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**THE
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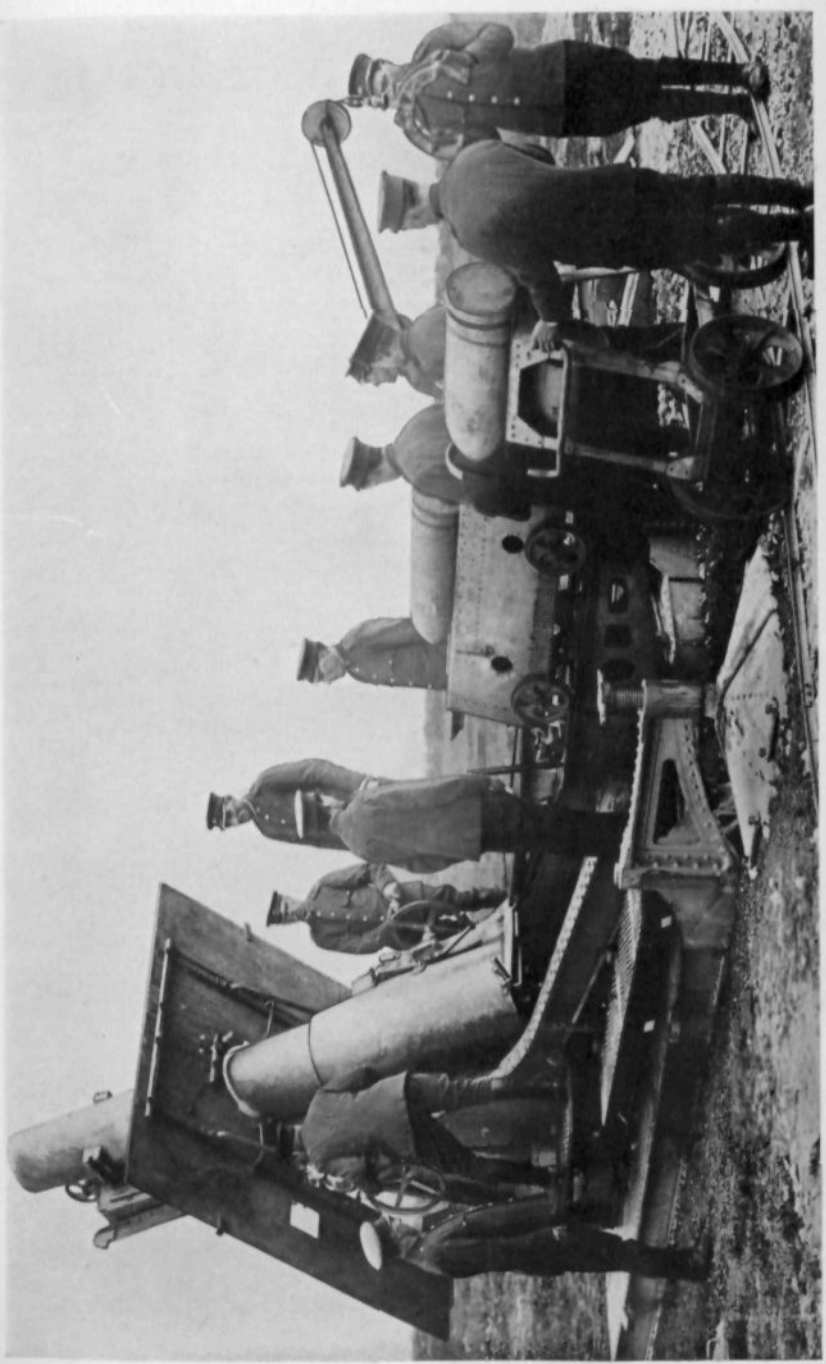
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FRENCH HEAVY ARTILLERY

THE FIELD ARTILLERY JOURNAL

VOL. VII

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NO. 4

The Mission of the School of Fire for Field Artillery*

THE object of this talk is to give you a brief outline of the *raison d'être* of the School of Fire, of what you may expect in the course you are here to take, and of what the School expects of you.

The School of Fire for Field Artillery was founded in 1911. Its beginning was modest. There were two classes per year for officers and noncommissioned officers; about 60 regular and 60 militia officers took the course annually. In 1914 the work of the School became more comprehensive and more prominent. Considerable research work was done and much valuable literature compiled and issued to the Field Artillery. After this promising progress the School was closed in 1916, because of the embroglio with Mexico. It was not reopened until last July, when, after a fresh and encouraging start, it received a severe blow in losing the majority of its instructors, due to their promotion into the National Army.

Just prior to this General Snow, who was then commandant, had evolved a bold and splendid project for the enlargement of the School. This project General Snow personally took to Washington, and to his untiring patience and perseverance is due its final adoption by the War Department, on September 12, 1917. Unhappily, he too fell a victim, by promotion, to the National Army and was ordered to his brigade before he could take steps to put his project into effect. The honor

* Address to an incoming class of student officers at the School of Fire for Field Artillery by the Commandant, Col. A. S. Fleming, 14th Field Artillery.

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of doing this fell to me. I shall not narrate the many obstacles that lay between the approval of this project and the concrete measures essential before its execution could be even begun. Suffice it to say that they were overcome.

Of the magnitude of the approved project few had any idea, and these had departed from the War Department by the National Army route. Even now there is but a meagre conception of this institution outside of its halls.

Briefly, the approved project was as follows: The capacity of the School was to be increased to 1200 student officers, entering at the rate of 100 per week for a twelve weeks' course; the School staff, including instructors, was to be increased to 150; three and one-half regiments of field artillery were to constitute the firing units; and \$730,000 was allotted for the construction of the necessary quarters, buildings, etc. These are only the outstanding features. Many of the details were worked out in advance. Some have since been modified and others elaborated. Several changes in the project have been authorized. A definite policy for the School has been submitted and approved, one that will have far-reaching consequences. In five weeks the construction for the School proper, including accommodations for instructors and students, has been about 40 per cent. completed. Your class, the second, should be followed in three weeks by the third, and in January classes should be reporting every week.

Before telling you about the organization and curriculum of the School I desire to explain its purpose and, in general, the means by which this purpose will be attained. The need of even partially educated field artillery officers is so urgent that the School term has been reduced to a minimum. Tactics and the broad knowledge necessary for the proper emplacement and use of artillery you must learn elsewhere. Practical *liaison* with the other arms you must also learn subsequently, except that some opportunity will be afforded for exercises, in conjunction with The Infantry School of Arms, illustrating the close coöperation necessary between the artillery and the infantry;

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also you will receive considerable instruction in air *liaison* in coöperation with the School for Aerial Artillery Observers establishment at this post for the purpose of training these observers in conjunction with this School. Time precludes any effort to make finished regimental or battalion commanders of you. Our efforts will necessarily be limited to teaching you those things which captains and subalterns of field artillery must know if their batteries are to be efficient and which field officers must know in order that they may either give competent instruction or supervise it. And since the ultimate reason for the existence of artillery *is to shoot*, our primary and final object is to teach you the technique of shooting.

The artillery of all nations is indebted to the French Artillery for the discovery and successful development of the two great principles which have made possible the rapid and accurate fire of modern field artillery. Without the long recoil carriage only accelerated fire is possible. Utilization of the possibility of this carriage resulted from the adoption of the *mil* as the field artillery unit of angular measurement. Since the *mil* made possible the rapid computation of firing data for indirect laying, all nations rearmed. The tactics of artillery were revolutionized. The resulting system invented by the French and copied by other nations has stood the acid test of the greatest war in history. Conceived, developed, and used with no idea of its application to the character of warfare now being waged in the trenches, it has proved its soundness and its applicability to such warfare for all field artillery. Prior to the present conflict, what has become known as open warfare was the only kind for which armies in general were trained. Nevertheless, years ago the principles and, to some extent, the practice of close shooting were developed. In the Russo-Japanese War the Russian Field Artillery made atmospheric corrections and used squared fighting maps similar to those now in use. For nearly ten years our field artillery has utilized a "Reference point," the "*point de surveillance*" of the French fighting map and the "Zero point" of that of the English. Our battery

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"in observation" is quite as old as the French one "*en surveillance*." The desirability and utilization of forward observers as near the enemy as possible were recognized in our F. A. Drill Regulations, 1911, Pars. 354, 356-7. Balloon and aeroplane observation of fire is a development, not a discovery of this war. Registration of fire was well covered in our F. A. Drill Regulations, 1911, Pars. 344, 458, 460, which provided for registering on prominent features of the terrain and, by minor changes in the data thus obtained, securing a quick adjustment on nearby targets in the same assigned sector. This registration is the *sine qua non* of the close shooting of trench fighting. These points are elaborated in our 1916 F. A. Drill and Service Regulations merely because the peculiar character of the existing phase of the war has rendered their application more necessary and more common.

None can say when trench fighting will give place to open warfare, and, when it does, the army that is not skilled in the latter is a beaten army. Especially is this true of the field artillery, which embraces all divisional artillery and all other artillery belonging to an army, except railway artillery.

In this war the artillery officer must be the master of his guns to a greater extent than ever before. He is not their master until he can shoot them to their limit of speed and accuracy, with all classes of projectiles and under all conditions. This mastery, this facility, he can acquire only through much shooting, using the same methods applicable to open warfare. Then, and then only, is he competent to make the special applications of fire rendered necessary by trench fighting. This point is so important that I shall emphasize it. You must first learn thoroughly the basic principles; then you must practise them until their application becomes subconscious. Do not seek a set of rules from which you may select the one appropriate to each problem. Every problem is a special case having its own best solution. Rules are illusory and lead to disaster. Do not make the mistake of generalizing from a particular case, no matter how important that case may be. The refinements

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in artillery fire which have been found necessary on the Western Front constitute only particular cases of the principles underlying field artillery fire. When the scene of action is shifting, a rapid adjustment of fire, using approximate methods, is all there is time for. When the combat becomes fixed greater deliberation and accuracy are possible. In trench warfare, when our own troops are very close to the enemy, extreme accuracy is essential. Hence in such a case all possible corrections are applied; *e.g.*, for atmospheric conditions. But, no matter what methods of refinement are used, the principles underlying barrage fire, for example, are those that can be mastered best by the study and practice of the methods of open warfare. And no man lacking in an understanding of them can lay a barrage that may not be worse than none from the viewpoint of his own infantry.

In general it may be said that all the close shooting done by field artillery in Europe is based upon particular applications of these fundamental principles. If these principles be neglected, no apparatus, however elaborate, no calculations, however accurate, will enable field artillery to perform its duty in trench warfare; and still less will it be able to do so when the present deadlock is broken. It need scarcely be added that the simpler the devices and methods used in this close shooting, as in all other field artillery firing, the more nearly will the task of the field artillery be efficiently performed.

