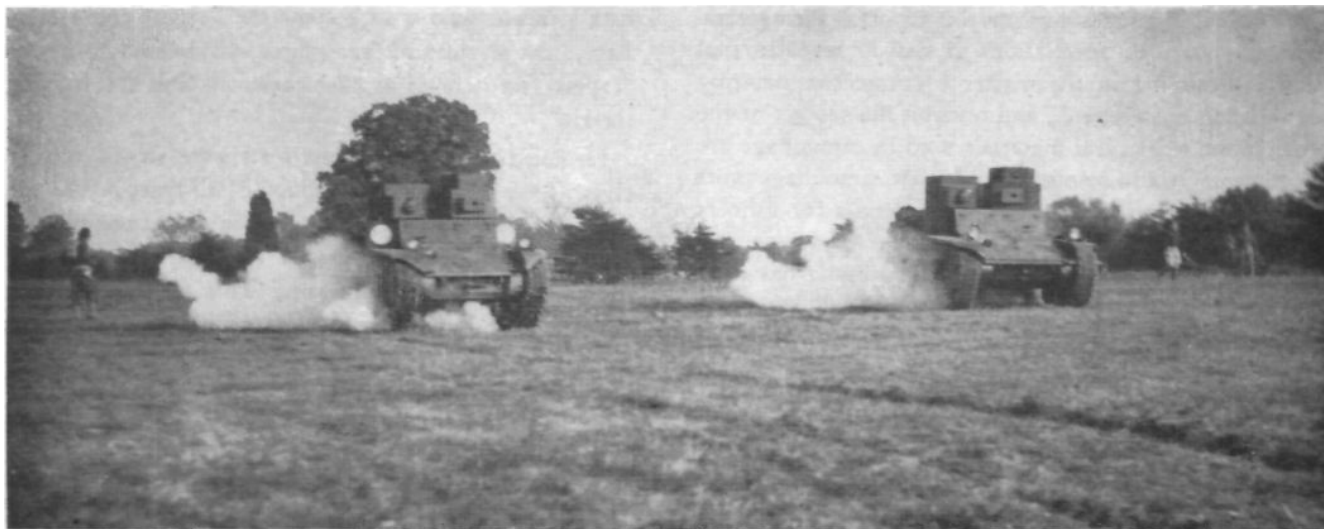


Fig. 9—Tanks passing through field of practice mines

believing that this was not a proper function for the division engineers, recommended an organization for a unit in which all matters of route marking and traffic control are centralized. The Field Artillery definitely hopes that whatever system of traffic control is employed will be efficient. Other than that there is little of direct significance in this report.

CAMOUFLAGE

This study was concerned with camouflage training methods rather than with the technique of camouflage. The report proposes a system of training somewhat similar to that now in effect in training for defense against chemical attack; i.e., a definite individual or group is charged with conducting this training. The committee report proposes

that intelligence personnel be used for this purpose but states that the Division Engineer could be used to conduct the camouflage course if the division commander desired. The committee drew up a rather complete course of 44 hours of training for the intelligence personnel within the division in order to prepare them for instructing their organic units. The programs stress the importance of the proper use of natural cover and of making concealment and camouflage measures an element of basic training.

Significance for Field Artillery. The camouflage problem of the Field Artillery is probably greater than that of any other combatant arm within the division. Adequate training is essential. Units which have not yet instituted a training program on this subject may find



Fig. 10—Effect of mine on Renault tank

some valuable suggestions in the report. Demonstrations and visits to installations at Belvoir revealed that additional studies in the matter of protective painting for vehicles, tentage, etc., and tests on the subject of the preservation of natural materials used in camouflage are in progress. It also seems probable that camouflage units will be able to provide garnishing materials for fishnets painted in colors appropriate to the area and season in a given theater. To any field artilleryman who has tried to paint yards and yards of burlap this will be a real blessing.

To this observer the idea of making S-2 responsible for camouflage training seems sound; however, there are more experienced field artillerymen who do not concur in this notion. In this connection it should be stated that there is here no attempt to relieve the commander of his responsibility for the training of his unit nor any suggestion that the camouflage officer should act as the agent of a

higher echelon. The idea is simply to indicate someone who is to become the "expert" on camouflage, just as the unit gas officer is supposed to be the "expert" on defense against chemicals and the training therein.

Demonstrations of various sorts were staged for the class. They included construction of all types of bridges, a tour of the map production unit in operation, and displays of the different types of standard and proposed engineer tools and equipment. This observer made a definite mental note that if he ever finds himself in combat and in need of a good gadget of any sort he will hunt the engineers, because they are almost sure to have it. The demonstration also proved the truth of the lines of the famous song which, speaking of engineers, say:

"They call for the balk,
And they call for the chess,
They work all day, and they never get a rest."

MINIMUM ELEVATION TABLE

By Captain Arthur R. Hercz, FA

As a hint to battery executives: It has been found helpful to paste a small table into the front of the firing tables to help in figuring minimum elevation. This sample was made up for the old 75-mm. shrapnel and the French 75 gun.

It is computed just as shown in FM 6-40, paragraph 32 a (2). For example, in the table below for a gun-mask range of 1,500 yards:

Elevation for 1,500 yds. Rn. (from tables)....	32.0	mils
2 forks at 1,500 yds. (from tables).....	2.2	
	34.2	mils
5 yd. at 1,500 yds. (5/1.5).....	3.3	
	37.5	mils

The value 34.2 is entered in the second column (crest not occupied by friendly troops); the value 37.5 is entered in the third column (crest is occupied by friendly troops).

To use this table simply add the greatest minimum elevation reported by the chiefs of section to the tabular value corresponding to the gun-mask range.

This simplifies and speeds up the work of the executive at a time when seconds count, and eliminates one possibility of error. The table has also been found useful in scouting for battery positions.

MIN EL FOR SHR (Add to greatest measured Min El)		
<i>Mask Rn</i>	<i>Not Manned</i>	<i>Manned</i>
100	4.0	54.0
200	5.7	30.7
300	7.3	24.0
400	9.2	21.7
500	11.0	21.0
600	13.1	21.4
700	15.4	22.5
800	17.4	23.7
900	19.7	25.3
1000	21.8	26.8
1100	24.0	28.5
1200	26.4	30.6
1300	29.1	32.9
1400	31.5	35.1
1500	34.2	37.5
1600	36.9	40.0
1700	39.8	42.7
1800	42.6	45.4
1900	45.7	48.3
2000	48.8	51.3



Motor Maintenance

INTRODUCTION

Prepared by the Field Artillery School as an article for The Field Artillery Journal, then published as INSTRUCTION MEMORANDUM MT-1, this study embodies the latest doctrines, and will apply until appropriate field manuals are published.

Existing regulations specifically state that the operations which may be performed in the various echelons of maintenance are limited by the personnel, the tools and equipment, the supplies, and the time available in the echelon. The using services should make every effort to have a reasonable supply of parts and units on hand before commencing the scheduled maintenance services which involve disassembly. The following list of accessory unit assemblies should be sufficient to sustain a motorized field artillery unit in the field provided prompt third-echelon service is available. The third echelon should exchange unserviceable units upon presentation. The reserve of units is thus maintained for emergency use and for the immediate repair of any vehicle. When a unit of this list is installed, it should be replaced at once from the third echelon. A minimum of one of each item should be carried for each type of vehicle.

Detailed instructions for automotive maintenance by the using arms and services

<i>Item</i>	<i>Number of items per hundred vehicles of each type.</i>
Distributors	4
Generators	4
Regulators	4
Starters	2
Ignition coils	4
Batteries	4
Brake master cylinders	2
Wheel cylinders	8
Air brake chambers	4
Carburetors	6
Fuel pumps	6
Gas tanks	2
Windshield wipers	4
Water pumps	2
Tie rods	1
Drag links	1
Propeller shafts	2
Springs	1
Steering gears	1
Ammeters	1
Horns	1
Governors	1
Heat indicators	1
Oil gauges	1
Ignition, light, and blackout switches ..	3
Speedometer	1
Viscosimeter, tachometer, and air	1
pressure gauge	1
Radiators	2
Spark plugs	6 sets, with gaskets
Breaker points	4
Condensers	4
Rotors	2
Distributor caps	2
Bulbs and fuses	8 of each size
Wiring harness	1
Miscellaneous wiring	Reasonable assortment
Separate starter switch	4
Ground straps, battery cables, and	
terminals	6
Brake parts	Reasonable assortment
Brake shoes, lined	2
Fan belts	2
Fuel lines and connections	4
Gas tank and radiator caps	5
Auxiliary fuel strainers	5
Sediment bowls	8
Radiator hose and clamps	Reasonable assortment
Gaskets and grease seals	Reasonable assortment
Bolts, nuts, and washers	Reasonable assortment
Universal-joint parts	2
Wheel bearings	1
Trunnion bearings	1
Steering-gear arms	1
Spring leaves (main)	2
Wheel studs and nuts	2 sets for each type of wheel
Valve springs	1
Winch shear pins	300
Thermostats	1
Tires and tubes	2
Chain and traction-device parts	Assortment according to nature of operations.

NOTE: This list will vary with the condition of the vehicles and the type of operation. In addition to the repair items listed, a reasonable assortment of items such as tape, tubing, solder, and cleaning and preserving materials should be carried.

The bulk of the accessories and parts should be carried in the battalion. In addition, a reasonable supply of high-mortality parts should be carried in the battery, mainly to accomplish routine maintenance. Items similar to the following should be carried in the battery for each type of vehicle.

Wiring	Miscellaneous
Light bulbs and fuses	5 of each size
Spark plugs with gaskets	1 set
Sediment bowls	1
Gas tank caps	1
Radiator caps	1
Hose and hose clamps	3 feet hose and 2 clamps of each size
Nuts, bolts, and cotter keys	Assortment
Screws, and lock washers	Assortment
Fan belts	1
Hydraulic brake tubes	1
Shear pins	25
Grease fittings	6 of each type
Tube valve cores	12
Tubes	2 of each size
Tube-repair material	1 for each vehicle
Tape	1 roll per vehicle
Wheel nuts	2 sets for each type of wheel
Spare parts for chains	2 side chains with locks and 50 crosslinks
Spare parts for traction devices ...	4 sections of 3 shoes each

Ninety per cent of troubles experienced under normal operating conditions can be corrected quickly if the items listed above are available immediately.

The responsibility for vehicle maintenance rests primarily with the battery commander. He therefore must maintain the means and institute a system to accomplish his task effectively. Higher commanders are responsible for the supervision of motor maintenance and for assuring the availability of supplies, parts, tools, and equipment.

The system of maintenance is prescribed generally in AR 850-15 and more specifically in FM 25-10. In garrison its accomplishment is rather simple. Time can be allotted for the service, parts and supplies are relatively easy to procure, stocks are easy to maintain, and working conditions are more or less ideal. In the field or on the march, another picture presents itself. Time usually is limited, supplies and replacements on occasion are difficult to procure, working conditions vary from fair to poor, and the tactical situation may demand a constant state of readiness. In spite of all these difficulties, vehicles must move without delay and without numerous fall-outs, and the organization should arrive intact except for battle casualties. Any system based upon "repair after failure" is destined to fail.

The maintenance system as now laid down provides that the battery perform the monthly (1,000-mile) maintenance service and the battalion perform the semiannual (6,000-mile) maintenance service. This division of work should afford battery and battalion commanders ample opportunities to schedule vehicles for maintenance services, without impairing the efficiency of their organizations in the field. Each service is divided into groups of operations which are not dependent necessarily upon one another, and therefore it is possible to perform these services by increments according to the time available. For example, the brake system may be placed in proper operating condition without regard to the steering system. It is possible, therefore, to work on the brakes at one time and the steering system at another, or on both simultaneously.

Work should be limited to those parts or units which actually need repair, cleaning, or adjustment, and thus reduce materially the time required to perform the services. A complete monthly (1,000-mile) service thus can be performed in from four to seven hours, and the vehicle should function properly for one month, or 1,000 miles of service, without further detailed mechanical attention other than normal driver maintenance. Therefore, a commander should investigate thoroughly each roadside failure to determine whether or not it was the result of poor maintenance.

Before any maintenance service is started, the vehicle records should be checked carefully to ascertain what work has

been done on the vehicle since the last maintenance service. The officer in charge then can decide what work is necessary. Every effort should be made to avoid repetitions. A study of the records should indicate whether or not the mileage is sufficient to warrant a complete service. Again, the good judgment of the officer in charge is relied upon for a proper decision. The type of vehicle operation is the determining factor in most cases. For example, continued operation through mud and water necessitates very careful inspection of the running gear and power-transmission system; certain portions of the maintenance service may be needed even though the mileage may be small since the last maintenance service.

As a guide for both the battery monthly (1,000-mile) and the battalion semiannual (6,000-mile) maintenance services, the outlined maintenance services can be made applicable to all wheeled vehicles, if supplemented by manufacturers' manuals for each type vehicle. It is impracticable to cover, in this document, all special operations pertaining to the various types and models of military vehicles.

DETAILED INSTRUCTIONS FOR MAINTENANCE SERVICES SECTION I—GENERAL

1. PERFORMANCE OF MAINTENANCE SERVICES.

a. No maintenance operations other than those indicated herein as mandatory will be performed unless inspection indicates need therefor.

b. The instructions as written apply generally to an all-wheel drive but with proper changes they can be applied to all makes and models of wheeled motor vehicles. Manufacturers' manuals should be consulted for specific adjustments and tolerances.

c. The semiannual (6,000-mile) maintenance service includes all items listed under the monthly (1,000-mile) maintenance service; hence no 1,000-mile maintenance service is needed during the month in which a 6,000-mile maintenance service is performed.

d. When the vehicle has operated less than 3,500 miles since the last semiannual (6,000-mile) maintenance service, the battalion motor officer may authorize the omission of the disassembly and adjustment of the assemblies known to be functioning properly, provided that the complete semiannual (6,000-mile) service be performed at least annually.

e. Lubrication is not specified in these services but when parts are disassembled and replaced they should be lubricated properly. Routine lubrication is a periodic service.

f. Repairs and replacements beyond the scope of the second echelon found to be necessary while performing a maintenance service will be made in the proper higher echelons of maintenance. (See Cir. 1-10, OQMG.)