These constitute the reason for the policy that the School of Fire will follow in your training—a policy intended to teach you, theoretically and practically, the principles of open firing and their application to the particular cases arising in trench warfare. You will get considerable firing of all kinds, and the more you get with the heavy guns the more you will appreciate the fact that their service is merely a variation of that of the light guns. The instruction in these various calibres will, to some extent, be concurrent, but it is to be kept in mind that all field artillery shooting is predicated upon a knowledge of open firing. In this policy the School staff is unanimous, and

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they are supported in this position by all the French officers who have been associated with the School and by the practice of both France and England.

As already stated, the ultimate purpose of this School is to teach the practical art of shooting, and all other instruction leads up to this. If you graduate from this School you will, upon your return to your regiments, be expected to instruct both officers and enlisted men and to prove your ability to do this. You must therefore acquire a working knowledge of the various things which must be taught there. These include the determination and use of firing data, the observation of fire, communications, reconnaissance, field engineering, field gunnery, matériel, and transportation. Accordingly the School has been organized into six departments:

1. *Department of Firing*, embracing firing instruction, the preparation and use of firing data, blackboard and terrain board work, smoke bomb practice, the observation of fire from positions near the batteries and from forward positions, and, in culmination, firing with all available types of field guns.

2. *Department of Liaison*, embracing all ground communications, including telephone, buzzer, flag, and *liaison* with the infantry, and also *liaison* with the aerial service (balloons and aeroplanes).

3. *Department of Field Engineering*, embracing such sketching as is necessary in the field artillery, the use of maps, etc., the construction of cover and shelter, and camouflage.

4. *Department of Field Gunnery*, embracing elementary probabilities, the practical use of range tables, the preparation and use of fighting maps, the preparation and use of barrage tables, correction for the day, calibration, the use of slide rules, etc.

5. *Department of Transportation*, embracing harness and harnessing and draft for light artillery; and motors and tractors for heavy artillery.

6. *Department of Matériel*, embracing the practical study and use of all available matériel, both American and French.

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The schedule of instruction requires long hours of application daily and close study on the part of all students for the attainment of proficiency. Necessarily, the course is predicated on the assumption that a large number of the student officers will have had little or no artillery training or experience. While some of you who are more advanced may feel inclined to chafe at being held back by this necessity, it is hoped that you will all realize that this condition is unavoidable, just as the speed of a squadron at sea is necessarily that of its slowest ship. You must be consoled by the thought and the fact that your time is well spent, even in reviewing that in which you feel proficient. In a couple of months or so classes will be following one another weekly, and then, as you will see, officers whose attainments warrant it will be transferred to more advanced classes.

At present there are 9 batteries available for school use. In the near future this number will be increased to 21. There will be 12 batteries of our 3-inch gun, 3 batteries of French 75's, 2 batteries of 4.7-inch guns, 2 batteries of our 6-inch howitzer, 1 battery of French 155-mm. howitzers, and 1 battery of French 155-mm. guns. There will also be a considerable number of trench mortars.

In addition to the above outline of the various subjects you are to cover, you will perform the duties of drivers and cannoneers and act as executive officers.

The matériel is already ordered for the construction of several light heavy battery emplacements, both Allied and German, to be modelled on those in use on the Western Front. You will see them building and will fire from the former at the latter. You will have actual opportunity to see the effect of your fire on the latter and on war wire entanglements and trenches. You will command the ground stations through which aeroplanes and balloons will on occasion control this fire. You will get ample close shooting.

The policy for this School, approved by the Secretary of War, contemplates that some officers shall be instructed in light artillery (horse drawn) and others in heavy artillery (tractor

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drawn). A limited number will also be instructed in trench mortars. The course is to be the same for all officers during the first five or six weeks, after which it will be differentiated. This policy is to be inaugurated upon the receipt of the necessary matériel.

I trust that all the heavy guns, tractors, and trench mortars may be received in time for them to be included in your course. The 155-mm. howitzers, the trench mortars, some caterpillar tractors, and perhaps the 75's are expected in the next few weeks.

Another part of the policy in which you may be interested is this:

"The Commandant is authorized to advance student officers to any class their qualifications warrant their attaining, and to relieve from the School and order to their regiments officers who show conclusively that they are not competent to complete the course. In case of such officers, this fact will be communicated to the Adjutant General of the Army, in order that instructions may be given to the proper division commander to dispose of the officer, if competent to hold a commission in some other branch of the service, by assigning him to fill a corresponding existing vacancy; otherwise, to take steps provided in law for his elimination from the service."

Thus you see that a great work is under way, one in which you are to play your part and one in which we will assist you in every possible way.

The Killing Power of Projectiles

TRANSLATED FROM THE REVUE MILITAIRE SUISSE, JANUARY, 1917.

BY CAPTAIN G. DE L. LANDON, M.C., R.F.A.

[Reprinted from the *Journal of the Royal Artillery.*]

FOREWORD

IT would be idle, before the end of the present war, to pronounce a definite judgment on the effects either on personnel or material of modern projectiles. We must wait until the military experts have drawn from the lessons of practice the principles which will assure to the defence adequate protection against the weapons of the attack. Two famous sieges, those of Port Arthur and Adrianople, had recently provided opportunities for appreciating to a certain extent the effects of fire on defences and defenders. It will be agreed that the tests were not conclusive. To-day, to employ the words of General Lewal, "the belligerents have industrialized war"; they have turned to their service all the progress realized in armament, electrical communication, mechanical transport, and aviation. Nowadays mechanical transport assures the employment and ammunition supply of the heaviest artillery, which formerly was limited in its action to the neighborhood of railways. The accuracy and rapidity of fire of field batteries, the intensity attainable by rifle fire, and the more general use of machine guns, together seem to have had decisive influence on the stationary character of the operations. To forestall a success or to retain possession of conquered territory the opponents have not hesitated to entrench themselves along the whole battle front, employing all the various resources of modern semi-permanent fortification. For the out-and-out offensive, originally intended by the German General Staff and recognized dogmatically in the majority of Field Service Regulations, is substituted the offensive-defensive. The tactician must resign himself to the organization of a defensive position the immense extent of which should deny to the enemy every path of invasion or permit of the gradual recoil of his own battle front. He must be content with the fighting

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methods appropriate to sieges and the slow progress afforded by such operations as sapping and mining. The maneuver battle has to-day but a passing character.

The determining factor in this evolution of modern warfare is to be found in the improvements carried out in weapons and explosives. From them has resulted a notable increase in fire effect; thence the importance of a careful determination of the effects of projectiles both on personnel and matériel. The former, the aim of which is to place living targets *hors du combat*, are obtained by rifle and shrapnel bullets and to a less extent by the explosive effects of shells of small calibre; the latter are the results of the explosion of shells of medium and large calibre, the aim of which is the destruction of shelters and obstacles, though their action affects at the same time both the garrison and the heavy defense of forts and redoubts.

The man-killing, or rather man-stopping, effects of projectiles as attained by the bullets and the breaking up of the shells alone form the subject of this study. Having recalled to mind some principles of exterior ballistics indispensable to the proper understanding of the subject, we will consider the projectile first individually and then collectively; we shall then be in a position to formulate some conclusions as to the defensive siting of trenches and the protection of their defenders from shell and rifle fire.

EXTERIOR BALLISTICS

To justify the importance of some knowledge of this subject I will cite the authority of Captain Collon, of the Belgian Artillery. In his "Traité pratique des tirs collectifs" this writer sums up in the following terms its influence on fortification: "The general theory of fire effect and a thorough knowledge of the properties of trajectories, considered either individually or collectively, constitute an indispensable factor in the choice of positions, both for defensive and offensive purposes."

Colonels Piarron de Mondésir and Clergerie, of the French engineers, express in somewhat different form an identical opinion contained in two very complete treatises relating to the connection between fortification, tactics, and armament. It

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would be superfluous to insist further on this point. The limited nature of this study will only permit us to recall some essential principles relative to the fundamental properties of trajectories and to the striking action of projectiles.

Galileo, towards the end of the sixteenth century, established the equation of the jet in its simplest form. He showed that an object, thrown freely into space, described a parabola on a vertical axis. The physical properties of gases being unknown at this period, he neglected the retarding action of the air. It is known that the parabolic trajectory is attained only in the hypothetical case of a vacuum; we must take into account, besides the acceleration due to the weight, the resistance of the air, which, according to Newton, should be proportional to the sectional area of the projectile, the square of its velocity, and the density of the atmosphere. This principle, admitted for a considerable time, gives sufficiently accurate results only when the initial velocity is less than 240 metres (790 feet) per second or more than 420 metres (1390 feet) per second. Our compatriots, Euler and Jaen Bernonilli, of Basle, continuing the work of their predecessors, smoothed the way for the famous geometers, Borda, Gauss, Cauchy, and Piobert, who laid the foundations of a new science, following on that of dynamics. The development of rational mechanics allows us to establish with a slight approximation the equations of the trajectory in a vacuum and in the atmosphere.¹ The results of experience confirmed the speculative

¹ According to Morel, these equations can be put in a relatively simple form, which it is interesting to recall.

$$\text{Trajectory in the vacuum: } y = x \operatorname{tga} - \frac{gx^2}{2 V_0^2 \cos^2 a} \quad (1)$$

$$\text{Trajectory in the atmosphere: } y = x \operatorname{tga} - \frac{gx^2}{2 V_0^2 \cos^2 a} (1 + K V_0^2 x) \quad (2)$$

From equation (2) we deduce, by the ordinary methods of the differential calculus, that of the tangent to the curve at any given point, and from thence at the point of impact, making $x = R$ (the range). You get for the angle of descent ϕ .

$$\operatorname{tg} \phi = \operatorname{tga} \left(1 + \frac{K V_0^2 R}{1 + K V_0^2 R} \right) = \operatorname{tga} \left(1 + \frac{S}{1+S} \right) \quad (3)$$

We have adopted the following signs: x, y , the coördinates of the centre of gravity of the projectile; a , angle of departure; $g = 9.81$ metres per second, the acceleration due to the force of gravity; V_0 , initial velocity at the muzzle in metres per second; R , the range.

$K = \frac{V_0^2 \sin 2a - gR}{g V_0^2 R}$ ballistic parameter, function of the locality and the weapon. $S = K V_0^2 R$, auxiliary constant.

researches of the savants. For initial velocities not conforming to Newton's law—that is, those of the majority of long-range weapons—M. Siacci admits the cube proportion except between 282 metres (925 feet) per second and 343 metres (1125 feet), in which case the air resistance would increase in proportion to the sixth power of the tangential velocity. As can be understood, without recourse to calculation, the atmospheric action has a perceptible effect on the movement of the projectile; it no longer describes a parabola, as in a vacuum, but an unsymmetrical curve, of which the ascending branch has a greater amplitude than the descending branch. The principal results of this lack of symmetry are as follows:

1. The angle of departure is always greater than the angle of descent ($a < \phi$).

2. The tangential velocity and the radius of curvature for inclinations of the trajectory equal and opposite in sense are greater in the ascending than in the descending branch.

3. The abscissa of the highest point of the curve is greater than half the range; *i.e.*, distance from origin to point of impact.

The principles enunciated above give rise to several complementary remarks. We have ignored the angle of jump r , practically negligible and varying with the extent of the recoil, vibration, and heating of the weapon. Actually it is added algebraically to a , so that you have $r + a = + i$ where i = the angle of projection. Again, the trajectory is generally regarded as a plane curve by reason of its small point of departure; this hypothesis is only correct for the material point compelled to remain during its course in the same vertical plane as the line of projection, not for the projectile considered, which is a revolving body, cylindrical or truncated in form, the axis of which is animated with a conical movement, known as precession, and an oscillatory movement at smaller periods, known as nutation. This somewhat complex movement is favorable to penetration and diminishes the loss of kinetic energy. Nevertheless, the rifle bullet, on account of its relatively small weight, has a tendency to see-saw about its centre of gravity. An attempt has been

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made to minimize this tendency by the substitution of the bi-ogival shape for the cylindro-ogival. As to the shrapnel bullet, it has a maximum effective flight of little more than 150 metres and starts from the bursting-point of the shell, so that its velocity is combined with that of the shell. Thus it is partially freed from the influence of the rifling of the gun and of the resistance of the air. It had therefore been possible to retain for the shrapnel bullet the spherical form originally common to all projectiles until the appearance of the Dreyse needle gun (1841) and of the rifled cannon (1859). To appreciate the dynamical action of the bullets and splinters, the penetration of which depends upon the range and the material of the target, we must evidently refer to the equation of kinetic energy— $K.E. = \frac{1}{2}mv^2$ where m = the mass of the projectile—*i.e.*, the proportion between its weight and the acceleration due to gravity— v its velocity at the point of impact.

The man-killing power of projectiles depends, then, upon the initial velocity, the weight, and the shape of the bullets or splinters. Certain numerical data relative to these elements are evidently indispensable for a reasonable estimate of the "striking" effects of which we will make a brief study.

THE "STOPPING" POWER OF BULLETS AND SHELL SPLINTERS

The irregular manner in which the body of a shell breaks up makes difficult the calculation of the remaining striking force or kinetic energy of its splinters. We will therefore consider more particularly the action of shrapnel and rifle bullets. The kinetic energy equation shows that for a given increase of velocity, which is the preponderating influence, you may have a considerable decrease of weight without loss of energy, and with the gain that, at long ranges, the projectile is less exposed to air resistance. This double improvement—that is, the increase of initial velocity and decrease of calibre—has been realized by the replacement of mechanical explosives by chemical ones. In fact, the invention of colloidal powders, with a base of pure

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nitrocellulose or the latter mixed with nitroglycerin, due to the French engineer Vieille, has allowed of obtaining initial velocities such that the effective fire distances have been nearly doubled (800 to 1000 metres for infantry and from 4 to 5 kilometres for field artillery). There resulted a change of armament, which took place between 1886 and 1892 in the case of the small-arms, while for economical and manufacturing reasons the creation of a new artillery material was deferred till about 1897.

To Vieille belongs the honor of being the first to discover a really stable ballistic explosive, produced by the gelatinization of gun-cotton, discovered in 1846 by the Basle chemist Schoenbein, dissolving cotton cellulose in sulphuric and nitric acids. When mixed with nitroglycerin this powerful ballistic is sometimes used for filling shells; for rifle cartridges it is generally used in its pure state, but with an increased degree of nitrification. It is powerful enough to impart to the rifle bullet an initial velocity of from 600 to 650 metres per second, which, owing to recent improvements, has even increased to over 850 metres per second. The power of this explosive naturally brought about a reduction of calibre (6.5 to 8 mm.) and thus a decrease of weight in the projectile, at first to 14 or 15 grammes and later to 10 or 12 grammes, when the cylindro-ogival shape was replaced by the bi-ogival in 1898. The fore part of the bullet became very tapering—almost pointed—while the hind part adopted a slightly conical form. To lessen the deformation due to the heat produced on striking, the hardened lead, containing from 2 to 10 per cent. of antimony, employed for a long time in the manufacture of the bullet, was wrapped in an envelope of some hard metal, copper, nickel-steel, or German silver (alloy of 50 per cent. copper, 25 per cent. nickel, and 25 per cent. zinc). This hard casing increases its penetration in solid material, but diminishes the spreading effect of the projectile; that is, its surface of attack. With the bi-ogival shape the striking force at the muzzle was increased from 300 kilogrammes to 350 kilogrammes. At the usual fighting distances, the remaining striking force is still sufficient to inflict grave

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hurt; *e.g.*, at a range of 800 metres it is between 65 and 70 kilogrammes (430 to 465 foot-pounds), and at 2000 metres it is not less than 20 kilogrammes (133 foot-pounds), the remaining velocity being 250 metres per second.

Some concrete examples will better serve to illustrate the progress realized in the infantry arm since the adoption of the colloidal powder. In Table I are collected the chief ballistic data relating to our former cartridge and those of two foreign armies. They are interesting for reference as showing the pronounced difference in the trajectories at the two ranges selected.

TABLE I

Ballistic data (rifle)	Switzerland Model 89/96 Schmidt-Rubin cal. 7.5 mm.	France Model 86/93 Lebel cal. 8.0 mm.	Germany Model 88 Mauser cal. 8.0 mm.	France Balle M 98 D Lebel cal. 8.0 mm.	Germany Balle S 1903 Mauser cal. 7.9 mm.
Initial velocity at the muzzle metres per second	600	632	645	726	875
Weight of bullet in grammes	13.8	15	14.7	12.8	10.0
Charge in grammes	1.9	2.75	2.75	3.0	3.2
Angle of descent { 800 m.	2° 05' 04"	1° 51' 06"	1° 47' 03"	1° 00' 50"	1° 05' 00"
in degrees { 2000 m.	14° 42' 10"	13° 48' 32"	12° 51' 45"	. . . . .	. . . . .

N. B.—The maximum range of the new Swiss rifle is between 3400 and 4000 metres for the bi-ogival bullet, which has an angle of descent of about 20 degrees with negligible remaining K. E. The ballistic data of the armored Swiss bullet of 1911, which we have not considered it advisable to reproduce, permit us to expect from our rifle (model 96/11) results equal or superior to those of the best modern weapons.

The comparison of the man-stopping effect of the shrapnel bullet and the rifle bullet is generally unfavorable to the former; but before formulating conclusions it is expedient to recall the elements which go to influence its striking action. As we know, it consists of a small sphere of hardened lead of weight varying from 9 to 13 grammes, and diameter from 11.77 mm. to 13.2 mm., the corresponding cross-sections being then from 1.075 square centimetre to 1.368 square centimetre. Thanks to the use of nitrocellulose, preferable as a ballistic to nitroglycerin on account of its greater stability and feebler erosive action, modern shrapnel has an initial velocity of 500 to 580 metres per second and has at the bursting-point *E* a remaining velocity V_1 , which

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decreases from 420 metres per second to 250 metres per second as the range increases from one kilometre to four kilometres. Taking into account V_1 and the velocity imparted by the explosion of the charge within the shell, we get a resultant velocity V_2 for determining the striking force at the point of impact; V^2 may be taken as from 350 to 520 metres per second for average ranges of field artillery. The bullets at the farthest limit of the cone of dispersion have still a velocity 180 metres per second, corresponding to a distance from the bursting-point of 150 to 200 metres and a striking force of 15 kilogrammes per

TABLE II

Ballistic data (field gun)	German 77 mm. Model 96n, A Krupp	Swiss, 75 mm. 1905, Krupp	French 75 mm. 1887, dePort Ste. Claire-Deville		
Initial velocity at 25 metres from the muzzle in metres per second	465	485	529		
Shrapnel {	Total weight.....	6.850 kg.	6.350	7.240 kg.	
	Weight of charge (internal)	.570 kg.700 kg.	
	Spherical {	Number	300	210	298
		Weight	10 gr.	12.5 gr.	12 gr.
Bullets..	Diameter	12.2 mm.	13.1 mm.	12.9 mm.	
Angle of descent, ϕ , at 4000 metres.....	13° 31'	13° 10'	11° 39'		
Average opening of cone of dispersion K, at 4000 metres	9° 30' (approx)	8° 22'	8° 37'		
Steepest inclination of cone at 4000 metres ($W = \phi + K$)	23° 01'	21° 32'	20° 16'		

N. B.—The maximum range of modern field artillery is between 5500 and 6500 metres; however, the progress realized since the war started has allowed of exceeding the limit indicated.

square centimetre, sufficient to place a man *hors du combat* (for a horse, 30 kilogrammes per square centimetre). Note that the spherical form of the bullet is justified not only by economic reason, but also by the uncertainty of the direction it will take at the bursting-point and the short distance it travels.

All the pieces of medium calibre—siege guns, such as the 155 (long), the majority of light howitzers, such as the 155 (short) and 120 (short)—fire shrapnel shells much more powerful than those of the field guns, and containing 250 to 500 bullets, weighing 20 to 65 grammes, in place of 300 bullets of 9 to 13 grammes' weight.

KILLING POWER OF PROJECTILES

In Table II are given the principal ballistic data of three modern types of shrapnel shell, also the steepest inclination of the cone of dispersion at 4000 metres. The maximum angle of descent of the artillery projectile serves us as a basis for our study of the defensive measure to be taken.

We have up to the present considered only the mortal effects of bullets, without taking into account the question of wounds more or less grave. It is obvious that the gravity of the wounds is also an element in the effect on personnel, which does not depend altogether on the striking force. According to Colonel Bircher, the human body has three vulnerable zones, subject to mortal, severe,

TABLE III

Striking force in kilogrammetres per square centimetres of foot-pounds per square inch	Wounds	
	Man	Horse
Below 2 kilogrammes or 10.8 foot-pounds	Contusions	.....
2-4 kilogrammes or 10.8-21.6 foot-pounds	Wounds more or less deep in soft parts	Contusions
4-8 kilogrammes or 21.6-43.2 foot-pounds	Bones bruised	Wounds more or less deep in soft parts
15 kilogrammes or 81.2 foot-pounds	Bones broken and pierced	Bones cracked
30 kilogrammes or 162 foot-pounds	.....	Bones broken and pierced

and slight wounds, respectively; the areas of these zones are in proportions of 25, 15, and 60 for rifle bullets and 30, 25, and 45 for shrapnel (25 grammes). It would appear that these results must be modified to the detriment of the gun and to the advantage of the rifle since the adoption for the latter of a bullet with hard metallic envelope and a flatter trajectory. From both the tactical and ballistic point of view, it is sufficient to determine the minimum remaining striking force necessary to place living targets, men or horses, *hors du combat*. Captain Campana, of the French Artillery, deduces, from the experiments of General Journée, a general classification of the wounds produced by the shrapnel bullet; the chief points are reproduced in Table III.