2. EXAMINATION OF RECORDS.—Before a maintenance service is begun, the vehicle records should be examined to determine the adjustments, repairs, and replacements effected since the last maintenance service.

SECTION II—TESTS

3. PREPARATION FOR ROAD TEST.

a. Check for adequate supply of oil, gasoline, and coolant.

b. Start and run the engine until the proper operating temperature has been reached. The engine should be brought to a temperature of at least 140 degrees Fahrenheit before it is placed under load. If the temperature gauge is defective, the engine may be assumed to have reached operating temperature when it can be accelerated without missing or backfiring with the choke fully open (choke control pushed against the instrument panel), the oil-pressure gauge needle remains reasonably close to the normal operating pressure, and the viscosimeter reads in the normal range. The normal warm-up time

will vary and, in cold weather, can be shortened by covering the radiator. The engine speed during the warm-up period should be about twice the engine idling speed.

c. While the engine is warming up proceed as follows:

(1) Examine the ground under the vehicle for evidence of leakage of lubricants, gasoline, coolant, and brake fluid.

(2) Raise the hood and examine all oil, gasoline, and coolant connections.

(3) Check for leaking manifold connections and for leaks in the exhaust pipe.

(4) In an air brake system, check for air leaks and observe for proper pressure on the air pressure gauge.

(5) Listen for blow-by. Blow-by, if present, is evidenced by a hissing sound and is audible at the crankcase breather pipe. It should be checked after the engine has warmed up, since a slight blow-by which is evident when the engine is cold may disappear when the engine warms up.

(6) Remove the bayonet gauge after the engine has been in operation and check the condition of the oil.

(7) Remove the radiator cap and look for air bubbles or oil in the coolant. If bubbles or oil are noted, the engine may have a defective cylinder head gasket, or there may be an air leak at the water pump or in the inlet hose.

(8) Test horn, lights, windshield wipers, fire extinguisher, and any other safety devices.

(9) Inflate tires to proper pressure. Improper inflation causes faulty steering and braking.

4. ROAD TEST.—Drive the vehicle and make the following tests:

a. *Steering.*—Check for the following:

(1) Excessive play.

(2) Difficult steering.

(3) Pull to the right or to the left.

(4) Shimmy.

(5) Wander.

(6) Excessive road shock transmitted to the steering wheel.

b. *Power delivery, acceleration, and noises.*—Check for the following:

(1) With the truck moving at 15 MPH in high gear, the engine should accelerate smoothly, without missing, backfiring, or excessive pinging, when the accelerator is depressed fully to the toeboard.

(2) There should be no unusual noises during operation. Sharp, pinging knocks that occur while the engine is laboring are caused by incorrect ignition timing or by low-grade fuel, or by both. Knocking other than detonations (pinging) probably is caused by loose or broken engine parts. Common causes of characteristic engine noises are:

(a) Loose pistons. Too much piston clearance causes piston slap. This slap is particularly noticeable while the engine is being accelerated.

(b) Loose connecting-rod bearings. This characteristic knock is particularly noticeable when the engine, without laboring, is moving the truck at about 25 MPH on a level road and when the engine is being decelerated.

(c) Loose piston pins or valves. These loose parts cause knocking under all load and road conditions and at all engine speeds.

(d) Loose main bearings. Knocking caused by loose main bearings is best detected when the engine is laboring at slow speed.

(e) Loose fan belt. A loose fan belt may cause a squealing noise while the engine is being accelerated and while the engine is being operated at high speed.

(f) Any other unusual noises should be noted and investigated.

c. Clutch.—Operate the clutch. Observe and note the following:

(1) *Toeboard clearance.*

(2) *Pedal free travel.*

(3) *Unusual noises.*—Unusual clutch noises occurring while the clutch is fully engaged and while the clutch pedal is being operated should be noted and investigated. Normal clutch noises are as follows:

(a) Clutch fully engaged. When the clutch assembly is in normal operating condition, the only noises are those caused by the transmission main-drive gear and the countershaft driven gear.

(b) During pedal operation. The only noise audible when the clutch pedal is depressed should be that caused when the load is applied to the clutch-release bearing. If the bearing is defective the noise will be louder than normal.

(4) *Disengagement.*—If the disengagement is not complete when the clutch pedal is fully depressed, the clutch is dragging. Dragging is indicated when, with the vehicle stationary and the clutch pedal fully depressed, it is impossible to shift transmission gears without clashing.

(5) *Manner of engagement.*—When the clutch pedal is released slowly after shifting gears, the vehicle should move smoothly in either direction.

(6) *Completeness of engagement.*—To test completeness of engagement, accelerate the engine while the vehicle is moving and at the same time apply the service brakes momentarily; the engine should decelerate rapidly. If the engine does not decelerate rapidly the clutch is slipping.

d. Operation of transmission, transfer, and front-drive declutching unit.

(1) Test the ease of shifting in all forward speeds and in reverse.

(2) While the clutch is being engaged, there should be no movement, other than vibration, of the brake pedal, the brake hand lever, or the transmission gearshift lever. Excessive movement generally indicates loose transmission-cover screws, loose transmission mounting bolts, or loose engine mounting. Slight movement caused by the flexible mounting of the engine is normal.

(3) Accelerate and decelerate the engine several times while the gear shift lever is in each position. Observe and note:

(a) Any clicking or other unusual noises.

(b) Whether there is any tendency for the gears to come out of mesh. This may be noted by resting the hand lightly on the gearshift lever.

e. Brakes.—Start and stop the vehicle several times at various speeds. Observe the brake action and note:

(1) Whether there is any tendency for the vehicle to pull to the right or to the left when the service brakes are applied.

(2) Whether application of the service brakes will stop the vehicle within the proper distance. This test should be made on a dry concrete road.

(3) For mechanical or hydraulic brakes: Whether the service-brake pedal has a solid feel and remains stationary. When the brakes are fully applied, the pedal pad should stop not less than two inches from the toeboard.

(4) For air or vacuum brakes: Whether the brake action is smooth and positive.

(5) Whether the parking brake will hold the halted vehicle on a hill and the ratchet will hold the brake level when the brake is applied. One third of the lever travel should be in reserve.

f. Instruments and gauges.—Observe the action and readings of the following gauges and instruments on the instrument panel.

(1) *Gasoline gauge.*—Note operation of the gauge when the ignition key is turned ON. The gauge should show a reading of zero when the ignition key is turned OFF.

(2) *Oil pressure gauge.*—Note whether the oil pressure is correct.

(3) *Ammeter.*—If the electrical load does not exceed the generator output, the ammeter should show a positive charge at all vehicle speeds faster than 12-15 MPH in direct drive. The ammeter needle should be steady while the generator is charging.

(4) *Temperature gauge.*—The temperature gauge should show a rise in temperature as the engine warms up. After warming up, the temperature should remain steady.

(5) *Speedometer.*—Check the speedometer for operation.

(6) *General.*—Check any other gauge(s) for proper operation.

g. Power transmission and final-drive units.—Note the action of the transmission and final-drive units while the vehicle is being operated on the road test.

5. INSPECTION UPON COMPLETION OF ROAD TEST.

a. Check wheel bearings and brake drums for overheating.

NOTE: The normal operating temperatures of transmissions, transfers, and differentials, in some cases, are too high to be tested by the hands. Experience with a group of similar vehicles should enable maintenance personnel to detect the overheating units. When replacement of grease seals is required at less than annual intervals, the cause should be determined and corrective action taken.

b. Block axles so that all wheels are clear of the floor.

c. Check tires for condition. Remove any foreign material that may be wedged between the dual tires.

d. CAUTION: *Do not get under vehicle when engine is running and vehicle is in gear.* Start the engine, place the transfer in high range, the transmission in high gear, engage front axle drive, engage the clutch, and observe and note:

(1) Whether all wheels turn at approximately the same speed and whether there is excessive run-out of the wheels and tires.

(2) Whether any evidence of improperly operating parts can be detected by placing the hand lightly on the top of each fender, in turn.

(3) Propeller shafts for run-out and whether any foreign materials are wrapped around the shafts.

(4) Tightness of mounting and unusual noises of transfer assembly while the engine is being accelerated and decelerated.

(5) Evidence of leakage of gasoline, coolant, lubricant, brake fluid, or battery electrolyte.

e. Repeat *d* with the transfer in low range.

f. Place the transfer in the OF position and note whether the drive to the front axle is disconnected.

g. Check and correct the lubricant level in the axle housings and in the transmission and transfer cases. The lubricant level should be even with the bottom of the filler hole (or level hole if present). If the condition of the lubricant is unsatisfactory, drain the gear case(s), flush with No. 10 oil, and refill to the proper level.

h. Pour a can of commercially prepared gum solvent into the engine. Follow the manufacturers' instructions.

SECTION III—MAINTENANCE OPERATIONS

6. INSTRUMENTS.—Inspect, tighten, or replace, as necessary.

7. STORAGE BATTERY, BATTERY CARRIER, AND BATTERY CABLES.

a. *Monthly (1,000-mile) maintenance service.*

(1) Replace broken cables.

- (2) Tighten loose connections.
- (3) Check for the following defects:
 - (a) Corroded terminals.
 - (b) Dirty or acid-covered battery.
 - (c) Cracked cases.
 - (d) Case loose in carrier.
 - (e) Low specific-gravity reading.
- (4) If any of the above defects are noted, remove and correct as indicated in *b* below.

b. Semiannual (6,000-mile) maintenance service.

- (1) *Cleaning and inspection.*
 - (a) Remove the battery from its carrier.
 - (b) Clean the battery and the battery carrier with a soda solution or with water. CAUTION: *The vents must be plugged before the battery is washed and the battery should be rinsed with water to remove soda solution.* Thoroughly dry all parts. Examine the battery for leaks and for cracks.
 - (c) Replace the battery if the case or the cell covers are cracked, if the seal around the cell covers is defective, if the battery terminals are loose, or if the battery is otherwise unserviceable.
 - (d) Paint the carrier with an acid-proof paint.
- (2) *Battery condition.*
 - (a) Test and record the specific gravity of each battery cell.
 - (b) Test the voltage of each battery cell.
 - (c) Replace the battery when the specific gravity of any cell is below 1.250 or when the voltage of any cell drops below 1.5 volts during the test. Battery recharging or reconditioning should be effected in the proper echelon of maintenance.
 - (d) Add pure water to each cell to bring the level of electrolyte to the correct height; follow the instructions for the battery in use.
- (3) *Battery cables and cable terminals.*—Replace the battery cables if unserviceable. Check the terminals for cleanliness and for attachment to the cables. Check the battery-cable-to-ground connection for cleanliness and for tightness.
- (4) *Installation.*—Install and secure the battery in the battery carrier. Apply a light coat of lubricant to the battery terminal posts and to the cable terminals. Connect the cable terminals to the battery terminal posts and tighten the clamp bolts. CAUTION: *Take care to secure the battery and attach the cables in a manner which will not distort or damage the case.*

8. BACKLASH IN FRONT AXLE DIFFERENTIAL AND FINAL-DRIVE ASSEMBLY.—To determine the amount of backlash: Jack up one wheel. Hold the pinion shaft from rotating and turn the free wheel in either direction until all backlash has been removed, then turn the wheel in the opposite direction until the pinion shaft starts to rotate. When the backlash is excessive, the vehicle should be sent to higher echelon for proper action.

9. FRONT WHEELS AND WHEEL BEARINGS.

a. Monthly (1,000-mile) maintenance service.—Check for the following:

- (1) *Loose wheel bearings.*—Use pinch bar underneath wheel and feel if any movement can be detected between brake drum and backing plate.
- (2) *Tight wheel bearings.*—Excessive heat will be noted after road test.
- (3) If either of the defects noted in (1) and (2) above are present, adjust or remove the wheel as indicated in *b* below.

b. Semiannual (6,000-mile) maintenance service.

- (1) Remove drive flange after noting any maladjustment of axle shaft end play (Bendix-Weiss joint).

(2) Remove the wheel-and-tire assemblies, the hub-and-brake-drum assemblies, and the wheel bearings. CAUTION: *Block the brake pedal to prevent its movement (hydraulic system).*

(3) Clean, dry thoroughly, and inspect the wheel bearings. Replace any bearings found to be unserviceable.

(4) Coat all wheel bearings with engine lubricating oil, and protect them against dirt and damage until they are required for reassembly.

(5) Replace unserviceable wheel-bearing grease seals.

(6) Prior to reassembly, perform the following operations:

- (a) Service the brakes (PAR. 10).
- (b) Service the universal-joint-axle-shaft assembly (PAR. 11).

(c) Service the steering-knuckle (trunnion) bearings and the tie rod (PAR. 12).

(d) Service the springs, shackles, and shock absorbers (PARS. 13 and 14).

(e) Service the drag link (PAR. 15).

(7) Install the brake support and brake-shoe assemblies.

Pack wheel bearings and reinstall.

NOTE: Saturate the anchor bolt felts with lubricant. If the brake shoe gauge is used, make the brake adjustment before installing the wheel.

(8) Adjust the wheel bearings.

(9) Properly lock the bearing adjustment.

NOTE: A wheel-bearing adjustment cannot be considered correct until the bearings have been checked for looseness and for overheating immediately upon return from a road test.

(10) Install the wheel drive flanges, shims (if any), and a serviceable gasket between the flange and the wheel hub.

(11) Install all lock washers, stud nuts, flange-puller screws and lock nuts, front-wheel drive-shaft stops, and stop cap screws.

(12) Check toe-in. (If toe-in is incorrect, carefully examine the tie rod and axle. Have steering angles checked.)

(13) Adjust turning radius.

10. BRAKES.

a. Monthly (1,000-mile) maintenance service.—Observe the brake linings through the brake drum inspection window. If linings are oil-soaked, loose, broken, worn too thin, or if brake operation is unsatisfactory, proceed as outlined in *b* below.

b. Semiannual (6,000-mile) maintenance service.

(1) All types of brakes.

(a) Clean and inspect the brake drums.

(b) Remove the brake shoes.

(c) Inspect and replace any unserviceable brake shoe return springs.

(d) Clean the shoe and lining with a wire brush.

(e) If the linings are loose, oil-soaked, or worn too thin, replace shoes.

(2) *Hydraulic brakes.*

(a) Inspect the wheel brake cylinders for condition.