We now have the elements necessary for a comparison of

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the effects of rifle and shrapnel bullets. The pointed shape and hard envelope of the former facilitate their penetration in hard matter, such as bone, the parapets of trenches, gun shields, and snipers' shields; the latter produce more serious wounds on account of their larger striking surface and the spreading out of the lead ball in mushroom shape, but they have the disadvantage of striking the target with much feebler force.

The explosions of high-explosive shells occasion wounds, if not more grave, at any rate more painful than the two projectiles already studied. The high-explosive shells of small calibre belong to two distinct types: the first, having a thin casing and a heavy charge (825 grammes of mélinite), produces a very dense fragmentation, consisting of about 2000 small splinters, with an initial velocity of 1200 metres per second (3937 feet per second) (the French "75"); the second (the German "77"), with a thick casing and small charge (135 grammes of picric acid), breaks up into about 500 fragments of varying weights (10 to 200 grammes), with a relatively small initial velocity (300 to 400 metres per second). To sum up, we may say that shell splinters are capable of producing very serious lacerated wounds on account of their irregularity in shape, their large surface of attack, or of the kinetic energy developed from the explosion of disruptive explosives, such as melinite, lyddite, émmensite, écrasite, and chimose. These different varieties of explosive are all derived from picric acid [$C_6H_2OH(NO_2)_3$], produced by the nitric acid of phenol, which, with the addition of di-nitrocellulose, dissolved in a mixture of ether and alcohol, was employed by the French chemist Turpin as early as 1885 for the charging of torpedoes. To-day trotyl (peroxide of nitrogen) is sometimes substituted for the derivatives of phenol. The French "75" shell has not only striking but also considerable shock effect, or violent expansion of the gases given off by the combustion of the powder when the explosion occurs in a confined space; it is therefore capable of demolishing a house or shelter, and producing in a man within four metres of the explosion internal hemorrhages which are always fatal.

KILLING POWER OF PROJECTILES

Besides the two characteristic types of shell, the fragmentation of which we have briefly described, field artillery employ others whose action is similar. For example, the German high-explosive shrapnel (285 bullets, 100 splinters of 5 grammes, and 140 grammes of explosive) is very efficacious against shielded guns; the French Robin shell, a species of shrapnel with a heavy mixed charge and 300 bullets, has great incendiary properties and is superior to all similar projectiles in use before the war, from the point of view of results obtained and ballistic coefficients.

TABLE IV

Weights and Charges of the Principal Shells of Medium (Heavy Artillery) on the Western Front

Species and calibre of piece	French					German			British
	Cannon, long 155 T. R.	Cannon, court 155	Cannon, court 120	Cannon, long 105 T. R.	Cannon, long 90	Heavy howitzer, 150 Krupp	Cannon, T. R. 130 Krupp	Light howitzer, 105 Krupp	4.5 howitzer
Total weight of shell (kilogrammes)	43	43	20.3	16.5	12	39	14	14	17.5
Weight of charge (kilogrammes)	12	12	6	...	2.1	7.3	1.6	1.6	2.7

R. DE DIEGBACH,

Capitaine du Genie.

Although the destruction of the enemy is generally attained by rifle fire, time shrapnel, and small high-explosive shells, we should not pass over in silence the sometimes considerable effects on personnel of shells of medium calibre. Their employment, formerly limited to breaching and demolishing fire, has become generalized since the war of position has assumed an extent hitherto unknown. Again, special circumstances have led to the intervention of heavy pieces in the artillery struggle in open fighting; thus the Germans, realizing the inadequacy of their "77" material, have given their counter-batteries the excellent 105 howitzer. The pieces of medium calibre (90 to 155 mm.) fire shells weighing from 12 to 43 kilogrammes, charged with

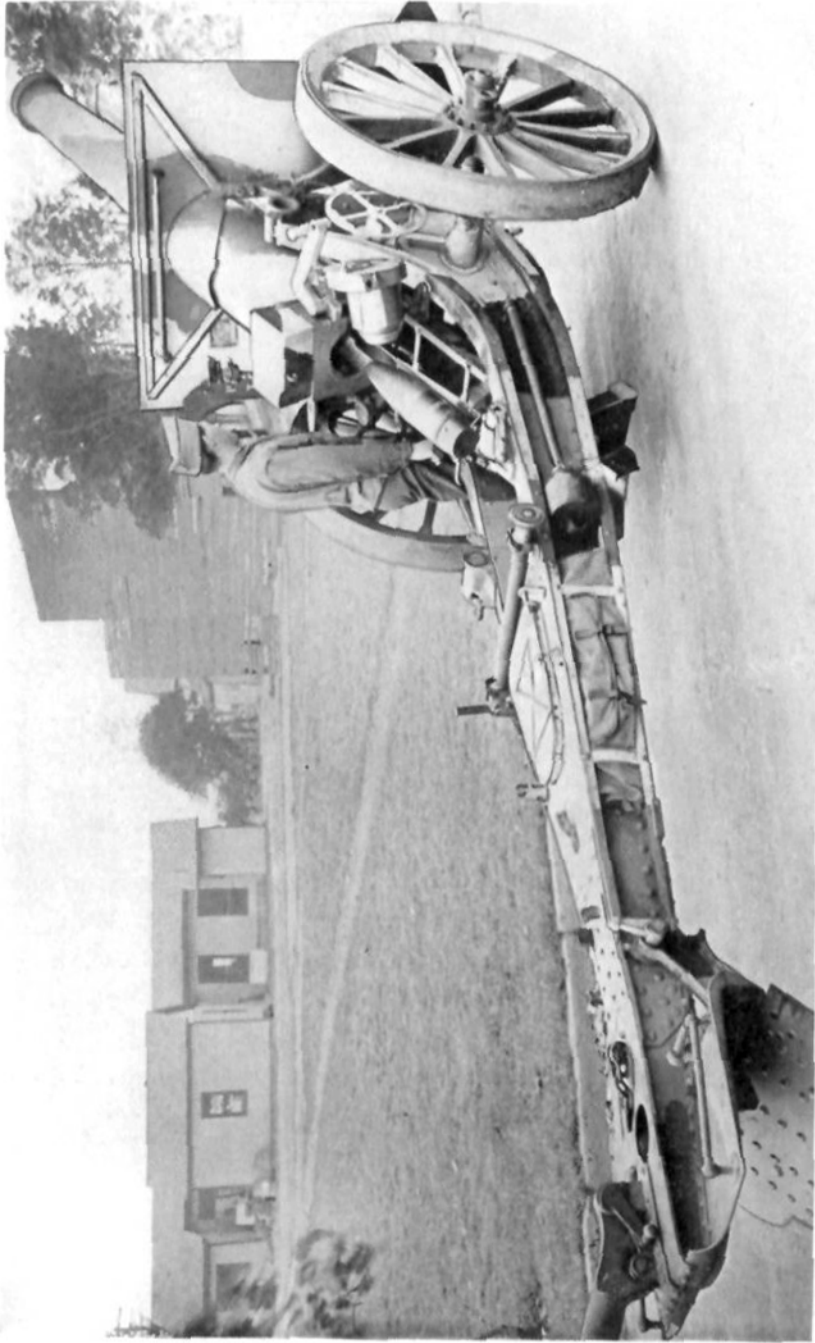
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explosives weighing in some cases over 10 kilogrammes. In Table IV are given some data relative to the total weight and weight of the charge of some medium-calibre shells actually in use on the Western Front.

This short study of the striking effects of bullets and splinters will allow us better to appreciate the results to be expected on personnel from shells burst in air and rifle fire; they have had a decisive influence on the present methods of fighting and on the defensive organization of the battlefield, according to the modern conception of war. Having considered the individual projectile, we will study the various groupings of weapons which go to make up the whole; its efficacy is subject to the distribution of the arm, the control of fire, and the slope of the ground.



155-MILLIMETER HOWITZER (SCHNEIDER)



155-MILLIMETER HOWITZER (SCHNEIDER)

Methods of Correcting Error

INTRODUCED BY USE OF NEAR AUXILIARY AIMING POST

BY 2ND LIEUT. J. N. KENNEDY, M.C., R.G.A.

[Reprinted from the *Journal of the Royal Artillery*.]

THE following method is suggested as a means of compensating for the error introduced when laying on auxiliary aiming points or pickets which are close to the battery position.

This condition is a common one, since near aiming points must of necessity be adopted.

- (a) In foggy weather.
- (b) At night.
- (c) When the view of the layer is limited by the configuration of the ground.

The error under consideration may be a very large one. For instance, with an aiming point 60 yards distant in rear, a side jump of the gun across the platform of one yard would cause an error of 1 degree, which at a range of 6000 yards, would represent 100 yards, and at 9000 yards, 150 yards. At present no means are taken to eliminate this inaccuracy.

Proposed Method of Correction

A second picket is planted in line with the picket which is to be used as an A.A.P., and exactly half way between it and the gun.

If the gun jumps on firing, the two pickets will cease to be in line. The gun is now relayed on the A.A.P., then the oscillating scale is moved until the sight is laid on the nearer picket.

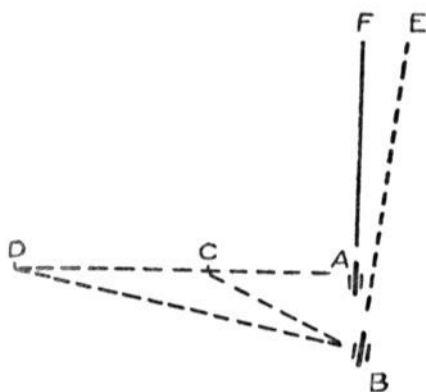
The error will now have been taken up on the oscillating scale, and when the gun is relayed on the A.A.P. the line of fire will automatically have been corrected.

If it is desired to correct again, the oscillating scale is brought back to zero, or to the reading originally ordered for parallelism, concentration, etc. (this will, of course, vary according to the

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methods employed by the particular battery), and the procedure detailed above repeated.

FIG. 1



TO ILLUSTRATE MOVEMENT FROM FRONT
TO REAR

D. Picket used as A.A.P. *C.* Picket planted half-way between A.A.P. and gun. *A.* Gun, first position. *B.* Gun, second position after jump. *A. F.* is line of fire.

FIG. 2



TO ILLUSTRATE SIDE JUMP

In Fig. 2, *BF* is a line parallel to *AF* through second position of gun *DC = CA = CB* (approx.).

If, after jump gun were to lay on *D* with same angle as when at *A*, the line of fire would be, in this case, *BE*, which is too far to the right, the amount of error being $\angle FBE$ ($\angle FBE$ in Fig. 2), which is equal to $\angle ADB$, for,

$$\begin{aligned} \angle ABD + \angle FBE &= \angle DBE = \angle DAF = \angle ABD + \angle RBD \\ \therefore \triangle ABD &= \triangle FBE \\ \text{and since } CD &= CB \\ \triangle ADB &= \triangle CBD \end{aligned}$$

Moving the oscillating sight from *D* to *C* (i.e., from left to right) would automatically give a *left* correction equal to $\triangle CBD$,

METHODS OF CORRECTING ERROR

which is what we require. Leaving the oscillating scale at this correction, the gun is once more layed on *D*.

NOTE.—The pickets would, of course, be aligned in the first place when the line of fire is originally laid out, or when the gun is firing accurately on a known point.

At night, when lamps are used, it would be preferable to use lamps of different colors. For night firing the correction ought to be adjusted at frequent intervals, as the gun is always changing its position on the platform.

Of course, when A.A.P. is to a flank, side jump is negligible, and when A.A.P. is to the rear, movement along line of fire is negligible, as the point of impact would theoretically be altered only by the actual amount of the jump in yards.

It may be urged that this method is not strictly accurate, for ΔDCB will not always be an isosceles triangle. The error introduced on this account, however, is infinitesimal. It is a matter of no great difficulty to devise a method which would be absolutely free from error, but the all-important advantage of simplicity and practical utility in the field would be sacrificed.

Report on Remount Depot at Lachine, Near Montreal, Canada

BY MAJOR J. S. HAMMOND, FIELD ARTILLERY

1. The following report on the Remount Depot at Lachine, situated about 13 miles from Montreal, is compiled from notes taken by Major Morris Hadley, F.A., O.R.C., Captain M. G. Randol, F.A., U.S.A., and the writer:

2. Although this is the largest remount station at the present time in America, and a very efficient system has been inaugurated through nearly three years' practical experience, there have as yet been no officers from the Quartermaster Department or Veterinary Corps, U. S. A., who have inspected the depot.

3. The depot was established in the early part of 1915 and comprises over 300 acres. Doctor Warnock (Colonel), Veterinary Corps, Canadian Army, is in charge. Mr. Campbell is the contractor and supplies forage, labor, and materials.

4. At the present time there are 4200 animals at the station. In 1915 there were a total of more than 38,000 animals shipped from this one depot to Europe. All animals were shipped during seven months of the year, no animals being at the depot during the winter months. This year arrangements are being made to keep animals at the station during the winter. At the beginning of the war animals were shipped directly from the stock yards, where they were first purchased, to the ships. Insurance companies, which then insured animals on a basis of 9 per cent. losses, lost a great deal of money. The losses are now far less than occurred during the shipment of animals under the most advantageous conditions before the war.

5. *Purchase of Animals.*—Most of the horses at present are coming from the United States, largely from St. Louis. The depot counts on having a good buyer inspect about 150 horses in a day, purchasing probably 70 or 80. Light artillery horses, running from 1050 to 1200 pounds, are bought at \$190 a head. Horses running over that weight to 1400 pounds are classified

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as heavy artillery and bought for \$210. The ages run from five to nine, although they are purchased, if in good shape, up to twelve years of age. Mares of good type over eight years of age and grays are purchased.

Horses purchased in the United States are branded with "U" on the right hip; horses purchased in Canada are branded "C" on the right hip; and an arrow pointing upward, branded on the left hip with the initials of the purchasing officer, indicates horses are for British service.

Most heavy artillery horses showed Shire, Clydesdale, or Percheron cross. Heavy artillery horses are branded with a small "H" on left cheek.

Although there has been a certain amount of inefficiency in buying, particularly at first, there has been an almost complete absence of anything like crooked dealing. Before shipment all shoes are removed.

6. *Transportation.*—The rail journey from St. Louis to Lachine occupies about 70 running hours. It is broken at Calumet and Toronto, the stops being from 12 to 24 hours. Not only are there no attendants for the stock cars, but there is not even a representative on the train. This has given satisfactory service, but the depot believed it would be an improvement to have one representative on the train who could look after the interests of the shippers and the Government. Additional attendants were regarded as unnecessary. During transportation all unloading, feeding, and reloading are done by the force at the depots *en route*. The railroads are often called upon to furnish transportation at exceedingly short notice, and have given very good service.

7. *Loading, etc.*—The loading platforms have a capacity of about 40 cars and open into as many separate corrals, from which the horses, by a system of alleyways, are distributed to any part of the depot.

Outgoing shipments are handled as follows: On the afternoon preceding shipment the selected horses are driven through a squeeze, unfit horses being rejected after a careful inspection. The horses are then taken to the corrals adjoining the loading

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platform, one carload to each corral. There is another inspection in the morning immediately before loading. If the weather has been bad over night, 5 per cent. of those passed the afternoon before will have to be rejected. Losses during transportation are by this means reduced to a minimum. Fourteen of the cargoes carried during this past year have gone through without the loss of one single horse. The average loss during the last two years has been less than one-fourth of one per cent. This does not include losses from submarines. Of the shipments, one vessel has been lost from this cause, carrying about 400 horses. Two transports have been sunk while returning empty.

Horses are shipped to Europe without shoes on the hind feet in any event, though they are shod on the fore feet if such seems necessary. They are loaded 17 to a 30-foot car or 18 to a 34-foot car. Out of all the shipments from this depot, mainly to New York, Boston, and Halifax, there have not been over a dozen broken legs.

The normal time for loading a car is $2\frac{1}{4}$ minutes. Two crews work at loading, and the crew making the best time during the day is given a bonus of \$5. Twenty-five cars can be loaded or unloaded at one time. No training is done at the Remount Depot at all. Well horses usually remain at the depot for about three weeks.

8. *Feeding.*—Well animals are fed 18 pounds of best timothy hay from the Ottawa Valley, 7 pounds of oats, and 4 pounds of bran. As the sick horses do not eat full rations, the well horses are given the surplus and are practically given all they will eat. Best quality of oats from Manitoba only are used. The veterinary in charge of the depot, Colonel Warnock, stated that he had returned as many as 6 carloads of inferior forage. Hay is fed in racks. Oats are mixed with the bran and fed in wooden troughs about 8 feet long and 4 feet wide, standing about 4 feet from the ground. The sides of the troughs are boarded about 8 inches high. These troughs are firmly set up in the center of the corrals in such a way that they cannot be knocked down by the horses, but may be taken down and relocated in a dry portion of the corral if desired. Sick

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animals are fed rock salt mixed with their grain. Salt is placed in convenient places in the corral for the well animals to get as they desire.

There are two men detailed for every 100 horses. The animals are watered in the corrals, water being hauled in water carts to the troughs.

The contractor in charge of the camp is paid 55 cents per horse per day. Out of this he feeds and also provides two men per 100 horses with necessary foremen. Beginning with the 10th of September, the feeding of hay is to be increased to 20 pounds for all horses in sound condition. The oats and bran are mixed in a special machine before feeding. The hay at present is costing \$12 a ton. It seemed of exceptionally good quality. It is not purchased through the Government, but is bought directly by the contractor. He states that lots offered to him, which he has rejected, have later been bought by the Canadian Government, baled and shipped overseas.

There are only two feeds a day, the greater part of the hay being fed at night.

Each corral had a wooden trough provided with a ball and cock for handling the water automatically. Troughs stood about 1½ feet clear of the ground, to make it possible to clean underneath them. In sections for well horses they were of wood, and were scrubbed out once a day; in A, the hospital section, they were galvanized iron and were cleaned three times a day.

No grooming is carried on at all, except for sick horses.

9. *Depot Arrangements and Facilities.*—The depot is centred about the loading platform, which is on a spur track of the Canadian Pacific and located on the highest ground in camp. The ground falls away gradually from this point, and the subsoil is a limestone which drains readily, except in a few pockets. Attempts to drain these pockets have been unsuccessful, as the tile drains become clogged after a few months' use.

The capacity of the camp is 9000 horses. Ten thousand could be handled at a pinch, but as a matter of fact they have never had over 8000 present at one time. This is in accordance with

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the theory of the contractor in charge that any such depot should run about 70 per cent. only of its full capacity. This permits corrals being left vacant for cleaning and repair.

The unit subdivision of the camp is a corral of about 1½ acres. One such shown as a model of the typical corral was 380 feet long by 180 feet deep. It held 70 horses. One hundred or more were at times accommodated, but whenever possible the smaller number was preferred in order to minimize the spread of disease.

The camp is divided into three sections—A, B, and C. The horses are shipped to section B. Horses are held in this section after arrival to watch for development of contagious diseases. They are inspected daily, and any sick horses are taken to section A, where they are placed in corrals according to their disease. Actual hospital accommodations are limited to tying room for 250 horses, but these are being increased. The hospitals are open sheds, and there is no floor of any kind throughout the camp. Horses are further subdivided into outlaw and convalescent paddocks.

In order to keep the depot in operation during the winter, closed and well-ventilated sheds without flooring are being constructed at the hospital to accommodate 350 horses. The rest of the horses will be left in the open in section C.

Section C is the largest subdivision of the camp and occupies ground broken by trees and high brush, which it is believed will give the horses sufficient protection against the winds. The corrals in this section are somewhat larger, and the horses are those convalescing from the hospital or being held to await available transports before shipment.

In sections A and B corrals are in nearly every case separated by 16-foot runways. All construction in the camp is standardized, the unit for corral fences being 8 feet, the distance from centre to centre of posts. Thus runways are usually twice this interval, though some of the narrower ones are only 8 feet. The advantage of the runways is not only in making access easy, but in facilitating isolation. In cases of emergencies any corral may be used as an isolation corral, and there

REMOUNT DEPOT AT LACHINE

is no chance of spreading of disease. No cases have occurred of transmission of disease to corrals across an intervening runway.

Fences in sections A and B are normally of vertical planking between the uprights and are kept freshly painted white. In section C, where the horses are more used to the depot, fences are of wire, the bottom of the mesh being at a height of 1½ feet from the ground, to reduce the chance of the horses stepping through the wire. The wire construction is the cheaper, and is used to some extent in section B.

The corrals were sprayed at intervals with a solution of Necco, a Parke-Davis preparation much like Creoline. This was to prevent ground contagion, though it also had some effect in keeping down the flies. No other attempt was made to deal with flies.

Mallein test was just being completed for all the horses in the depot.

10. *Diseases.* — The common diseases are laryngitis, strangles, resulting from shipping fever, which often runs into pneumonia. These animals are at once segregated and kept out of doors as much as possible and given stimulants, principally of ammonia compounds. Medicine is never given in the form of a drench except for colic. There have been some cases of purpura-hemorrhagica (treatment for which is dichromate of potash and iron), practically no tetanus or glanders. They have had very few cases of diseases of the foot during the last year, although in the first period of the war there were a good many cases of hoof rot. The hospital holds about 250 cases. Colonel Warnock stated that the sickest horses came from the stock yards in East St. Louis, but he said that the Kentucky horses were more susceptible to disease and were least adaptable to hardships, as they had been pampered since birth.