(b) If the pistons do not move freely in their cylinders or if the wheel cylinder leaks brake fluid, replace damaged parts or replace unit.

(c) If brake fluid shows signs of contamination, the entire brake system should be drained, flushed with alcohol, and refilled.

(d) When the master cylinder leaks or is otherwise defective, install a serviceable assembly.

(e) Tighten the master-cylinder mounting.

(f) Fill master-cylinder reservoir to the proper level.

(g) Check to see that the vent hole is open.

(h) If the brake pedal (after correct adjustment) has

a spongy feel when the brakes are applied, there is air in the brake system. When this condition is noted and when any operations have been performed which might have permitted air to enter, bleed the brake system. Check the brake-pedal clearance and the brake-pedal free travel before starting the bleeding operations.

(i) When the brakes are applied fully, the brake pedal should have a solid feel and the pedal pad should remain stationary not less than two inches above the toeboard. If, when the brakes are applied fully, the pedal pad sinks slowly to the toeboard, there is leakage at some point in the brake system. Correct this leakage.

(3) *Vacuum booster systems.*

(a) *General.*—Clean and test operation of the check valve and power cylinder. Lubricate, test operation, and correct adjustment.

(b) *Operating valve.*—Service the air cleaner. Test the operation and make necessary adjustments or repairs.

(c) *Hose and hose connections.*—Correct any evidence of leakage, hose abrasion, sharp kinks, or collapsing.

(4) *Air brake systems.*

(a) Service the air compressor.

(b) Test for leakage; check the range and pressure of the governor.

(c) Test for leakage and adjust the brake valve.

(d) Test relay valve for operation.

(e) Test quick-release valve for operation.

(f) Check and adjust the tank safety valve.

(g) Check operation of the brake chambers.

(h) Clean and adjust all linkages.

(i) Test by means of soap bubbles all lines, units, and connections.

(j) Drain the air tanks of water accumulations.

(5) *Parking-brake system.*

(a) check the action of the parking-brake lever to see that it is held in position when the brake is applied. Tighten the parking-brake segment.

(b) Tighten parking-brake band or shoe support.

(c) Replace defective brake bands or shoes.

(d) Adjust brake.

CAUTION: *Keep all lubricants off the brake drum and brake-band lining.*

(6) *Stop light.*

(a) Check switch operation when brakes are applied.

(b) Check switch terminal connections for cleanliness and tightness. Replace the switch if it is defective.

11. FRONT AXLE UNIVERSAL-JOINT-AND-AXLE-SHAFT ASSEMBLY.

a. *Monthly (1,000-mile) maintenance service.*—None.

b. *Semiannual (6,000-mile) maintenance service.*

(1) Remove, clean, and inspect the universal-joint-and-axle assemblies.

(2) Adjust the axle shaft shim pack.

(3) Repack the universal joints.

12. STEERING-KNUCKLE (TRUNNION) BEARINGS.

a. *Monthly (1,000-mile) maintenance service.*—When there is any play in the steering-knuckle bearings or when steering is adversely affected because of insufficient preloading of the bearings, adjustment is necessary. Excessive play can be determined by using a pinch bar to move the wheel and feeling for movement between steering-knuckle flange and axle housing. If the wheels and wheel bearings have been removed earlier in the service, the steering-knuckle bearings should be adjusted when necessary before the wheels are remounted. For the proper procedure, see *b* below.

b. *Semiannual (6,000-mile) maintenance service.*

(1) Remove the tie rod from the steering arm. Straighten bent tie rods when cold.

(2) Disconnect the drag link; service as outlined in paragraph 15.

(3) Remove, clean, and inspect the steering-knuckle bearings; replace those bearings found to be unserviceable.

(4) Examine the steering-knuckle seals; replace those found to be unserviceable.

(5) Pack and reassemble the steering-knuckle bearings.

(6) Reassemble the bearing cap shims, upper and lower, and the bearing caps, upper and lower; adjust the steering-knuckle (trunion) bearings as follows: If shims are present, verify that the total thickness at top and bottom agree within .005 inch. Remove or add shims as necessary to adjust bearings. Preload the bearings.

NOTE: If a tension wrench is available, preload the bearings to a minimum of 10 or a maximum of 20 foot pounds, with the tension wrench at the center of pivot and with the wheel, tire, brake drum, axle, and tie rod removed. It is essential that this adjustment be made within these tolerances to prevent damage to the bearings and to prevent shimmy. When reassembling the tie rod, tighten the yoke bolts and back them off ½ turn.

13. SPRINGS, SHACKLES, AXLES, AND HOUSINGS.

a. *Monthly (1,000-mile) maintenance service.*—Same as *b* below.

b. *Semiannual (6,000-mile) maintenance service.*

(1) *Spring center bolts.*—Replace broken spring center bolts.

(2) *Rebound clips.*—Tighten loose rebound clips. Replace broken or missing rebound clips.

(3) *Spring hold-down bolts (U-bolts).*

(a) Aline spring leaves.

(b) Check alinement of the axle housing. Aline axle if necessary.

(c) Tighten hold-down bolt nuts.

(4) *Shackle bolts.* — Adjust shackle-bolt side clearance. When the up-and-down clearance between the spring or shackle bolts and their bushings is excessive, steering will be impaired. Replace worn bolts and bushings.

(5) *Axle housings.* — Replace unserviceable or missing lock washers. Tighten cap screws and bolts. Clean the breather.

(6) *Spring hangers.*—Loose or broken spring hangers should be repaired or replaced.

14. SHOCK ABSORBERS.

a. *Monthly (1,000-mile) maintenance service.* — When shock-absorbers show evidence of binding, leakage of fluid, or excessive wear, replace them.

b. *Semiannual (6,000-mile) maintenance service.*

(1) Fill with recommended shock-absorber fluid to the level of the filler plug. CAUTION: *Clean dirt away from filler plug before plug is removed. When filling shock absorbers, move arm through entire travel to expel all air.*

(2) Disconnect the shock-absorber links from the axle.

(3) Check all grommets, pins, and link-pin holes for serviceable condition. Replace unserviceable parts.

(4) Move shock-absorber arm through full range of travel in both directions and note the resistance to movement. Resistance to downward motion should be greater than that to upward motion.

(5) Note the uniformity of resistance of the two front shock absorbers and of the two rear shock absorbers. When the shock absorbers mounted on the same axle show unequal resistance to motion, remove both assemblies, empty the fluid, refill with recommended fluid, and again check the action. If the resistance is now the same, install both shock absorbers; if not, replace the defective shock absorber.

(6) Tighten the shock absorbers to the frame.

(7) Connect the shock-absorber links to the axle. Hold the link in proper alinement while tightening the nut.

15. STEERING-GEAR ASSEMBLY.

a. *Monthly (1,000-mile) maintenance service.*—Same as *b* below.

b. *Semiannual (6,000 - mile) maintenance service.* — The steering gear should operate freely throughout its full range of action. If the road test indicates adjustment of the steering gear is necessary, the steering linkage and sector shaft bushing having been checked, disconnect the drag link from the steering-gear arm and proceed as follows:

(1) *Bent steering-wheel tube (shaft).*—Loosen the steering-gear-column-jacket-to-instrument-panel attachment. Observe the center of the steering wheel while the wheel is rotated to the right and to the left; if the center of the steering wheel moves through an arc, the steering-wheel shaft is bent and the assembly should be replaced. If the shaft is not bent, proceed with the adjustment.

(2) *Defective steering-gear-column jacket.*—Examine the steering-gear-column jacket for serviceability. Cracks or breaks, when present, generally occur just above the steering-gear housing. If the jacket is cracked or broken, replace. If no cracks are noted and the tube is not broken, proceed with the adjustment as indicated in the vehicle manual.

(3) *Alinement and attachment.*

(a) Tighten or adjust the cab-to-frame attachments.

(b) Aline the steering-gear assembly and tighten the steering gear to the frame.

(c) Adjust and tighten the steering-gear-column-jacket-to-instrument-panel attachment. If necessary, the hole in the instrument panel may be enlarged to permit shifting of the steering-column bracket.

(4) *Drag link.*

(a) Disassemble the drag-link ends.

(b) Clean, dry, and inspect all parts.

(c) Replace all broken or unserviceable parts.

(d) Install the drag link, and assemble and adjust the drag-link ends.

(e) Install dust cover, lock, and grease fitting.

NOTE: A bent drag link may be straightened cold if the tube is not collapsed before or during the straightening operation.

(5) *Steering-gear arm (Pittman arm).*

(a) Replace the steering-gear arm when the ball is badly worn or the arm is bent or cracked.

(b) With the steering wheel in the straight-ahead position and the drag link properly installed, the front wheels should be in the straight-ahead position. If not, change the position of the steering-gear arm on the sector shaft.

(c) Tighten the steering-gear arm to the sector shaft.

16. CLUTCH, TRANSMISSION, TRANSFER, AND PROPELLER SHAFTS.

a. *Monthly (1,000-mile) maintenance service.*—Same as *b* below.

b. *Semiannual (6,000-mile) maintenance service.*

(1) *Clutch.*

(a) Tighten the clutch housing to the engine.

(b) Tighten the clutch pan and open the drain hole in the bottom of the pan.

(c) Tighten the clutch-pedal bracket. Inspect the condition of the clutch-pedal spring.

(d) If the clutch-release bearing is particularly noisy when pressure is applied to the clutch pedal, take corrective action.

(e) The clutch pedal should rest against the pedal stop; adjust if necessary.

(f) Adjust clutch-pedal free travel.

(2) *Transmission, transfer, and shifter assemblies.*

(a) Tighten the covers.

(b) When any defect in the shifter mechanism is noted, repair or adjust.

(c) Tighten case attachments.

(d) Tighten bearing retainers.

(e) Adjust bearings if necessary.

(f) Tighten power-take-off-opening cover.

(g) Tighten brackets.

(h) Clean breathers.

(i) Tighten speedometer cable attachments.

(j) Correct any abnormal leakage of lubricant.

(3) *Propeller shafts.*

(a) Replace bent or damaged shafts.

(b) Replace the slip-joint members when there is sufficient clearance to cause propeller-shaft run-out and vibration.

17. UNIVERSAL JOINTS.

a. *Monthly (1,000-mile) maintenance service.*—None.

b. *Semiannual (6,000-mile) maintenance service.*—Inspect all universal joints for wear and defective grease seals. Replace any unserviceable parts.

NOTE: Mark all universal joints before disassembly and reassemble as marked. The axes of the yokes on the propeller-shaft ends must be in the same plane

18. REAR AXLE.—See paragraphs 8, 9, 10, 13, and 14 for adjustment of corresponding parts of the front axle.

19. BOGIE-DRIVE AXLE.

a. *Monthly (1,000-mile) maintenance service.*

(1) *Spring trunnion bracket.*—Check for broken parts or rivets. Tighten studs.

(2) *Springs.*—See paragraph 13.

(3) *Radius or torque rods.*—Replace bent rods. Tighten mounting bolts.

(4) *Spring seat bearings.*—Remove bearing cap and check quantity and quality of lubricant. If the lubricant is contaminated, force grease out of both sides of the bearing until the contaminated grease is removed.

(5) *Propeller - shaft - center - bearing assembly.*—Check grease seals and gasket.

(6) *Center bearings.*—Check adjustment.

(7) *Attachment.*—Tighten housing to bracket. Check housing for cracks.

b. *Semiannual (6,000-mile) maintenance service.*

(1) *Spring seat bearings.* — If removal of spring seat bearings is necessary, remove U-bolts, loosen stud nuts, raise or remove springs to facilitate disassembly of bearing and bearing housing. Remove spring seat bearing cover, remove locking and adjusting nuts, and remove bearing housing with inner bearing and grease seal. Clean, inspect, and replace unserviceable parts. Hand-pack bearings and replace, then adjust bearings.

(2) *Propeller-shaft-center-bearing assembly.*—Disconnect universal joint. Remove universal joint driving and driven yokes. Remove pillow block assembly from bracket; disassemble, clean, inspect, and replace unserviceable parts; assemble and adjust. Repeat the operations prescribed in paragraph 5 *d*.

20. COOLING SYSTEM.

a. *Monthly (1,000-mile) maintenance service.*—Same as *b* below.

b. *Semiannual (6,000-mile) maintenance service.*

(1) *Radiator.*

(a) Remove and replace the radiator core if it leaks coolant or is otherwise damaged. Tighten the core-to-the-shell-and-bracket

attachment. Clean the air passages in the radiator core. Take care to prevent damage to the radiator core. Blow or wash obstructions from rear to front.

- (b) Check and aline the radiator supports.
 - (c) Check the lacings for serviceability and attachment of the radiator shell and cowl.
 - (d) Tighten the hood lock brakets.
 - (e) If dirt is present in the coolant, if deposits are noted in the top reservoir, if the engine overheats, or if sections of the radiator are not cooling properly, proceed as listed in (f), (g), (h), and (i) below.
 - (f) Clean the cooling system with a good cleaner; follow the manufacturers' instructions. CAUTION: *The use of unauthorized caustics and acids is prohibited.*
 - (g) Remove the thermostat and the water hoses. Flush the radiator and the engine block separately, forcing the flushing water through the water passageways in the opposite direction of the normal flow of the coolant
 - (h) Test the operation of the thermostat by slowly heating it in water. Allow it to cool slowly.
 - (i) Replace the thermostat and the waterhose. Fill the cooling system. CAUTION: *The cooling system cannot be completely filled until the engine has reached an operating temperature sufficient to cause the thermostat to open.* There should be no leakage past the radiator-filler-cap gasket.
- (2) *Hose and hose clamps.*—Replace unserviceable hose and hose clamps. Tighten loose hose-clamp bolts.

(3) *Leakage.*

- (a) *Water-outlet gasket.*—If the leakage cannot be corrected by proper tightening, replace the gasket.
 - (b) *Cylinder-head gasket.*—When proper tightening will not correct leakage around the cylinder-head gasket, replace defective gasket.
 - (c) *Water pump.*—Repair or replace defective pump.
 - (d) *Defective cylinder head or water jacket.*—Any leakage of coolant caused by a defective core hole plug, cylinder head, or a cracked water jacket must be corrected.
- (4) *Fan belt (s).*—Check the fan belt(s) for serviceability.

21. STARTING MOTOR.

a. *Monthly (1,000-mile) maintenance service.*

- (1) *Mountings.*—Check the starting-motor mountings.
- (2) *External electrical connections.*—Inspect electrical connections for condition, serviceability, and tightness.
- (3) *Operating condition.*—When the starting motor is unserviceable or is functioning improperly, replace.

b. *Semiannual (6,000-mile) maintenance service.*

- (1) *Commutator.*—Remove the cover band and clean the commutator. If the bearings, the commutator, or the brushes are unserviceable, replace the starting-motor assembly.
- (2) *Operation.*—With the transmission gear shift lever in neutral and the clutch disengaged, close the starter switch and note the operation of the starting motor. The starting motor should crank the engine without unusual operating noises or excessive arcing.

22. GENERATOR AND REGULATOR SYSTEM.

a. *Monthly (1,000-mile) maintenance service.*

- (1) Check the generator mountings.
- (2) Inspect the electrical connections for condition, serviceability, and tightness.
- (3) When the generator or regulator is unserviceable or is functioning improperly, replace.

b. *Semiannual (6,000-mile) maintenance service.*

- (1) If bearings are noisy, commutator defective, or brushes worn, replace the generator.

(2) *Cut-out relay.*—Remove wire from terminal marked *bat*. Connect one *test* ammeter lead to this wire and other test ammeter lead to terminal marked *bat*. Connect one voltmeter lead to ground. Start engine and slowly increase the speed to determine closing voltage of cut-out relay. Decrease the speed and note the opening amperage. See Note 1 below.

(3) *Generator output.*—After above operations have been performed proceed as follows:

(a) *Three-brush type.*—Remove the voltmeter lead from the *gen* terminal and connect to the terminal marked *bat*. Increase the engine speed to give maximum generator output. See Notes 1, 2, and 3 below.

(b) *Two-brush generators.*—Operate the engine at a speed equivalent to 30 MPH and test the charging rate. If the battery is fully charged, turn on all lights and either reduce the battery charge or add sufficient electric load so that the generator may reach rated output, or prevent the operation of the voltage regulator by bridging the points of the voltage regulator with a jumper lead. See Notes 1, 4, and 5 below.

(4) *Voltage regulators.*—Run the engine at a speed to give a 10-ampere output. Read the voltmeter to determine if the voltage is correct. Insert resistance in charging circuit. Voltage should not increase.

NOTES:

1. For specifications and method of adjustment refer to vehicle manual.
2. When voltage is below specifications, insert a variable resistance in the charging circuit to raise the voltage.
3. When adjusting output of three-brush generators with external regulation, ground the field terminal of the generator.
4. When generator output is insufficient, ground the field terminal of the generator to determine if the fault is in the generator or in the regulator.
5. For heavy-duty regulators, see manufacturers' manuals.

23. IGNITION SYSTEM.

a. *Monthly (1,000-mile) maintenance service.*

(1) *Distributor cap.*—Clean the cap and the electrical contact surfaces. If cracks are noted, replace the distributor cap. Use fine sand paper to clean the wells.

(2) *Distributor rotor.*—If the rotor is defective, replace it.

(3) *Wiring.*—Repair or replace all damaged or unserviceable wiring, protective nipples, grommets, and wire terminals. All terminal connections should be clean and tight.

b. *Semiannual (6,000-mile) maintenance service.*

(1) *Automatic advance.*—Check the automatic-advance mechanism for freedom of action. If the advance mechanism is inoperative, replace the distributor.

(2) *Condition of breaker housing.*—Moisture, dirt, or excess lubricant in the breaker housing should be removed. When removal is necessary, note the position of the rotor to facilitate reassembly.

(3) *Breaker points.*—If the breaker points are out of alignment, pitted, or burned, replace the distributor assembly.

(4) *Installation of distributor assembly.*—If removal of the assembly was necessary in any of the above operations, observe the following precautions in reinstalling: Set the distributor-lock-plate adjustment at zero and tighten the clamp bolt. Install the distributor assembly with the rotor in the same position it occupied before removal.

(5) *Spark plugs.*—Inspect the spark plugs for type, serviceability, cleanliness, and adjustment. In case of replacement, be certain that spark plugs have the correct heat range. The porcelain insulator on top of the plug should be

clean and free from cracks, and there must be no leaks between the porcelain and the spark-plug shell. That part of the insulator inside the spark-plug shell should be a light brown color after service and should be free of cracks. The spark-plug electrodes must be serviceable. Use a round feeler gauge to measure the gap. The spark plug should be installed on a clean seat with a new spark-plug gasket.

(6) *Coil.*

(a) *Primary circuit.*—Clean and tighten all connections or terminals in the primary circuits, and replace any conductors having damaged insulation. Turn on ignition switch, operate starting motor, and observe ammeter for fluctuation between zero and discharge. A fluctuating ammeter indicates primary circuit in order. No reading on the ammeter indicates an open primary circuit. Locate the trouble by use of a test lamp. A steady discharge reading of the ammeter indicates a grounded primary circuit. To locate the ground, start at the distributor and work back toward the battery.

(b) *Secondary circuit.*—Remove the high-tension wire from the distributor-cap center well and hold the end of the wire $\frac{1}{4}$ inch from a good ground. Operate the starting motor with the ignition switch on; a spark should jump between the high-tension wire and ground. If no spark is obtained, the coil wire may be at fault. Substitute a new coil wire and repeat the test; if there is no spark, the condenser or coil is at fault. Replace the condenser and repeat the test; if no spark is obtained, the coil may be at fault. Substitute a new coil wire and repeat the test; if there is no spark, the condenser or coil is at fault. Replace the condenser and repeat the test; if no spark is obtained, replace the coil.

24. ENGINE ASSEMBLY AND LUBRICATING SYSTEM.

a. *Monthly (1,000-mile) maintenance service.*

(1) Check the engine-mounting brackets for serviceability and tightness of attachment to frame.

(2) Tighten the timing-gear cover.

(3) Remove the carburetor air cleaner and service as follows: Remove and wash the filter elements. CAUTION: *Do not use an air hose to dry the element.* Remove the oil, and wash and dry the reservoir. Fill the reservoir with oil to proper level. Assemble and install the air cleaner.

(4) Remove and wash the filter elements of the crankcase-ventilator air cleaners. Inspect the spring inside the oilfiller cap. The spring should be serviceable and sufficiently strong to hold the cap in place. CAUTION: *If the spring breaks and falls into the oil pan, it must be recovered before the engine is operated.* Saturate the filter elements with engine oil.

(5) Install new oil filter or element at proper mileage. Tighten the filter mounting and loose connections, and replace unserviceable lines.

b. *Semiannual (6,000-mile) maintenance service.*

(1) Bring the engine to operating temperature. Drain the lubricating oil. If the drained oil is excessively dirty or if there is evidence of an excessive amount of foreign material in the valve chamber, remove the pan and clean the interior of the engine. Install the oil pan and fill with oil of the proper grade. Replace the oil filter if necessary. Install the valve-cover plates. Start the engine and check the oil pressure.

(2) Replace defective manifold gaskets. Tighten stud nuts.

(3) Operate the engine for 20 minutes after it has reached normal operating temperature. Remove the valve-cover plates and adjust the valve clearance with the engine running.

(4) Repair or replace unserviceable parts of exhaust pipe, muffler, and tail pipe. Tighten connections and attachments.

(5) Tighten accessory attachments and other bolts and nuts.

(6) When engine knocks, unusual noises, and unsatisfactory performance continue after completion of the foregoing operations, send the vehicle to a higher echelon for proper action. The compression and vacuum gauges may aid in determining unsatisfactory conditions.

25. FUEL SYSTEM.

a. *Monthly (1,000-mile) maintenance service.*

(1) *Fuel tank and filters.*—Check the fuel tank for condition, the attachment of the fuel-tank supporting brackets to the frame, the tank support straps and the padding strips for serviceability and condition, and the mounting of the fuel tank in its supports. Check the fuel-line-to-tank connection and the support of the fuel line from the fuel tank to the fuel pump. Remove the fuel-tank cover and check to see that the vent hole is open. Remove the fuel-tank drain plug and allow about a pint of fuel to run out to remove water and any loose sediment that may be in the tank. Clean gasoline filter(s).

(2) *Fuel pump.*

(a) If the fuel pump leaks gasoline, tighten the diaphragm-flange screws, the air dome, and the valve plugs.

NOTE: The fuel-pump vent must be open.

(b) When oil leaks occur at the fuel-pump-to-crankcase gasket, with the cap screws tight, replace the gasket.

NOTE: A special gasket is required. The thickness of the gasket affects the operation of the pump.

(c) Repair or replace leaky fuel lines and unserviceable fuel-line connections. CAUTION: *Use two wrenches when tightening or removing fuel-line connections; never use pliers.*

(d) Clean the sediment bowl and screen when necessary; reinstall, using a new gasket. Use only finger-and-thumb pressure to tighten the sediment-bowl nut. When the sediment bowl requires cleaning more often than once per month, the fuel tank should be drained and cleaned.

(3) *Carburetor.*—When the engine is running and immediately after the engine is stopped, examine the fuel-line connection, the carburetor-to-manifold attachment, and the carburetor body for leakage of gasoline. Examine the carburetor body and the carburetor-to-manifold attachment for air leaks while the engine is running. When leaks are noted, make appropriate repair or replacement. Adjust the idling speed and idling mixture.

NOTE: Do not mistake the presence of dye coloring, which is deposited around the carburetor connections, for a gasoline leak.

b. *Semiannual (6,000-mile) maintenance service.*

(1) *Fuel pump.*

(a) *Output.*—Install a T-connection between the fuel line and the carburetor. Operate the engine at a speed equivalent to 30 to 35 MPH in high gear and check the output of the fuel pump. If the output is less than the quantity specified, perform the vacuum test as described below. Replace the pump if defective.

(b) *Pressure test.*—Attach the pressure gauge to the T-connection. Operate the engine at idling speed and note the pressure reading on the gauge; if not within the specifications, replace.

(c) *Vacuum test.*—Attach the vacuum gauge to the fuel pump at the inlet connection. Operate the engine at idling speed and note the reading on the vacuum gauge. A steady reading of five inches, or more, is normal. If the reading is less than five inches, the fuel pump is faulty and it should be replaced. When the pump output is unsatisfactory and the vacuum reading is five inches

or more, the trouble is between the pump and the gasoline tank.

(2) *Carburetor.*

(a) *Float level.*—With the air cleaner removed and the engine idling, observe the high-speed nozzle in the carburetor throat. The float level may be assumed too high if moisture is present at the nozzle. Remove the float-chamber cover. If the chamber is clean, make correct adjustment of the float level or replace the carburetor. If the float chamber is dirty, replace the carburetor.

NOTE: On the down-draft carburetors, all carburetor parts above the throttle plate should be dry when the engine is operating at idling speed.

(b) *Low-speed circuit.*—If the low-speed circuit is operating properly, movement of the idling-mixture screw should change the speed of the engine. If it does not, the low-speed circuit is defective and the carburetor should be replaced. With the correct idling mixture, the engine should operate smoothly for any throttle setting up to a speed of approximately 20 MPH. If the engine operation cannot be controlled as stated, the low-speed circuit of the carburetor is faulty. CAUTION: *Never force the idling-mixture adjusting screw against its seat.*

(c) *Economy of operation.*—If the records show that fuel consumption has been excessive and if the float level has been found to be correct, replace the carburetor.

(d) *Accelerating-pump circuit.*—Remove the carburetor air cleaner. Start and operate the engine; then stop it. Turn the throttle to the wide-open position after the engine has stopped and observe the pump jet; a solid stream of fuel should issue from the pump jet and should continue to flow for a short period of time after the throttle has reached the wide-open position. If the accelerating circuit does not function as stated, replace the carburetor.

(e) *Idling speed.*—Adjust the throttle lever adjusting screw to give an engine idling speed of 350 to 400 RPM.

(f) *Idling-mixture adjustment.*—Adjust the idling mixture as follows: Install the carburetor air cleaner. Start the engine and bring it to operating temperature. Connect a vacuum gauge to the intake manifold. Operate the engine at idling speed and turn the idling-adjustment screw, in or out, until the highest steady reading on the vacuum gauge is obtained. Readjust the idling speed if necessary.

26. LIGHTS AND SAFETY DEVICES.

a. *Monthly (1,000-mile) maintenance service.*—Same as b below.

b. *Semiannual (6,000-mile) maintenance service.*

(1) *Lights.*

(a) The fuze holder should be clean and should make good contact with the fuze.

(b) Check the operation of all light switches and lights. Locate any trouble and take the necessary corrective action.

(c) Adjust headlamps, if necessary.

(d) Replace defective sealed-beam lamps.

(2) *Safety devices.*

(a) Check the horn mounting for tightness and the electrical connections for cleanliness and tightness. Adjust or replace as required.

(b) The rear-view mirrors should be serviceable and securely attached.

(c) If a windshield wiper becomes defective, replace the assembly. The wiper blades should be serviceable and should make full and uniform contact with the windshield.

(d) The fire extinguisher should be serviceable, filled with the prescribed fluid, and properly mounted.

27. FRONT-MOUNTED WINCH.

a. *Monthly (1,000-mile) maintenance service.*—Same as b below.

b. *Semiannual (6,000-mile) maintenance service.*

(1) Tighten all attachment bolts.

(2) Clean the sliding clutch. Inspect lubricant in gear housing for condition and amount. Check the operation of the sliding clutch to include the ease of operation, the condition and action of the drag brake, and the action of the yoke locking device.

(3) Run out the cable; clean, lubricate, and rewind it under tension.

(4) Adjust the automatic brake.

(5) Inspect the drag brake for operation and condition.

(6) Remove any foreign material that may be wrapped around the drive shaft. Check the drive shaft and the universal joints for alignment, and the drive shaft for run-out. Check the universal joints for condition. Check to see that the proper shear pin is installed in the universal-joint-yoke-to-worm-shaft connection.

(7) Check the control-lever safety lock, the movement of the control lever to each position, and the action of the drum shaft with the control lever in each position.

NOTE: General tightening operations are the responsibility of the driver. When the vehicle is undergoing the operations prescribed in this section, the driver should accompany the vehicle, and his performance of tightening operations should be checked by the motor sergeant.