He said the British were asking for American horses, due to the fact that they had been seasoned before shipment. He said the horses from England and Ireland arrived in France subject to shipping fever, and gave a great deal of trouble and large numbers of them died; whereas horses shipped from the depot were through with diseases of all kinds, thoroughly inoculated,

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and were in gun teams three days after they had been taken off the ships.

11. *Miscellaneous*.—The veterinary in charge receives \$10 a day. There are usually about 100 cases of hoof-prick in the hospital.

The employees are civilians, though soldiers go on guard at night. The best men at the depot are the Russians, who came over in the Canadian immigration. Most of the foremen are Western cattlemen of long experience.

12. *Conclusion*.—Colonel Warnock stated that the outstanding feature of his three years' experience was the necessity to "salt," as he called it, the horses before sending them abroad. He stated that animals were bound to be sick, and that they can be better cared for at the depot than nearer the firing line. He emphasized the importance of shipping horses in thoroughly healthy condition to insure safe arrival in France, and that this can be accomplished only by a very systematic system of inspection and rejection of animals until they are in good condition.

Importance was also laid upon the fact that his personnel had been trained by months of experience to a high state of efficiency, and the entire appearance of the depot emphasized efficient service and supervision.

Attention was called to the fact that the animals in shipping, particularly in the first shipment, from the stock yards to the depot lose greatly in weight, and for that reason they are fed practically all they will eat and are thus in fit shape for the trip to Europe.

Particular attention was also called to the fact that the animals which developed pneumonia in the serious stages, although it was realized that they might live, were destroyed. Colonel Warnock stated that in about 90 per cent. of the cases these horses would never be of any military use whatever, and under the emergency it had been found much more desirable to destroy them. As many as 500 animals had been destroyed in one year for this reason.

September 5, 1917.

Comparison Between the German "77" and the French "75"

EXTRACTS FROM "LE '75' NOTRE MERVEILLEUX CANNON"

PAR MAURICE DUVAL

THE GERMAN "77" AND OUR "75."

The "75" has not a colossal appearance; it has not a massive air, cut out of the rock; its appearance made the Germans smile. Its elegant form, its graceful appearance could evidently not attract German stupidity, and very quickly they qualified this French toy as a "cigar holder," but in particular they made fun of the gun shield. They lie down to-day in their subterranean trenches and wage against us war like moles and rabbits, but then they had a more chivalrous disdain of the danger. Their writers did not have enough disgust for our gun shield, vile means of protection. "Its use," they write, "would be a shame to German artillery."

But the "75" was not long making its proofs, and the reports of German officers who followed our maneuvers did not delay in edifying the Kaiser and his staff on the overwhelming superiority of the French cannon.

Germany, which had believed to surprise us by creating secretly its "77," and to this end had spent enormous sums in 1896 to endow its artillery, did not like the joke.

General Rohne, one of the first, raised a cry of alarm, and the admirers of the "77" had to change their tune. The maximum speed of firing this piece was, in fact, only six to eight shots per minute: we have seen this figure raised, but the result was attained only at the expense of precision. Besides, it was continually off the target, the consequence of the absence of any mechanism capable of taking off effectively the shock caused by the departure of the projectile. Finally, the velocity of the

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"77" did not equal ours, and the fire itself was far from having the variety, interest, precision, and suppleness of ours.

But what was to be done? Modify from top to bottom a matériel which had just been finished? The Government with difficulty resolved itself to this end.

However, with the collaboration of Ehrardt and Krupp, a cannon was devised approximately similar to the French cannon. This was the "77," Model 1896 N. A. (Neuer Art, new type). And this model was like ours, with a gun shield! German artillery was no longer ashamed. The gun shield of the "77" was even thicker and larger than that of the "75"!

But sending back all the matériel which had just been made to be recast was not to be thought of. Certain parts were used: the tube, munitions, carriage wheels, and the cannon. On the other hand, the mechanism of the breech and the carriage were entirely made over.

The new German cannon is different from the French piece:

First.—In its dimensions. The tube measures 2.1 metres; that is to say, 27.3-calibre. The bore is composed of a smooth part, followed by a rifled part, 32 progressive riflings with rectangular profile, turning from left to right.

Second.—By its ornamentation and general appearance. Our "75" bears no markings, and the appearance of the cannon as a whole lacks neither suppleness nor grace. The "77" is evidently of thicker appearance, has markings permitting us to distinguish to what kingdom, Prussian, Saxony, Bavaria, or Württemberg, belongs each piece. On the tube there is engraved in aqua fortis the arms of these different states, surmounted by the motto: "Pro Gloria et Patria." Above the breech there is an imperial crown with the monogram of William II and the proud inscription, "Ultima Ratio Regis."

Third.—By the system of breech closing, a kind of prismatic block, actioned by a crank. Moreover, the firing apparatus and the extractor of the cartridge case may be compared in simplicity and facility of handling to those of our matériel for the "75."

GERMAN "77" AND FRENCH "75"

Fourth.—By the recoil system, hydraulic and with spring, while the recoil system of the "75" is hydro-pneumatic. The German recoil brake is placed under the cannon, in an envelope almost as long as the tube and called small carriage or upper carriage. This small carriage includes, also, the cradle in the rear and the pointing apparatus. This recoil brake, much less precise than ours, consists of a cylinder fastened to the tube of the cannon. This cylinder contains glycerine: its interior walls slide against a piston whose stem, immovable, is fastened to the front part of the cradle. The recuperator, instead of being, as with the French recoil, a cylinder of compressed air, consists of a metallic spring whose spirals surround a metallic cylinder, and it is, throughout the path of the cylinder, the compression of the springs as much as pressure of the liquid which contributes to bring back to its first position the cannon tube, which moves on the two gliding paths which the cradle carries.

Fifth.—By the mechanism which fastens the cannon to the carriage. The tube of the French, resting on the recoil brake, is mounted on the fixed cradle, which constitutes a sort of table whose position is invariable for a given range. The Germans have mounted their cannon with its upper carriage on a vertical axis, permitting variable orientation to the piece, the lower or large carriage remaining fixed. In the "75," on the contrary, thanks to an ingenious control, the carriage is displaced by gliding on the axis, so that the recoil action is always on the axis of the base, which, for this reason, does not get off the target, while in the "77" the cannon, taking an oblique position with respect to the carriage, has a tendency at each recoil to get somewhat off the target.

Sixth.—By the wheel brake, which in the German piece is a cable brake acting on the axles and on the spokes of each wheel, so that these have no need of being placed on shoes, which does away with the operation of "lowering" when put in battery.

Seventh.—By the trail, which bears, besides the control spade, formed of a ploughshare, which buries itself in the earth

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at the first shot, a range level held in position by a hoop or strap.

Eighth.—In addition, a caisson of munitions, instead of containing, like ours for the "75," pigeonholes from which the artillery servers take the shells, has baskets which must first be taken out of the caisson before the shells can be removed. This complicates matters and causes loss of time. In the battery position the German caisson is to the right of the cannon, and ours to the left.

Ninth.—The matériel of the "77" has no mechanical fuze setter. The fuzes are set by hand and often very badly, for in the course of the present campaign a number of misfires have been recorded.

Tenth.—As for the range apparatus, it is adapted to the German method, quite different from ours, which has a character eminently practical, thanks to the introduction of the "mil," due to Colonel Estienne (the "mil" is the angle on which one metre at a distance of a thousand metres is seen). Everything in artillery is brought back to angle measurement. Now, instead of calculating them in degrees and minutes, we have adopted as the unit the "mil," which facilitates excellent control, and renders the battery extremely easy to work and the fire of incomparable precision.

With the French it suffices, as we have seen, for the captain overseeing the field of battle to cry out numbers in order to cover with shells any objective to be destroyed. The matériel lends itself to this marvellously. "Let the battery be masked behind thick coverts, buried on the other side of hill crests, no matter since the horizon of the artillery servers, as the 'Auto' has well said, is limited by the distance which separates their eyes from a graduation scale. They do not see, they do not even know on what they fire. Only the chief has need of seeing." If he commands 3000, for example, instead of a fire of 2000 metres, the range cranks will work and the shells will burst not nearly at, but exactly at, 3000 metres. In the German method this somewhat mechanical fashion of regulating the fire is unknown, and the artillery service can hardly do without range finding.

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The German piece is not without advantage. It weighs, once in the battery, 150 kilogrammes less than ours. But it is not for this reason more easily transported, for its weight on the limber, including the five servers, who are there, is sensibly equal to the weight of our "75," where each limber has only three servers.

The "77" has another advantage: It does not exact, we have seen, "lowering," that is to say, recoil movement necessary to the wheels in order to put them on the shoes of the wheel brake. It is true that with the French piece we may, if necessary, fire without "lowering."

Finally, if the Germans still criticise our "75" gun shield, it is because they do not find it a sufficient protection. Theirs is thicker and the surface area is somewhat larger: 1.44 m² as compared with 1 m² in the French piece (1.3 m. in our new piece), but these advantages are small compared with the numerous causes of inferiority of the German cannon:

First.—The German recoil spring cannot be compared with our hydro-pneumatic recoil springs. It does not assure the absolute stability of the piece. Now, there is an abyss between a cannon which gets off the target a little and a cannon which does not get off target at all.

Second.—The arrangement of the German piece on its small carriage, independent of the large carriage, is defective and causes the cannon to get off the target, for in pointing in direction the cannon takes an oblique position with relation to the axis of the carriage, the recoil action no longer being perpendicular to the axle, strikes falsely and tends to modify somewhat the direction of the cannon, which is never the case in the French piece.

Third.—Range finding for the German cannon is less rapid and less easy. It scarcely allows fire in the direction of breadth, sweeping fires, nor fire intermittent or progressive. German batteries which have to fire on objectives changing often their direction, must undergo successive range finding.

Fourth.—The French method of range finding is much

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superior to the German as regards simplicity and rapidity of execution. The German method causes a considerable loss of time, during which the battery is exposed to the adversary. These difficulties do not permit it to overwhelm instantaneously a zone very broad or deep, which is play for the French battery, and permits it to approach very near the adversary before the latter has had time to modify his fire.

"The French artillery excels in this kind of sport," wrote an artilleryman to his mother. "I can even say that we are extraordinary 'mowers' of infantry. Think that when it is a question of helping infantry, nine times out of ten we can remain some kilometres in the rear, but the tenth time, when the configuration of the ground does not permit, we must go forward. Then it must be quickly and well done. The first time, we were in a Devil's stew to get within a thousand metres of the trenches! Then we found out that no one had been wounded. Our infantry could advance without firing one shot. Never did we need to do this work more than 15 minutes!"