SECTION IV—ROAD TEST AND RECORDS

28. ROAD TEST.—After completion of a maintenance service, the vehicle should be road tested by the motor officer or the motor sergeant to check the correctness of the adjustments and the performance of the vehicle. When adjustments are found to be incorrect or when the vehicle performance is unsatisfactory, proper remedial action should be taken before the vehicle is returned to duty.

29. RECORDS.

a. *Vehicle service record.*—Make appropriate entries in the vehicle service record book, QMC Form No. 248, of all data required. Supplementary records should be maintained to indicate the exact operations performed during the service; supplementary records prior to those of the last semiannual (6,000-mile) maintenance service need not be retained.

b. *Check sheet and record.*

(1) *General.*—The check sheet and record should show the operations performed, the work required of higher echelons, pertinent data for the permanent record, and the personnel who performed the operations. The completed check sheet and record should enable the motor officer or other inspecting officer to form a reasonably accurate opinion concerning the condition of the vehicle. A comparison of several completed check sheet and record forms will show improper operation, defective maintenance, or vehicle weakness, if such exist. Experience has indicated that a check sheet of the type shown at the end of this instruction memorandum is satisfactory.

(2) *Authentication.*

(a) *Mechanic's and motor sergeant's.*—The initials on this certificate show which mechanic(s) performed the operations and that the operations were checked by the battalion motor sergeant. If a maintenance inspection or future operation discloses improper performance of the maintenance service operations, the motor officer knows whom to hold responsible.

(b) *Maintenance service inspection.*—The battalion motor officer should check the performance of the scheduled maintenance operations as fully as time will permit. He should check the records and, when time does not permit a complete check, should spot-check enough operations to assure himself that the service has been performed properly.

SECTION V—SPECIAL SERVICES

30. *GENERAL COMMENTS.*—It should be noted that the semiannual (6,000-mile) maintenance services in the battalion include all of the monthly (1,000-mile) maintenance service charged to the battery for the month when the semiannual (6,000-mile) maintenance service is performed. In other words, the battery shop performs five monthly services while the battalion performs one. In a year's time the battery performs ten services and the battalion performs two. This system serves to acquaint the battalion motor maintenance section with the quality of maintenance performed by the battery; the battalion commander and the motor officer are kept informed of the quality of battery maintenance. In the same manner, the third-echelon technical inspections inform higher commanders of the quality of maintenance in lower echelons.

31. *COLD-WEATHER SERVICE OPERATIONS.*—Vehicle operation in cold weather demands a high state of mechanical perfection. For that reason certain units may require additional attention, particularly if the semiannual (6,000-mile) maintenance service has not been performed recently. If a vehicle does not start promptly, check the electrical and fuel systems.

a. Antifreeze solutions.—A thorough flushing of the system prior to the addition of antifreeze solution is advisable. The cooling system should be checked carefully for leaks, the hose connections tightened, and new hose installed if necessary.

b. Radiator covers.—Radiator covers are recommended as a means of accelerating the attainment and maintenance of the normal engine operating temperature. Covers can be improvised.

c. Lubrication.—Vehicles should be lubricated with a proper grade of lubricant, according to the manufacturers' specifications. Exceptionally cold weather generally requires that a diluent be added to the winter grades of lubricants; in case this is necessary, the higher echelon should issue specific instructions and furnish the supplies needed. In extremely cold climates it may be necessary to use auxiliary heat to facilitate starting.

32. *SUBMERGENCE.**a. Service operations after complete or partial submergence.*

During flood periods, cars and trucks may be partially or completely submerged for hours, and sometimes days, in flood water invariably heavily laden with dirt and abrasives. In case of complete submergence, prompt and proper action should be taken to clean thoroughly and lubricate such important units as engines, clutches, transmissions, driving axles, steering gears, batteries, fuel tanks, brakes, wheel bearings, and accessories. The surest and best means of removing all traces of injurious foreign matter is to dismantle completely every unit of the vehicle, thoroughly wash each part in solvent, and spread a film of oil over each part except hydraulic

brake cylinders, brake pistons, and brake linings. Such operations should be performed by higher echelon. Should the demands of an emergency render impossible such complete cleansing by higher echelon, some of the damage may be deferred temporarily and partially by the following procedure accomplished in the second echelon.

(1) Drain, flush, and refill the cooling system. Clean thoroughly, dry with air stream, and lubricate where necessary the starter, generator, distributor, and water pump. Clean fuel tank, fuel pump, lines, and carburetor. Drain the engine oil, refill with equal parts of kerosene and S. A. E. 20 engine oil, and run engine for ten minutes at about idling speed. Then drain engine and refill with correct grade of fresh engine oil. Replace oil filter; clean and service, or replace, the carburetor and oil-filler-pipe air cleaners.

(2) Remove filler plugs from the battery. Check the electrolyte for level, appearance, and specific gravity. Normal level after submergence indicates that little or no water entered the battery. Clean electrolyte, even though slightly above level, indicates no contamination.

(3) Remove floor boards and calk the lower openings of the clutch housing. Pour two quarts of clean solvent in the clutch housing and run the engine just above idling speed for ten minutes. Frequently work the clutch pedal in and out during this period so as to allow the solvent to clean thoroughly the working parts of the clutch. Drain off all the solvent and block the clutch pedal in the released position for several hours, or overnight if possible.

(4) Drain the transmission, transfer case, and all differentials. Refill with equal parts of solvent and gear lubricant. With the vehicle jacked up, drive the wheels for ten minutes. Drain and refill with the proper lubricant.

(5) Disassemble the universal joints. Wash thoroughly in solvent and reassemble.

(6) Remove, clean, and reassemble all wheel bearings and steering-knuckle bearings. Replace grease seals.

(7) Flush the hydraulic brake system completely at least twice, and refill with fresh brake fluid.

(8) Perform routine lubrication.

NOTE: Two or more of these operations may be carried on at the same time to expedite getting the vehicle back into operation. In cleansing operations, the clutch, transmission, transfer case, and differentials all may be flushed at one time.

b. It should be understood that anything less than a complete disassembly of each unit may not remove all dirt and abrasives. The emergency cleansing covered by subparagraph *a* above cannot be considered as assurance that further damage will not result. No delay should be allowed in taking these protective precautions; otherwise serious damage will occur. In case of partial submergence, only those units submerged should be cleaned and serviced as indicated above. Inspection ordinarily will disclose such units.

33. *NEW-VEHICLE SERVICE.*

a. Upon receiving a new vehicle, special precautions are necessary prior to operation. If the vehicle is strapped to the floor of a railroad car, remove the straps. Remove any special bolts used on the frame. Roll the vehicle off the car. Fill the radiator with coolant. Check the crankcase for proper oil level, the battery for proper water level, and the transmission, transfer, and differentials for the correct level of lubricant. Fill the gas tank and start the engine. Make the usual inspections (BFM 25-10, Chapter 2) prior to and after starting the engine. Examine the vehicle for bent, broken, or missing parts of

equipment. After a thorough examination, move the vehicle a short distance under its own power to determine whether or not the controls are working properly. To develop faults, run the vehicle about 100 miles as continuously as practicable. During this period, make frequent halts to check wheel bearings, brake drums, gear cases, and other housings for overheating. If lubrication or adjustment does not correct overheating, allow them to cool before continuing operation.

b. After completion of the first 100 miles of operation perform the following special services:

- (1) *Engine.*
 - (a) Tighten cylinder heads.
 - (b) Adjust valve clearance.
 - (c) Adjust spark-plug gap.
 - (d) Adjust distributor points.
 - (e) Set ignition timing.
 - (f) Tighten manifolds.
 - (g) Adjust carburetor controls.
 - (h) Set idling rate and idling mixture.
 - (i) Adjust fan-belt tension.
- (2) *Cooling system.*
 - (a) Tighten all hose connections.
 - (b) Correct all leaks.
- (3) *Fuel system.*—Correct any leaks in fuel system.
- (4) *Instruments and lights.*
 - (a) Test operation of lights and horns.
 - (b) Test operation of dash instruments.
- (5) *Front end.*
 - (a) Adjust toe-in.
 - (b) Tighten spring clips and adjust shackles.
 - (c) Inspect for lubrication and leaks.
- (6) *Rear end.*
 - (a) Inspect for lubrication and leaks.
 - (b) Tighten spring clips and adjust mounting.
- (7) *Transmission and transfer.*—Inspect for lubrication and leaks.
- (8) *Wheels and brakes.*
 - (a) Inspect tires for inflation.
 - (b) Inspect wheels and tires for run-out.
 - (c) Check wheel bearings for lubrication and adjustment.
 - (d) Tighten wheel lugs and cap nuts.
 - (e) Adjust brake linkage.
 - (f) Adjust turning radius.
- (9) *General.*
 - (a) Adjust clutch pedal.
 - (b) Service the battery.
 - (c) Test operation of generator circuit.
 - (d) Test operation of starting motor.
 - (e) Tighten body bolts and screws.

c. After the above service is completed, the operating organization continues the reduced-speed operation as recommended by the particular manufacturer. Driver maintenance should be stressed and all repairs accomplished promptly. A mechanic should be present to inspect each vehicle at the end of the day's run.

CHECK SHEET AND RECORD
MAINTENANCE SERVICE OPERATIONS
 Monthly (1,000-mile) Semiannual (6,000-mile)
 (Delete one)

(Description of vehicle)

USA No. ORGANIZATION

Speedometer mileage: Last inspection Present inspection

SYMBOLS.

Satisfactory.

Defects noted (corrective action is necessary).

Defects have been corrected by battery (regimental) personnel.

Corrective action by higher echelon is necessary.

Defects have been corrected by higher echelon.

—STORAGE BATTERY (Gravity readings)

....Cleanliness	....Electrolyte	....Starter cable
....Condition (leaks)	....State of charge	....Ground cable
....Terminals and connections	....Installation	....Carrier

....BODY, CAB, AND FENDERS

....Injuries		
....Instrument panel	....Cab	....Body welds
....Fenders	....Doors	....Transoms

....Attachment

....BodyCab	
----------	---------	--

....INSTRUMENTS (including connections)

....Ammeter	....Temperature gauge	....Speedometer
....Gasoline gauge	....Ignition switch	....Miles per hour
....Oil-pressure gauge	....Air-pressure gauge	....Odometer
	....Viscosimeter	....Tachometer

....BRAKES, SERVICE (foot)

....Brake pedal	....Adjustment	....Master cylinder
....Free travel	....Lining	....Attachment
....Feel	....Drums	....Fluid, quantity
....Reserve pedal	....Wheel cylinders	....Vent
....Pull-back spring	....Fluid lines and connections	....Boot
		....Switch, stop light

....VACUUM BOOSTER SYSTEM

....Power cylinder		
....Leaks		....Rubber guards
....Attachment		....Linkage
....Lubrication		....Vacuum line
....Air cleaner		

....AIR-OPERATED SYSTEM

....Air tank	....Compressor	....Brake chambers
....Attachment	....Attachment	....Attachment
....Leaks	....Alinement	....Push-rod travel
....Drain cock	....Operation	....Leaks
	....Leaks	
	....Air cleaner	
....Brake valve	....Unloader valve	....Quick-release valve
....Attachment	....Valve clearance	....Attachment
....Stroke	....Lubrication	....Operation
....Linkage		....Leaks
....Leaks		
....Air lines	....Relay valve	....Governor
....Service	....Attachment	....Operation (limits)
....Emergency	....Leaks	....Attachment
....Attachment		....Leaks
....Leaks		

....BRAKE, PARKING (hand)

....Braking effect	....Lining	....Support
....Lever latch	....Adjustment	....Linkage

....WHEELS AND TIRES

....Wheels	....Tires	
....Bearing adjustment	....Conditions	....Valve stems
....Studs and nuts	....Inflation	....Valve stem caps
....Run-out	....Wear	....Matching

-SPRINGS
 -Condition
 -Alinement
 -Center bolts
 -Rebound clips
 -Spring hangers
 -Spring bolts
 -Shackle bolts
 -Attachment to axle
 -SHOCK ABSORBERS
 -Fluid
 -Attachment to frame
 -Action
 -Linkage
 -STEERING MECHANISM
 -St knuckle brgs
 -Tie rod
 -Condition
 -Pins and bushings
 -Adjustment
 -St gear arm
 -Condition
 -Adjustment
 -FRONT AXLE
 -Alinement
 -Lubricant (quantity)
 -Grease seals
 -Vent
 -Driving flanges
 -Diff carrier bolts
 -Pinion cage screws
 -Backlash
 -Turning radius
 -REAR AXLE
 -Alinement
 -Lubricant (quantity)
 -Grease seals
 -Driving flanges
 -Diff carrier bolts
 -Pinion cage screws
 -Backlash
 -BOGIE AXLE
 -Axle bumper pads
 -Spring ends and guides
 -Axle bumper bracket
 -Spring center mountings
 -Torque rod ball ends
 -Propeller shaft center bearing
 -CLUTCH
 -Pedal free travel
 -Housing
 -Release bearing
 -Housing pan
 -Drain
 -Pedal bracket
 -Pedal pull-back spring
 -TRANSMISSION ASSEMBLY
 -Action
 -Reverse stop
 -Shifter mechanism
 -Hand brake segment
 -Fractures
 -Lubricant level
 -Cover screws
 -Power take-off cover
 -Power take-off
 -TRANSFER ASSEMBLY
 -Action
 -Shifter mechanism
 -Declutching unit
 -Shifter cover screws
 -Mounting screws and nuts
 -Case bracket
 -Cover screws
 -Grease seals
 -Breather
 -Bearings (adj)
 -U-joint yoke atch
 -Speedometer atch
 -Fractures
 -Lubricant level
 -PROPELLER SHAFT AND UNIVERSAL JOINTS
 -Run-out
 -Alinement
 -Clearance
 -Grease seals
 -Lubrication
 -COOLING SYSTEM
 -Radiator
 -Core (condition clean)
 -Core-to-shell attachment
 -Overflow pipe
 -Air passages (open)
 -Coolant (quantity)
 -Grille-to-fender bolts
 -Hood lock brakets
 -Support and alinement
 -Support pads
 -Lacings (shell and cowl)
 -Hood fit (on cowl)
 -Hood fit (on radiator)
 -Water passageways
 -Hoses
 -Hose clamps
 -Water outlet gasket
 -Water pump
 -Cyl head gasket
 -Cyl head
 -Water jackets
 -Core hole plugs
 -Fan belt
 -Condition
 -Adjustment
 -FUEL SYSTEM
 -Fuel tank
 -Condition
 -Supports
 -Filler cap vent hole
 -Fuel gauge
 -Fuel lines and connections
 -Fuel pump
 -Action
 -Condition (leaks)
 -Attachment to crankcase
 -Fuel lines and connections
 -Sediment bowl and screen