Sixth.—In consequence of these complications, the German battery cannot use all kinds of ground, profit as ours by the accidents of the ground to defile out of sight and out of the range of the adversary, all the while overwhelming him with shot, even without seeing him, since it suffices, with our matériel, for the captain alone to be able to see the goal, either by going up the crest of a hill or by going up the field observatory of the cannon and translating his orders into very simple numbers, so that the range finding is very quickly made. In other words, the Germans have not as we have, the means of using indirect fire.

Seventh.—For all these reasons, the "75" fires three times more quickly than the "77."

Eighth.—The initial velocity of the German projectile is less.

Ninth.—The effects of these projectiles do not equal ours, nor does the precision of their shots.

Tenth.—The matériel of the "77" has no fuze setter to

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regulate the bursting-point. The fuzes are set by hand. In addition, while our fuzes are regulated according to the calculation of distance, the German fuzes are based on the calculation of time, which is not a simplification.

Eleventh.—The German battery has at its disposal only 397 shells, whereas ours has 501.

Twelfth.—The service of the German cannon is executed by eight men, including the battery chief; the service of the French needs only seven men. Therefore it is less complicated.

Thirteenth.—The German battery consists of six pieces; ours of only four, which makes it more mobile, more easily transported, more easily hidden; in a word, less heavy, less visible, better adapted to the necessities of war and to the rational use of the topography.

COMPARISON OF THE FRENCH "75" AND THE GERMAN "77"

	The "75"	The "77"
Length of the piece	2.475 m.	2.4 m.
Maximum range (time firing)	6.5 km.	5.3 km.
Number of shots per minute	25	8 to 10
Weight of shrapnel	7.2 kg.	6.85 kg.
Weight of explosive shell	5.3 kg.	5.3 kg.
Initial velocity	529 metres	465 metres
Number and weight of shrapnel balls	300 of 12 gr.	300 of 10 gr.
Danger zone for a target 1 metre high	At 1000 metres..... 41 metres	31 metres
	At 2000 metres..... 15 metres	12 metres
Number of shells to the battery	501 shells	397 shells
Surface of the shield.....	1.3 metres	1.44 metres
Thickness of the shield	3 mm.	5 mm.
Weight of piece in battery	1100 kg.	950 kg.
Number of servers of the piece with the chief.....	7	8
Number of pieces in battery	4	6
Number of batteries per army corps.....	30	24
Total number of cannon	2520	3600

Let us point out, in ending, the common criticisms of the French and German cannon, in fact, of nearly all field cannon, by the *Civil Engineer* of the 19th of September, 1914, by Mr. A. Dumas, Engineer of Arts and Manufactures. "These cannon have a vertical field of fire and horizontal field of fire very restricted in consequence of, first, the obstacle which the carriage offers to the movements of the breech in the vertical plane, and,

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second, the smallness of the anchorage base, which limits the movements of the cannon in the horizontal plane."²

Let us note, besides, that our matériel dates from twenty years ago, and that the German has been in existence only eight years. And yet our "75" is still much superior. This is not small praise of the inventors of the French piece and of the artillery personnel which has been able to make wonderful use of modern methods and which has learned how to handle with a dexterity without rival a field cannon up to the present without equal on any battlefield.

Let us add, finally, this detail. We have incontestably fewer cannons than the Germans, but we are not inferior for that reason; on the contrary. Each French army corps has 30 batteries of 4 pieces—that is, 120 cannons—which represent 501 shells per piece, a regulation number raising the supply of provisions of each cannon in projectiles to 60,120 shots. Now a German army corps has 24 batteries of 6 pieces—that is to say, 144 cannons—but the supply of each one of them in shells is only 397 shots. The German army corps has then at its disposal, in spite of the larger number of pieces, only 57,168 shots.

Thus by the intrinsic value of the cannon, the quantity of munitions, the number and rapidity of range, our matériel of "75" leaves far behind the field matériel of the Honorable William II.

So in the present war, in which our soldiers spend themselves magnificently to defend justice and right as well as the honor of the country, we should see what disdain our people affect for the German cannon! Certainly they have no fear of death: they prove it heroically at every hour of the day. But how can they fear the "77," which, 70 times out of 100, does not give death! Letters, so touching and so comforting which come to us from the front, furnish very interesting detail on this subject.

"Our artillery works wonderfully, causing considerable ruin and without any loss," writes an officer. "That of the Germans is something different. Their fire is not regulated;

² Colonel Deport, inventor of the "75," has overcome this difficulty. An entire battery has been delivered to the Italian Government, which has put it to test on a large scale. (*Civil Engineer.*)

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shells burst now to the right, now to the left, some 200 metres from our line, and 70 out of 100 at least don't burst at all. We must say, too, that those which burst cause only very small ruin. But you should see how ours are fired. No error, no deviation, and no wounded. It is horrible. Those whom it reaches are scattered on every side, arms, legs torn off, some even have no longer a head."

A cannoneer who was present on the 22d, 23d, and 24th of August last, at the battle of Longwy-Longuillon and Saint-Laurent, in which the 5th and 6th Corps were opposite four army corps having at their head Prince Eitel-Frederick, son of William II, and who was wounded on the third day, gave to the *Toulouse Despatch* the following valuable indications:

"During the first two days I was able to observe very minutely our adversaries, for I am passionately fond of the branch to which I belong (all our artillerymen say as much)."

The groups of German artillery are composed of 6 pieces. Their range firing takes place by salvos of three shots. During our defile the enemy put considerable time in finding our direction, and they find it only from the furrows of shots of our shells which strike percussion.

The German artillery is large, which permits it rapidly to bring up field battery (their "77"). But their percussion shells are ineffective. Fuze setting is by hand, whence a lack of speed in execution, which forces them to make use of a range table. Perforation is bad, and a number of shells do not burst. Shrapnel or ball shell give a "blow of an axe." The blow is, moreover, on the firing plane of the batteries. Bursting is in the direction of breadth, with a single jet, and, as we know this, we make trenches perpendicular to the line of fire.

"Our positions are, several times a day, spotted by their aviators, which our '75' can bring down, on condition that our range finders work with the trail in order to augment the angle of fire, which is then effective, all our ball shells being with time fuze."

"Our soldiers have almost always preserved themselves with

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sacks. The Germans do not enjoy the same advantage, for their sacks are traversed by balls from our shells."

"Germans have opposed to our troops numerous armies, and their siege batteries have been installed in advance on places of combat. Our places are spotted with precision. I told you so a while ago, but the lack of skill of their fire is a thing to-day legendary. The best proof is the following: When they fired beside our battery without causing any harm, our whole personnel took to shelter. This was a ruse. We thus let them use up their munition, and when they finally fired on us in the first zone, we would begin to fire, actually under their shells which were raining down. Consequently, in a general way, we have suffered very little."

If now we look through the road journals of the Germans or look over their letters, it is quite a different song. Our enemy has a real feeling of terror at the thought of the effects, terribly precise, of the king of battle, the glorious "75."

"It is not a cannon for war which you have, it is a cannon for butchery," exclaimed a German officer, a prisoner.

Generals themselves shudder when they speak of it. Listen to this confession from General Von Bülow before his defeat at the Marne:

"Your artillery," he said to a chatelaine who was forced to put him up, "I don't like to speak of your artillery; it is terrible. It is the first in the world. Our soldiers call your artillerymen the 'black butchers.' They are right; they do so much harm. I prefer to speak of something else."

A German officer, wounded in France, communicated to the military critic of the *Berliner Tageblatt*, Major Moratti, some of his impressions on the French and German artillery compared. He affirms that the appearance of German field mortars was a success. "They can keep pace," he said, "with the heavy Rimailho mortars of 155." Then he adds:

"In this war the last word is to the artillery. It is from it that we must expect final victory. The French artillerymen aim with extraordinary precision. Their signal service must be

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likewise very good. The supply of munitions in the French Army is perfect. There is never cessation of fire in consequence of the lack of munitions, and this is more remarkable, considering that the French have a predilection for the system of firing *en rafale* (in gusts), which consists in selecting a broad square space and causing a torrent of projectiles to rain there.

"Under fire, when our range finding is precise, the French sometimes abandon their piece; but if our range finding is less precise, they rapidly change the position of their battery in order to get away from it."

The officer recognizes also that the shells of our heavy piece are very powerful and that they all burst.

Here is now the letter of a German captain to his wife. This military testimony is a rare document. Never has there yet been a more striking description of the moral effects of our artillery on the enemy. The scene took place last September on one of the fields of the battle of Marne.

"We were to fall back. During the last two hours we were continually exposed to enemy artillery firing, for our artillery had been destroyed or was retreating, or had ceased firing. I seized my comrade by the hand, and we lay down flat, as close together as possible, like herring, and we awaited death. Enemy aviators turned around above us, describing two circles, which means: Here there is infantry.

"Then there was a violent outburst. The hostile artillery mowed all the earth with its fire in progressive lines. In a single minute I counted 40 shells. Imagine that! Shrapnel was exploding nearer and nearer. Finally it arrived at our ranks. I turned around rapidly, my bag over my stomach in order to cover it a bit, and already shouts of grief resounded. Tears came to my eyes on hearing the poor fellows wailing thus while shots succeeded shots. The air groaned with them. Dust, powder smoke, and stench prevented our breathing. It was more and more terrible.

"All of us shouted out after our artillery; we did not know that it had fallen back. Finally, after a long and agonizing

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wait, the fire became more distant from the rear line. The Major shouted out: 'Finish with it.' Bending over as much as possible, our sack or bag turned around, gun in hand, forward march!

"We were to pass under the enemy's fire. Men began to fall like flies. Thank God that I was able to run as I did! I was at the end of my breath. My heart seemed to be breaking!

"We arrived finally at our batteries. The ground is turned up by projectiles; three cannon are in ruin, limbers and carriages burned. Farther on, farther on! We made a few steps slowly to catch our breath. New cries for help. Some one calls out: 'Comrade, don't abandon me . . . my poor wife.' A carriage comes to meet us. It turns around sharp. We put in the wounded man, and with him two other men who are finished. We whip the horses; we prod them on, we must get out of it! And always this noise, a whistling Piuu and Boum-krach. They are the shells. One of them falls at the carriage. It is a miracle that we do not go mad.

"Finally, after about four kilometres, projectiles no longer reach us. I command then, 'March, in order, by intervals.' All of a sudden everything becomes black before my eyes. I stumble, the man beside me holds me. I pray out loud. Don't laugh; you do not know through what we had passed! I was safe.

"Then began a terrible forced march. We had marched twenty-six hours with only two hours' halt."

On the other hand, newspapers have published this extract from a road note found on a Bavarian infantryman, killed in the course of the battle of Marne by bursting shell:

"September —, at 9 o'clock, during the night we received such fire from the French artillery that soon our positions are untenable and we fall back.

"September —. In the darkness we make trenches 50 centimetres under mortar fire of French artillery. Ours is too weak. In the morning French aviators spy on us without interruption. Full of anxiety, we remain seated in our trenches.