-ENGINE
 -Engine mounting, chain case cover, engine attachments
 -Mounting brackets
 -Engine rear hangers
 -Engine mounting bolts
 -Chain case cover
 -Front support bolts
 -Front support clamp bolt
 -Filters
 -Carburetor, air
 -Starting motor and generator
 -Starting motor
 -Operating condition
 -Attachment
 -External connections
 -Starting motor switch
 -Electrical wiring
 -Distributor
 -Cap
 -Rotor
 -Spark plugs
 -Type
 -Condition
 -Valve clearance
 -Carburetor
 -Attachment to manifold
 -Controls
 -Engine performance
 -Acceleration
 -Power output
 -Valve operation
 -Brkr housing
 -Brkr points
 -Automatic advance
 -Crankcase breather
 -Oil
 -Generator
 -Operating condition
 -Attachment
 -External connections
 -Generator output
 -Gaskets
 -Gap
 -Idling speed
 -Idling mixture adjustment
 -Fuel system
 -Ignition system
 -Engine knocks
 -WINCH
 -Attachments
 -Sliding clutch
 -Drive shaft and U-joints
 -Control lever
 -Operation
 -Rope and chain
 -Condition
 -Winding
 -SAFETY DEVICES AND LIGHTS
 -Horn
 -Rear view mirrors
 -Windshield wiper
 -Fire extinguisher
 -Fuse and fuse holder
 -Lights, operation
 -Headlamp, adjustment
 -Light switches
 -Headlamp
 -Tail light
 -Panel light
 -RATING OF DRIVER
 -Tightening
 -Drivers lubrication
 -Cleanliness of vehicle
 -Condition of tools
 -Condition of equipment
 -(Enter Ex (excellent), G (good), P (poor).)

I (We) have performed the maintenance operations as outlined in the guide for monthly (1,000-mile), semiannual (6,000-mile), maintenance operations. Defects noted which will impair satisfactory operation during the next 30 days or 1,000 miles, 6 months or 6,000 miles, are listed under remarks.

Date Initials
 Signature.....
 (Mechanic(s))
 (Motor Sergeant)

I have performed the maintenance inspection of this vehicle as required by AR 850-15.
 Date Signature
 (Motor Officer)

REPAIRS BY HIGHER ECHELON
 Date repairs were requested.
 Date vehicle was delivered for repair.
 Date vehicle was returned to duty.

DATA FOR PERMANENT RECORD (cost of parts, materials, etc.)

NOTE: This check sheet is intended as a guide for mechanics in the performance of maintenance services. As mechanics become familiar with the services, an abbreviated form may be used. The check sheet itself, or pertinent extracts therefrom, may be filed as the record.

FROM THE CHIEF'S OFFICE

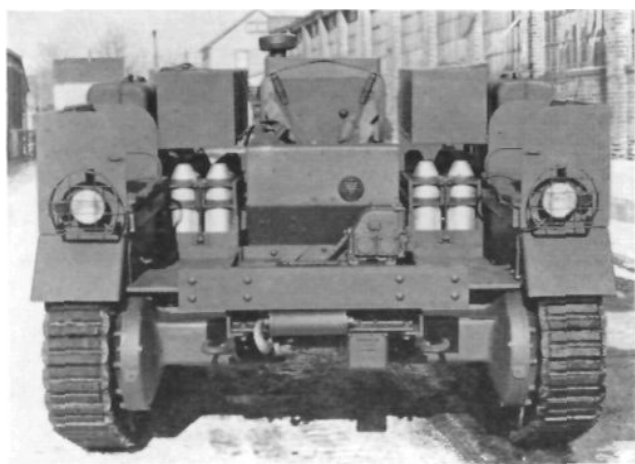
ELBOW TELESCOPE SIGHT Quite naturally, many inquiries are reaching the Office of the Chief of Field Artillery relative to improved facilities for direct laying with the 75-mm. Gun M2A2. A thoroughly satisfactory elbow telescope and mount have been developed for this weapon and are under manufacture. The date of issue of these items cannot be estimated with accuracy at this time. Their need by units is well understood and their provision is being expedited by the Ordnance Department to the greatest practicable extent.

HIGH-SPEED COMMERCIAL TRACTORS The necessity for assured tactical mobility of field artillery under adverse conditions of terrain and weather has impelled the Chiefs of Ordnance and Field Artillery to follow closely all commercial tractor developments and to encourage the development of tractors providing both the strategic mobility of trucks and the tactical mobility of track-laying tractors. During 1936 and 1937, the Ordnance Department successfully developed high-speed tractors suitable as prime movers for light and medium artillery. These tractors, being a non-commercial item, were unusually expensive, and, consequently, no units were ever equipped with them for extended test and training.

After a number of conferences during 1940, between a commercial tractor manufacturer and representatives of the offices of the Chiefs of Ordnance and Field Artillery, a high-speed tractor was developed commercially and accepted by the Field Artillery for test. The object of the test by the Field Artillery Board was to determine its suitability for use as a prime mover for medium artillery, to comment upon the probable suitability of a lighter tractor of its type for use as a prime mover for light artillery in case a track-laying vehicle should become desirable, and to compare its suitability in general with that of the Ordnance medium high-speed tractor M1.

This tractor has several unusual features. Some of its characteristics are:

| | |
|--|-------------|
| Weight, fully serviced and without body load | 14,130 lbs. |
| Weight, fully serviced, with complete body load | 18,000 lbs. |
| Length, front bumper to pintle | 174 inches |
| Width | 98 inches |
| Ground clearance | 19 inches |
| Passenger capacity (with personal equipment) | 9 |
| Ammunition capacity (155-mm. howitzer, complete round) | 24 |
| Fuel capacity | 75 gallons |
| Rated top speed when towing medium artillery | 35 m.p.h. |
| Winch, capacity 15,000 lbs., front mounted type | |



Tractor MG2, front and side views

The transmission is of the selective four-speed type. The truck is a center-guided, 10-inch Goodrich band-block type with replaceable tread blocks. The track width of production models will be 12 inches. The track suspension is of the bogie type in which the rear idler is designed as a load bearing member. Drive to the tracks is through a controlled differential and rigidly mounted front drive sprockets. Gasoline tanks are of the bullet-sealing type.

Significant extracts from the Board's report are:

Its small turning diameter (47 feet with howitzer) and the ground clearance (19") made it handy in close quarters and able to maneuver in timber and rough ground with ease. . . . Is able to operate satisfactorily in columns marching at speeds of from 2 miles per hour up to approximately 30 miles per hour . . . is capable of towing a trailed load of approximately 5 tons up all grades normally encountered on roads in high gear at a speed of 20 or more miles per hour. . . . Maintains a higher average speed over rolling terrain than does the 4-ton, 6x6, prime mover, towing comparable loads. . . . during all cross-country operation, the tractor, towing the 155-mm. howitzer, T3, proved faster and more agile than either the 4-ton, 6x6, prime mover, towing the 155-mm. howitzer M1918A1, or the 2½-ton, 6x6, truck, towing the 105-mm. howitzer. . . . Under favorable conditions of traction, the truck prime movers with their very low gear ratios proved capable of climbing grades beyond the ability of the tractor. In similar tests during wet weather on slopes, the tractor proved to be the better grade-climbing vehicle . . . obstacle crossing ability superior . . . easy to steer, less tiring to drive . . . easy to conceal in brush from ground and air observation . . . remarkably smooth riding . . . greater general ability over other prime movers known to the Board for the 155-mm. howitzer. . . . With minor changes in superstructure, promises to be a very satisfactory prime mover for the 105-mm. howitzer. . . . The subject tractor, as tested, is a more capable prime mover for medium artillery than the present 4-ton, 6x6, prime mover or the Ordnance medium tractor T-1, and is superior in cross-country ability to the 2½-ton, 6x6, prime movers for light artillery.

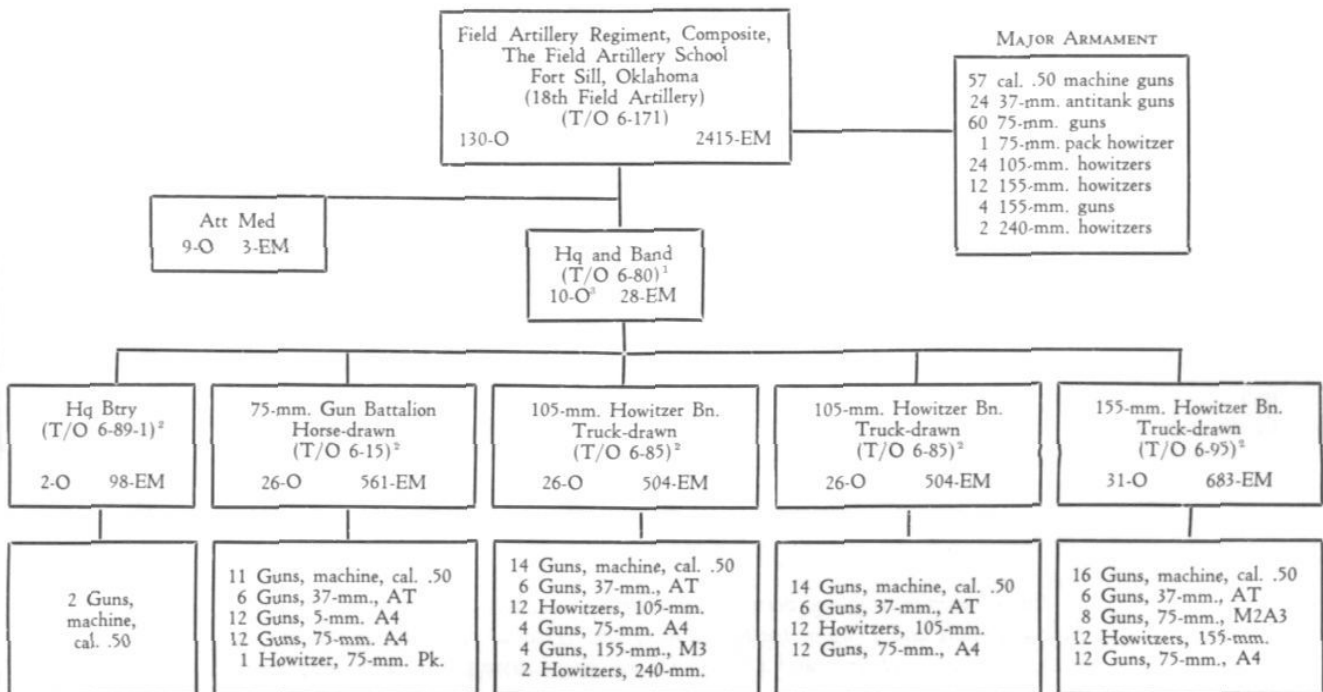
**FIELD ARTILLERY
REGIMENT, COMPOSITE, THE
FIELD ARTILLERY SCHOOL,
FORT SILL, OKLAHOMA**

The assignment of a majority of the combat troops at Fort Sill to tactical units, with the consequent

likelihood of their frequent, and possible permanent, absence from the post, has necessitated the provision of a special school-troops regiment to furnish the troop requirements of the School. Based upon a recommendation by the Chief of Field Artillery, such a regiment has been authorized by T/O 6-171 and designated the 18th Field Artillery. While not entirely adequate for the greatly expanded needs of the School, an examination of the organization and equipment of its 2,582 officers and men will indicate a maximum use of the men and equipment allotted by the War Department.

Tactical units stationed at Fort Sill are giving additional valuable assistance on a voluntary basis when feasible. Not only is their work of great value to the School, but it provides training of the highest order for the units themselves. What more valuable training for battery executives and gun squads of the Field Artillery Brigade of the 45th Division than their firing of several thousand rounds of service and subcaliber ammunition for the Gunnery Department?

The chart below shows the organization of the regiment and its major items of armament. An examination of it will show that its battalions conform to those of corresponding types in the triangular and square divisions. Additional armament (and other important items



¹Brigadier General listed in T/O 6-80 is not authorized.

²Basics not included.

³Includes a chaplain.

of equipment not shown on the chart) have been provided in order to make available all calibers of weapons in use by the Field Artillery and to permit the improvization of additional firing batteries for service practice. This regiment will be among the first to be equipped with 105-mm. howitzers.

NEW TYPE BLACKOUT LIGHTS

The need for improved blackout lights for motor vehicles and towed loads has been urged by the Chief of Field Artillery for some time. For several months the Holabird Quartermaster Depot has been studying the problem. Several different types of lights have been tested by the most interested arms and services. MCM No. 12 of February 13, 1941, provides characteristics of lights considered markedly superior to present equipment. In addition to satisfactory lighting characteristics, they have the additional important advantage over some of the other lights tested of being obtained by the relatively inexpensive conversion of the thousands of lamps now on our vehicles.

The lights are of the direct-beam type instead of the diffused (louvre) lights now furnished. They are to be of standard construction so that, even though manufactured by different companies, all parts will be interchangeable. Definite stereoscopic effects are provided as follows:

Front (white) marker lights will appear as two lights at distances of 60 feet or less; one light at distances greater than 60 feet.

Rear (red) tail and stop lights will appear as four lights at distance of 60 feet or less; two lights at distances between 60 and 180 feet; one light at distances greater than 180 feet.

Thus a driving range between 20 and 60 yards is provided for the driver following a vehicle equipped with these tail lights.

Two small white lights will mark the right and left front of the vehicle. Two lights will mark the right and left rear of the vehicle; in the left rear light will be combined a blackout tail light and a service stop and tail light; in the right rear light will be combined a blackout tail light and a blackout stop light. Each artillery cannon will be equipped with one combination blackout tail light, and blackout stop light to mark the muzzle. This light will be attached to a universal-type bracket suitable for fastening to the muzzle of any cannon by a strap.

REPORTING DEFECTS AND DEFICIENCIES IN NEW MOTOR VEHICLES

It is especially important to the Field Artillery that all its personnel responsible for the care and maintenance of motor vehicles familiarize themselves with Circular Letter No. 35, Office of the Quartermaster General, March 13, 1941, dealing with the reporting of defects and deficiencies in motor vehicles, and cooperate fully with post motor-maintenance officers in effecting its provisions. Detailed instructions relative to the preparation of these reports are contained in Motor Transport Technical Service Bulletin No. Z-5, as well as information on "breaking-in" of new motor vehicles. In connection with these reports, the following extract from that bulletin is of special interest:

"The specifications and contracts covering the purchase of motor vehicles by the Army include the following guarantee by the contractor:

"The successful bidder shall guarantee the vehicle against defective material and workmanship; prevalence of vapor lock; excessive front wheel shimmy and tramp; excessive spring set; gear hopping and objectionable gear noise; leakage of lubricants; cracking and sagging of frame members; loosening and breaking of rivets; tearing and cracking of sheet metal stock and welds; and cracking, splitting and warping of wood structure. This guarantee shall be effective for a period of one (1) year, exclusive of time in transit of vehicles shipped to stations outside the continental limits of the United States, or four thousand (4,000) miles road travel, whichever condition shall first occur. He shall guarantee against dry rotting of wood structure occurring, within the continental limits of the United States, for a period of one (1) year. Further, for a period of one (1) year or eight thousand (8,000) miles road travel, whichever condition first occurs, he shall guarantee the vehicle against faulty design that results in recurring maintenance and part or unit replacement being required."

"Defects and deficiencies of motor vehicles procured by the Quartermaster Corps which in the opinion of the operating organization are due to defective material and/or workmanship will be reported to the Post Motor Maintenance Officer who will inspect the vehicles reported upon and prepare a report * * *."

In connection with the data contained in the report, it is especially important under present conditions that *the station* of the organization be given in order to facilitate a follow-up by the Holabird Quartermaster Depot.

NOT SWEET ENOUGH

An old woman, who had been buried in an air raid, was being dug out. Presently a hole was made and a cup of tea passed in to her. After a short interval the cup was passed out again, undrunk, and a firm voice was heard saying: "More sugar, please!"

—The Gunner (London)



WITH THE ARMIES OF FOREIGN NATIONS



THE EYES AND EARS OF THE ARTILLERY. Translated from *Voelkischer Beobachter*, by Major Thomas North, FA.

Today the eyes of the commander, consistently observing from our own lines and reporting all occurrences promptly to the Division Commander, is the artillery observation battalion. Indeed, these units which were systematically developed from most modest beginnings in the interval between World War I and the present disagreement, have also been called the eyes and ears of the Army. Whenever visual observation becomes impossible because of terrain, or weather conditions, the battalion installs its highly sensitive acoustical equipment in order to locate the enemy artillery.

The missions of the Observation Battalion are so varied, and the solution of its problems is so highly technical that it is difficult for a soldier of another Arm to appreciate the amount and nature of the tasks of these specialized troops while the battalion is functioning at the front. The Infantryman in the front line gets his daily situation maps upon which are shown the results of reconnaissances in the enemy terrain; the artilleryman is assigned targets which are invisible to him, and is aided in the attack of these targets; the artilleryman also receives his daily "Barbara" report, which, by means of the meteorological data set forth therein, enables him to fire accurately at long ranges because the necessary corrections of the firing data occasioned by weather conditions are made possible by this report. These reports, these aids, are taken for granted. Someone provides them for the doughboy, artilleryman and commander.

This "somebody" is the Observation Battalion, whose personnel, together with their technical and scientific equipment, are entirely devoted to the needs of the combat troops and who represent a happy combination of the technician and the soldier. Recently, for the first time in this era of publicity, a brief view of the operations of the Observation Battalion was afforded through the medium of a conducted press tour. The selected battalion had desired not to carry out all of the practice under combat conditions. Otherwise the visitors would have seen a few wire lines, but otherwise, no more of the battalion's installation than did we infantrymen in the

combat in the West. Anyhow, soon after the command to establish the system had been given, the details of men and equipment disappeared across country. Without a guide it would have been impossible to find the isolated stations; a glance at the operations map made quite plain the broad scheme of distribution of the individual stations. This wide scattering of activity makes necessary the use of radio and telephone. Otherwise, how could the survey data be quickly collected and evaluated? Here, far behind the front line, is a microphone in a field; in a small tent a short distance away are a few men who take care of the proper functioning of their apparatus. "Sound Ranging Station A." In the distance a gun roars. The microphone picks up the sound and sends it as an electric impulse to the sound-ranging central, which is some kilometers distant. This discharge is also picked up by the microphones of the other three stations which are located on a line across the sector of the Division. The difference in the time at which the detonation impinges upon the different microphones are the data for the complicated procedure by which the source of the sound, the enemy battery, or one of our own bursts (if our own artillery is firing) is located. Several reports are heard, activating the microphone; they are recorded at the central on a film band in the order of their arrival, and are located on the gridded map.

Five minutes after the arrival of the sound from the gun the sound ranging battery of the Observation Battalion can report to the artillery commander the exact location of the enemy gun—a remarkable performance that looks like magic since it is not necessary for anybody to see the gun that fires—in fact, in most cases it cannot possibly be seen. The men of the sound-ranging battery are at their posts day and night.

Whoever has faced the enemy recognizes the setting. Here and there on the distant horizon the flash of the enemy guns lighten the darkness. Other men of the Observation Battalion make use of these flashes, also, in order to locate the positions of the enemy guns. Their stations are located closer to the front line. They must stand where they can observe the enemy terrain with their scissiors instrument. With it, they see the flash, read the direction to it, and report this to the central station. Again, these observation stations are spread over a wide front. The angles at which the gun-flashes

appear in the instruments of the flash-ranging battery are different. In plotting, the rays corresponding to these angles intersect at a point; that point is the location of the gun that is firing. It is obvious that this system of spotting can only reach its greatest exactness if the observation stations are accurately located on the map. This is taken care of by the survey battery which operates without regard to the enemy or enemy activity. It lays the cornerstone, as it were, for the system of lines and angles from which the eyes and ears of the battalion reach out to their artillery opponent, fix it at a certain point in order to pass it on to our own weapons so that they may take it under fire. The Observation Battalion has been called the maid of all work. That has certainly some justification; for it is the duty of the men of the flash-ranging battery, in addition to intersecting on the enemy artillery, to keep the battlefield constantly under surveillance and to make tactical reconnaissances.

As our own infantry has rushed forward, how often has the artillery fire been lifted in the last moment through the help of the Observation Battalion? How often are timely reports made to the high command of critical moments in the battle through the rapid communication system of this battalion? Still other tasks are performed by the Observation Battalion. Yonder may be seen some of the men engaged in the task of constantly keeping the troop commanders equipped with new maps, new survey data, firing charts and target data; and alongside the reproduction section of the headquarters battery, the men of the meteorological section are working out the sound-ranging meteorological data. It is obvious that the wind conditions make corrections necessary in the distance and direction of the origin of the sound as computed in the computing room of the sound-ranging battery. Here the "Barbara" report is prepared by the help of which, in long-range fire, errors in the trajectory resulting from wind velocity, density of the air, and temperature, may be eliminated by appropriate corrections.

It was clear to the guests on this trip to what extent the needs of the troops, particularly in the rapid movement against Poland and France, could be met, thanks to the equipment and training of this Observation Battalion which attracted so little attention during the period of its development. In this battalion, however, the technical has been most ably built into the combat organization of the army. Technical procedures are not reduced to a mere end in itself but are alive and have become an organism of the whole German Army.

Qualified for its mission, the Observation Battalion may be called in this special case, and the men in it are proud of its title—the eyes and ears of the artillery.

EDITORIAL COMMENT

It is known, from other German articles published within the last two years, that the German observation battalion, which is a part of the divisional artillery, not the

corps, consists of a headquarters battery, a survey battery, a sound-ranging battery, and a flash-ranging battery. The foregoing translation indicates that the battalion operates four microphones on a straight-line base across the divisional front. A few other facts may be gleaned from the article:

a. The observation battalion is an information-gathering agency for other arms as well as for the artillery of the division.

b. Sound ranging is used to locate bursts of friendly artillery as well as to locate hostile guns.

c. A sound-ranging location can be obtained in five minutes.

d. What in our army is called a "Mif-mif" message or a metro message ("meteor" to the British), the Germans dub a "Barbara" message—not a bad name for it.

e. The flash-ranging battery uses the BC Scope as an observing instrument. But it should be remarked that the German BC Scope is a finer and more accurate instrument than the similar device (of World War vintage) in our army.

f. The auxiliary duties of the observation battalion are worth noting. It performs battlefield surveillance; keeps the high command informed as to the location of front-line units; provides an additional communication net; reproduces maps and charts; performs higher survey; secures and disseminates metro data.

ARTILLERY VERSUS TANKS. (From *Artilerisko Pesadiski Glasnik*, Yugoslavia, No. 40, 1940.)

This article undertakes to make a study of the part to be played by the artillery in antitank defense.

Having pointed out that tanks may present themselves either as fixed or as movable targets, the author indicates what considerations a commander of artillery must take into account before and during action against tanks, special attention being devoted to the type of cannon used, the type of formation adopted, and the distance at which to open fire.

Three phases of artillery combat against tanks are examined in the article: the phase that precedes opening the action, the phase of attack, and the phase of actual penetration into the position of defense.

Prior to actually opening the engagement, the purpose of the anti-tank defense is to strike at the enemy tanks before they start moving; that is while they are still in their position, waiting or in the act of departure.

If they are still quietly waiting, action will be developed by using long-range artillery and, possibly, some of the artillery regularly assigned to the division. Armor-piercing projectiles will be used in combination with chemical projectiles (preferably persistent poisonous gases). If the enemy tanks are in a position near a forest, it may prove useful also to employ incendiary shells.

If the enemy tanks are in the act of departure, provided their point of departure happens to be in the vicinity of the position to be attacked, action will be developed by bringing into play the division's own artillery, with the same types of projectile as suggested in the foregoing, proper precautions being observed in the use of toxic gases (direction of the wind).

At this point the article recalls that many of the foreign armies' regulations require the artillery to fire, in advance, into zones that the enemy tanks are expected to make use of in breaking through the defenses. The author is of the opinion, however, that while this procedure might succeed in delaying the progress of enemy tanks, it would not likely inflict heavy losses.

While the attack is in progress, it will devolve upon the artillery to support and integrate the action developed by the infantry. The author expresses slight confidence in the use of indirect fire in that connection, but considers that direct fire from guns far apart in suitably chosen and perhaps concealed positions is likely to be very effective. The action of these pieces might be supplemented by the action of units definitely assigned to the task of developing a barrage both with smoke and HE.

If the tanks succeed in breaking into the defensive position, the action reaches a phase where the defensive must take any risk to dislodge them. One might use for that type of action the antitank weapons of the infantry, some individual pieces of artillery, also whatever reserve units of artillery there may be available grouped in positions far back, relying upon forces further to the front. In view of the high speeds attained by tanks, only batteries located very far to the rear of the line are likely to have time to shift into more advantageous positions for the same purpose.

In concluding, the author maintains that in the struggle between artillery and tanks the decisive factor is always the morale of the artillery units, and they should be given training in combat both at long and short range.

NORWEGIAN ARTILLERY. (From: *Der Schweizer Artillerist*, Switzerland, June 15, 1940.)

Prior to the outbreak of the war in 1939, the Norwegian field artillery was equipped with the following materiel:

Cannon, 75/31 M. 01, Ehrhardt: Muzzle velocity 500 m/s; weight of the projectile, 6.5 kg.; range 60,000 m.; traverse 7 degrees; elevation —5 degrees plus 15.5 degrees; weight in the battery 1,002 kg.

Mountain Cannon 75/20.5 M. 27: Muzzle velocity 395 m/s; weight of the projectile 6.5 kg.; range 8,800 m.; elevation —5 degrees plus 47 degrees; traverse 5 degrees; weight in the battery 600 kg.

Mountain Howitzers 75/17 M. 11, Ehrhardt: Muzzle velocity 350 m/s; weight of the projectile 5.3 kg.; range 6,300 m.; elevation —7 degrees plus 39 degrees; traverse 5 degrees; weight in the battery 500 kg.

Howitzers 120/20 M. 09, Rheinmetall: Muzzle velocity 450 m/s; weight of the projectile 20 kg.; range 11,000 m.; elevation —5 degrees plus 45 degrees; traverse 54 degrees; weight in the battery 1,970 kg.; limber with two trails, armored.

Howitzers 120/13.5, Kongsberg: Muzzle velocity 300 m/s; weight of the projectile 21 kg.; range 7,000 m.; elevation —5 degrees plus 43 degrees; traverse 5 degrees; weight in the battery 1,280 kg.; limber with one trail, armored.

EDITOR'S NOTE: *There is reason to believe that the Germans have made use of the Rheinmetal-Kongsberg 120-mm. howitzers. They appear to have mounted some of them on a track-laying vehicle, thus making an armored self-propelled mount for use with armored units.*

SWEDISH ARTILLERY. (From *Der Schweizer Artillerist*, June 15, 1940.)

At the beginning of the war in 1939 the Swedish field artillery was equipped with the following materiel:

Cannon, 75/30 M. 02, Krupp: muzzle velocity 500 m/s; weight of the projectile 6.5 kg.; range 8,000 m.; elevation 0 degrees plus 16 degrees; traverse 7 degrees; weight in the battery 1,070; limber with one trail, armored.

Cannon, 75/30 M. 02/33: Muzzle velocity 500 m/s; weight of the projectile 6.5 kg.; range 11,300 m.; elevation 0 degrees plus 43 degrees; weight in battery position 1,500 kg.; limber with two trails, armored.

Howitzers, 105/16 M. 10: Muzzle velocity 304 m/s; weight of the projectile 14 kg.; range 8,400 m.; elevation —10 degrees plus 40 degrees; traverse 4 degrees; weight in battery position 1,225 kg.; limber with one trail.

Howitzers, 149/14 M. 06, Krupp: Muzzle velocity 300 m/s; weight of the projectile 41 kg.; range 6,800 m.; elevation —5 degrees, plus 43 degrees; traverse 4 degrees; weight in the battery 2,150 kg.; limber with one trail.

Howitzers, 149/24, Bofors: Muzzle velocity 775 m/s; weight of the projectile 46 kg.; range 12,000 m.; elevation —2 plus 45 degrees; traverse 60 degrees; weight in the battery 3,150 kg.; limber with two trails, armored.

Mortar, 210/18.5, Krupp: Muzzle velocity 390 m/s; weight of the projectile 120 kg.; range 10,200 m.; elevation 6 degrees —70 degrees; weight in the battery 9,220 kg.; caisson limber.

Cannon, 105/50, Bofors: Muzzle velocity 850 m/s; weight of the projectile 16 kg.; range 20,000 m.; traverse 60 degrees; weight in the battery 4,500 kg.; limber with two trails, armored.

BOOK REVIEWS

By H. S. F.



"When you study military history don't read outlines on strategy or the principles of war. Read biographies, memoirs, historical novels. Get at the flesh and blood of it, not the skeleton."
— GENERAL SIR ARCHIBALD WAVELL.

ALLENBY. A STUDY IN GREATNESS. By General Sir Archibald Wavell. Oxford University Press, New York, 1941. \$3.00.

British public men are literary minded. Winston Churchill wrote as readable a history as the present era has produced. Wavell's book demonstrates, also, that British generals can write good books as well as win battles.

Some fourteen years ago Wavell wrote an excellent history of the Palestine campaign, but his present book does not merely repeat the same data. This book is a portrait of Allenby as a man and general; the military operations serve only as the background to Allenby's personality and generalship. As Wavell served throughout the Palestine campaign on Allenby's staff he is eminently fitted for his task. There is to be a second volume on Allenby's post-war career as High Commissioner for Egypt, but as the author remarks, it "forms a chapter of history of which the results are still being unrolled," and the story would be better told when peace returns.

In many respects Allenby was a peculiar soldier. He made a good record in the Boer War, though not a spectacular one. In 1914 he went to France in command of the Cavalry Division, and although he did good service in this post, as also later when in command of the Cavalry Corps, his record was certainly not sensational. Transferred to the Fifth Corps, he earned such a reputation as a hard and ruthless commander that, as Wavell tells us, he served as the model for the central character in C. S. Forester's famous novel, "The General." Yet this same Allenby would play for hours with small children, and spent all his spare time in the study of bird and flower life. Allenby achieved his greatest success on the Western Front when in command of the Third Army on the first day at Arras, but his early advances were overshadowed by subsequent failures. When, in June, 1917, he left France to take up the command in the East it might have been supposed that he would do a competent job, but there was little in his record to indicate that he was to be an overwhelming success.

The story of the Palestine campaign is well known, as is its principal feature—Allenby's superb handling of his mounted troops. Wavell rightly calls Allenby the last great cavalry general, and points out the odd coincidence that the last great cavalry campaign in 1918 ended within a short distance of where the first great cavalry campaign had begun — Alexander's victory at Issus in 333 B. C. Success softened Allenby somewhat, but he still

demanded the strictest adherence to the most insignificant regulation, and would explode in fearful anger if he discovered a trooper dressed in shorts, or who failed to have his chin strap down—regardless of the temperature. Nevertheless, it is difficult to deny Wavell's conclusion that Allenby was the greatest of Britain's Great War generals.

Today it is obvious that Wavell has profited by his old master's teaching. He has done more, for where Allenby fought with superior numbers Wavell has achieved as great results with the balance weighted the other way. In short, this is a first rate book about a great general by a great general.

BLITZKRIEG. By S. L. A. Marshall. William Morrow & Co., New York, 1941. \$2.00.

The military critic of the *Detroit News*, himself a veteran of the Great War, has here written a sound text on the present war. The reports of newspaper correspondents and radio commentators are filled with confusing and disjointed accounts of secret weapons, seemingly impossible maneuvers and illogical strategy. This book gives a concise and well written description of the significant developments of the present war to which one can always refer with profit.

HE MIGHT HAVE SAVED FRANCE. THE BIOGRAPHY OF ANDRE MAGINOT. By Marguerite Joseph-Maginot. Doubleday. Doran & Co., New York, 1941. \$3.00.

After seven years as colonial administrator in Algeria, Maginot was elected to the Chamber of Deputies in 1910, and was serving in that body at the outbreak of the Great War. Though exempt, he volunteered for service as an enlisted man, and in November, 1914, as a sergeant leading a patrol, Maginot received such serious wounds in the leg that further military service was impossible. Invalided out of the army, he returned to politics, and became a cabinet officer. When minister of the first time in the post-war era he had the responsibility of directing the French occupation of the Ruhr. His most important term as minister of war was from 1929 until his death in 1932, for in 1930 he obtained the first appropriations for the now famous Maginot Line. Maginot did not rely solely on a fixed defense, and agitated continually for a larger air force. This book, written by his sister, is sketchy in parts and perhaps

would be improved by a little less sisterly admiration, but it nevertheless contains a considerable amount of interesting and hitherto unavailable information.

WHAT THE CITIZEN SHOULD KNOW ABOUT THE NAVY. By Hanson W. Baldwin. W. W. Norton and Company, New York, 1941. \$2.00.

The distinguished critic of the *New York Times* needs no introduction to military readers. He is a graduate of the Naval Academy, and was a naval officer before becoming a journalist. In order, the book takes up the elements of sea power, the enlisted men and officers, the fighting ships and places, equipment and communications, and bases of the fleet. The two concluding sections on the organization of the fleet and its tactical maneuvers—with accompanying charts—are particularly interesting. Well illustrated, this book has a useful appendix containing a glossary of naval terms, tables of relative naval strength, a bibliography of naval books and an index. If you want to know what the Navy is like today, this is your book.

WHAT THE CITIZEN SHOULD KNOW ABOUT THE COAST GUARD. By Hickman Powell. W. W. Norton & Company, New York, 1941. \$2.00.

The recent seizure of certain vessels in American ports by the Coast Guard has brought that service once more to the public attention. The Coast Guard occupies a unique position in armed forces of the nation. In peace it is controlled by the Treasury Department, transferring to the Navy immediately on a declaration of war. Organized in 1790 by Alexander Hamilton, the Coast Guard has served in all our wars, and the sinking of the cutter *Tampa* with all on board in 1918 was our second greatest naval disaster of the Great War. The Coast Guard patrols not only the coastal waters and the high seas, but the inland lakes and rivers as well, and this book is a thoroughgoing, competent description of the organization and operation of the Coast Guard and the training and duties of its officers and men.

THE BELGIAN CAMPAIGN AND THE SURRENDER OF THE BELGIAN ARMY. Belgian American Educational Foundation, Inc., New York, 1941. 25c.

This pamphlet consists of a number of short statements and documents by former President Hoover, the American military and naval attaches, King Leopold III, Prime Minister van Zeeland, Chief of the General Staff Major General Michiels, and several other distinguished men of the United States and Belgium. After reading this valuable contribution to contemporary history it is difficult to refute former Ambassador Cudahy's statement that King Leopold's surrender was "the only action compatible with honor and duty."

BOOK SUGGESTIONS

SOME NOTES FOR BATTERY EXECUTIVES, by Captain Harold F. Handy. Price per copy..... \$.20
Lots of 10 or more, each..... .15

Because of repeated requests from numerous individuals and organizations. The Field Artillery Journal has reproduced in pamphlet form Captain Handy's popular and instructive article which was originally published in the March-April, 1939, Journal. This treatise is invaluable for battery officers, especially the newly commissioned.

A PRACTICAL MANUAL OF MARTIAL LAW, by Frederick Bernays Wiener. Published by Military Service Publishing Co., 1940..... 2.00

An extremely readable and informative book. The author says: "The purpose of this Manual is to provide a practical guide to the much-discussed and much confused field of martial law."

CARBINE AND LANCE: THE STORY OF OLD FORT SILL, by Capt. W. S. Nye. Published by University of Oklahoma Press, 1937..... 3.00

The historical and military background of the Field Artillery School. "This is a meaty and invaluable volume for collectors of Americana and for students of American history and it is a thrilling book for the general reader."—Burton Rascoe in *Esquire*, January, 1938.

WHAT THE CITIZEN SHOULD KNOW ABOUT THE ARMY, by Lieut. Harvey S. Ford. Published by W. W. Norton & Co., 1941..... 2.00

The background development, organization and operation of the Army. "It is a comprehensive book of information, excellently arranged and interestingly written."—*New York Times*.

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This pamphlet contains three articles on antitank training which originally appeared in the January and March, 1941, issues of the FIELD ARTILLERY JOURNAL. These numbers have now been completely sold out, and the articles are reprinted here in response to popular request.

Army Mess Management Simplified

By MAJOR E. A. HYDE

Revised edition published in 1939. \$2.00

The title of Major Hyde's book describes its scope and purpose. It simplifies the management of the unit mess, it reduces the labor in connection with it, and if the system is carried out, a SUPERIOR MESS will be the result. The basic scheme of the book is the use of a 15-days' Bill of Fare. Each Bill of Fare is followed by instructions and recipes for each of the items included in it. All the Company Commander has to do is to prescribe that the Bills of Fare be followed out in his kitchen, turn a couple of copies of the book over to his kitchen crew, and then see that the plan is being followed.

10 per cent discount on book orders
 amounting to \$10.00 or over.

RIFLE MARKSMANSHIP. By William L. Stephens. A. S. Barnes and Company, New York, 1941. \$1.00.

Lieutenant Stephens is an Ordnance officer, and his book is designed primarily for the beginner who wants to learn how to shoot. However, the book is sufficiently broad in scope to include material for the marksman who is striving to become an expert. The book is a unit in a series of twenty-seven similar volumes dealing with various sports, and therefore emphasizes competitive match shooting.

GENERALS AND GENERALSHIP. By General Sir Archibald Wavell. With a foreword by General Sir John Dill. The Times Publishing Company, Ltd., London, 1941. Sixpence.

This valuable pamphlet is composed of three Lees Knowles Lectures, respectively entitled "The Good General," "The General and His Troops," and "The Soldier and the Statesman," and they were delivered by Wavell at Trinity College, Cambridge, in 1939. As the Chief of the Imperial General Staff remarks in his foreword, "they show very clearly how Wavell and the army under his direction have gained their great victories in Africa and why they will gain others," which should be sufficient recommendation for anyone.

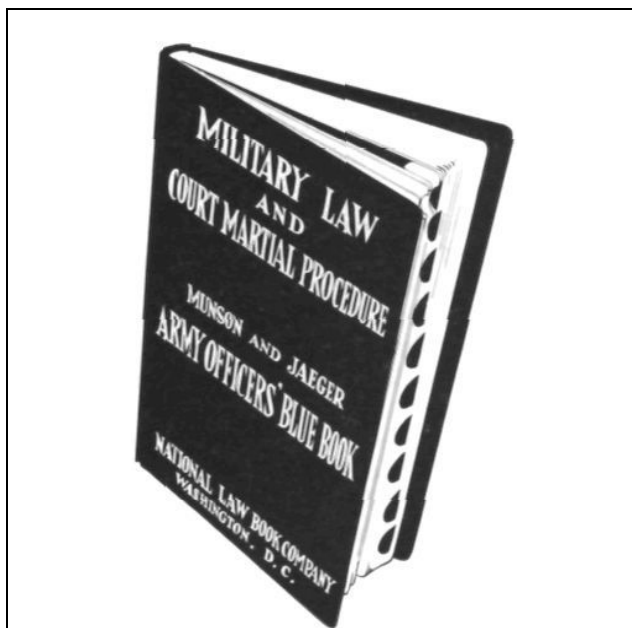
MAHAN ON NAVAL WARFARE. Edited by Allan Westcott. Boston, Little, Brown and Company, 1941. \$2.50.

"The Influence of Sea Power upon History" has long been accorded its proper recognition, but it is only in recent years that the "influence of Mahan upon history" has been acknowledged. It is now realized that Mahan's books did much to inspire the pre-1914 Anglo-German naval race, which in turn was a leading cause of the Great War. Mahan's main distinction was won as a scholar and historian, and he himself felt that he would have been more successful out of the Navy. Apparently the Navy agreed, for an officer in the Bureau of Navigation once curtly informed him that it was "not the business of a naval officer to write books." Of late, Mahan's theories have been challenged, and with some justice, for, as the editor admits, "Mahan did not always recognize fully the limitations of sea power against a nation supreme and self-sufficient on land."

Nevertheless, opponents and proponents of Mahan both will welcome this selective anthology of the best of his works, carefully edited by Professor Westcott. If this book is a success, and it deserves to be, perhaps some publisher will be encouraged to follow suit and do likewise with the works of Mahan's equal in the military world—Clausewitz.

ZACHARY TAYLOR. SOLDIER OF THE REPUBLIC. By Holman Hamilton. Bobbs-Merrill Company, Indianapolis, 1941. \$3.50.

The author of this book succeeded the historian-diplomat Claude G. Bowers—who contributes the introduction—as editorial writer of the *Fort Wayne Journal-Gazette*. This is the first of two volumes, and will doubtless be the most interesting to soldiers, since it covers Taylor's entire military career; the second volume will be devoted to Taylor in the presidency. As a soldier, Taylor's native ability was well seconded by the work of a number of extremely capable subordinates, particularly among his junior officers. In this connection, it is interesting to note that Taylor is probably the only soldier who ever had as officers serving under his command Lincoln and Davis, and Grant and Lee. The twelfth President of the United States has never been adequately dealt with by historians, and it seems more than probable that this well documented book will become his definitive biography.



Military Law and Court Martial Procedure

By Colonel F. Granville Munson, LL.B., and
Major Walter H. E. Jaeger, Juris. D.

This convenient Pocket Manual is intended for the use of all officers (especially reserve and National Guard officers on active duty) who realize the need of familiarizing themselves with the basic principles of military law and court-martial procedure, and of all soldiers ambitious for promotion.

Every step necessary to the development of a case, from the pre-trial investigation to the actual court-martial and the final imposition of sentence, is fully outlined and explained in detail, without the use of complex legal terminology. It will save you time and guard you from error. The Handbook is up-to-date and is thoroughly reliable. It is truly one of the most needed books published for the Army and should be in the hands of every officer and every candidate for a commission.

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