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It is the day of French artillery. Besides, out of a group of 100 men, there remain 25! Our troops have suffered terribly.

"September —. We take our only rest in 22 hours, then we continue to march all night until eight in the morning. They tell us that it is not a retreat, but a movement. It has all the appearance of flight. We stopped. It rains in torrents. We dig trenches, and they give us no rest. We must always dig up the earth. Suddenly shells and shrapnel arrive, which force us to fall back. The whole army corps must flee.

"September —. The attack is violent on the outside; we remain close together, man to man, inundated by the shell from the French artillery. It is a fire of hell."

And here is the extract of another note-book, kept from day to day by a soldier of the 76th German Infantry Regiment, killed above Berru. The infantrymen insist also on the terrific ravages of our artillery.

"On the 9th of September we move toward Sillery. We arrive at a place where the guard has been swept away. We replace it. We are swept away in our turn. On the 15th I pass the day looking for my regiment. On the 16th I arrive at Nogent-L'Abbesse, where I finally find my squad. Three men are left; I am the fourth. They had already written me down as lost."

On the 20th of September the soldier enters the trenches without having eaten. The French artillery covers this trench with shells. It has to be abandoned. "The effects of this artillery are terrific," notes the German. "None of us will escape."

This last phrase we find reproduced almost verbatim in all the documents of this sort. Our troops, too, marvel at the prowess of our "75," which wrings from the Germans this expression of terror: "French cannon, villainous."

"A French piece," wrote one of them to the *Republican Union* of Besançon, "fires on a hostile battery. The cloud of smoke having passed away, our officers look with a spy-glass on the effects of their fire and discover with astonishment that the

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enemy artillery servers are fixed at their places. Later they discover that it is the immobility of death."

That is why the German General Staff, worried at the incontestable value of the light field artillery and heartbroken at the ravages, which it has made in the German ranks, gave, in October last, precise instructions to make as invisible as possible to our aviators on reconnaissance the position of their batteries and masses of infantry, knowing full well that wherever our aviators have spotted these positions the fire of our artillery have quickly sown devastation, terror, and death.

"At the approach of an enemy aviator all sign of life should cease," says this document. A true confession of our superiority.

"It is absolutely necessary to assimilate artillery coverings and infantry trenches to the surrounding landscape, not only in front, but also against spying from above. Avoid every movement in battery position as soon as an aviator flies over the position. A single man in motion may cause the battery to be spotted. No fire from the moment an enemy aviator approaches, for the flash from the piece shows the position from afar.

"To persuade themselves of the visibility of their own positions, the commandant of brigades or regiments or groups of artillery will find in the escadrilles the greatest desire to give them a flight of 10 to 20 minutes above their own positions.

"It is recommended that advice be asked of aviators as to the best means of hiding positions.

"Success of the French artillery, which has caused us such evident losses, is due, in the first place, to the fact that most often the French are able to determine the emplacement of our batteries, while we do not succeed in determining with certainty the emplacement of the enemy batteries. To be able to equal in this respect French artillery, our reconnaissances and observations should be pushed as are theirs, far in advance of the lines, even if they should make impossible the conduct of battery fire by the voice.

"It is also necessary that the artillery make greater use of flanking fire."

With a Trench Mortar Battery on the French Front.

TRANUCTION AND COMMENTARY BY GEORGE NESTLER TRICOCHÉ, FORMERLY OF THE FRENCH ARTILLERY

(The following extracts were taken from a book by Mr. Paul Duval-Arnould, and entitled "CRAPOUILLOTS; Feuilles d'un Carnet de Guerre" (Leaflets from a war note-book).¹

Crapouillot, in French war slang, is a familiar name for trench mortar; it is extended also to the men who serve such a gun. The name is derived from "Crapeau" (toad), and alludes to the batrachian-like appearance of this mortar, especially when loaded. Lieutenant Arnould's volume is not a diary, but a collection of anecdotes written chiefly for the general public. Yet so little is known—comparatively—in the United States, about the Trench branch of the Artillery, its use and tactics, that, at the present time, details about *Crapouillots* might be welcome, even when they are not strictly scientific. At any rate, we have deemed it appropriate to complete our commentary upon some passages of these extracts by particulars taken from a paper that appeared in the August, 1917, issue of the *Revue Militaire Suisse*, under the caption "Artillerie de Tranchées," and written by E. Van Erde, of the Belgian Army. Lieutenant Van Erde is not a stranger to the readers of the FIELD ARTILLERY JOURNAL, for some of his notes on the field batteries of his country have been used in our January number ("Contemporaneous Notes on Belgian Artillery").

The author first introduces his gun to us, and the description is well worth quoting:

Do you spy out, into that bent of the trench, that diminutive field gun? Does it not look like a beautiful plaything just brought in from a toy shop? Its bluish robe is brand new; the flat edge of its tiny jaw shines in the sun and seems to smile to Life and Light. The whole

¹ Plon-Nourrit, Editors, Paris.

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affair gives the impression of something fine and smart: it reminds one of the tree frog, the pretty batrachian of our meadows: it is our *crapouillot*. But oh, what is this sudden metamorphosis? The cannoneers have loaded the gun: enormous, heavy, blackish, the torpedo emerges, entire, from the tube. The toy has turned into a hideous reptile; some kind of formidable crotalus, coiling up, sticking out its horrid head that is armed with a beak, and striated with three crests. . . . A little grease patters at the muzzle and is dripping along the tube—a blackish, stinking drivel.

It must be remembered that the peculiar way of loading this mortar—the placing of the projectile *outside* of the tube—was an improvement upon the first type of trench artillery. In the early models of trench gun, the shell or torpedo was about normal in respect to the calibre of gun used; it was placed inside the tube as usual. But in order to obtain a very short trajectory the propelling charge had been considerably reduced. All this had serious drawbacks: *First*, it was impossible to use, with such guns, projectiles heavy enough to produce the crushing effects needed at close range. *Second*, the tube was too long, and uneasy to handle in narrow trenches.² *Third*, the powder's properties had been determined by experiments under normal pressure conditions—for instance, 2000 kilogrammes per each square centimetre: with a pressure ten times smaller, new and unknown conditions presented themselves; the deflagration became somewhat erratic, causing hang-fires, wild trajectories, and therefore endangering the lives of near-by friendly troops and gun crews themselves. If we stop to think how dangerous the latest types of trench mortars are, sometimes, for men in the neighboring trenches, we may form an approximate idea of conditions at the birth of that kind of artillery. These conditions were even worse than in the Middle Ages, when pieces somewhat similar were in service, because, then, powder was always used in a normal way, so to speak.

² Besides, the propelling charge being much reduced, it had seemed advisable to save metal by making the tubes thinner but it soon became obvious that, even with that diminished amount of powder and gases, the inside of the tube deteriorated quickly; accidents became frequent.

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To remedy these defects, it has been decided to come back to a normal propelling charge, but, on the other hand, to increase the weight of the projectile. Small, short mortars are now used and the torpedo is practically outside of the tube.

One of the advantages of this way of loading is that the "small wings"³ or fin-like appendages, which are used to steady the torpedo during its flight, are no more liable to be broken or bent in the tube of the gun at the time of the discharge. Not only the danger from premature bursts and erratic trajectories is considerably lessened and the fire accuracy and efficiency much improved, but the trench mortar has become much less cumbersome and can be easily moved from place to place.

But let us go back to the book. From some pages, more or less disfigured by the censor, we may infer that it was not an easy task, at first, to organize and drill the trench mortar batteries.

Speaking of the baptism of fire of his own unit, Lieutenant Arnould says:

. Fifteen days ago we hardly knew one another; we had never seen our weapon. But in wartime, in France, it does not take long to do things right, especially with Poilus such as ours.

It seems that, at the beginning, the personnel was somewhat heterogeneous and hard to manage. In describing his captain's personality, the author says:

. It was certainly a difficult thing to "build up" that battery and give it the needed degree of efficiency. Personnel, matériel, chiefs, all had to be transformed. He succeeded, by dint of firmness, diplomacy; but had it not been for his robustness, he would have lost his health and courage in the undertaking.

Here the censor cut off what was obviously a scene anything but edifying as regards discipline; the last paragraph of the narrative reads thus:

. Like a professional lion tamer, the captain appeased them with a few words, brief and to the point; he turned them

³ *Ailerons*, in French.

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into a flock, still grumbling, of course, but which stoically, that day, made up its mind to obey without further ado. Since, he made heroes out of them.

We can understand this condition of things, unusual in the French Army of to-day, if we remember the genesis of that branch of the arm. Trench artillery in France had been created by a certain general who was allowed to experiment on a very limited scale with a few platoons. The personnel of the new service numbered only about 180 officers and men. The remarkable success of this venture caused the hasty formation of a number of batteries, the personnel of which had to be taken from other field artillery organizations. It seems that, as customary in such cases, the new service was not, at first, very popular, and, although we have no positive proof of our assertion, we are inclined to believe that regimental commanders took this opportunity to get rid of what they considered undesirable elements. We had seen a similar condition of things, personally, in 1883, when the Fortress Artillery was first organized in France.

Who they were when we first met? Well, they were "all kinds": veterans who had been forgotten in the trenches for months; who had seen the birth of the new arm; who had handled bronze guns and fired wooden torpedoes; also men whom a natural craving for freedom, action, and an adventurous life had prompted to volunteer for this service. Lastly, some fellows soured by their military experiences, who had rebelled against inconsiderate or misunderstood orders and been courtmartialled.

A motley crowd in which the best and the worst elements are side by side; a body of soldiers which at first conveys to one's mind grave misgivings, sometimes, in the evening after a battle, causes its chief to thrill with pride.

Be it as it may, the fact remains that the *crapouillots*, at the time this book was written, were not particularly popular among artillerymen, while, on the other hand, infantry men admired and treated them with much consideration. This ludicrous condition

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of things, which can be observed throughout the book, is easy to understand, for trench mortar's work is so closely related to that of the infantry that the latter alone is generally able to appreciate it at its full value. To the ordinary field artilleryist the new branch appears like a mongrel, doomed to an ephemeral existence and using obsolete contrivances. Yet this and the peculiar recruiting of the new units are not the only causes of the attitude of the ordinary artilleryman toward his young brother of the trenches. The *crapouillot* is a favorite with divisional and brigade commanders—with all general officers, in fact. He fights at close range and accomplishes, almost out of necessity, daring deeds, that make him conspicuous and give him an enviable position in the army. Hence some jealousy, which, at times, manifests itself by some nagging and, even, unfairness. The following extracts give a rather amusing instance of it:

When our first winter was at last at an end, a wise General Order prescribed to all unit commanders to build immediately comfortable stables for their respective horses. . . . They had only to fill requisition blanks for the material and great many other blanks and forms; also to use a great deal of patience, and they would finally obtain everything they needed. . . .

The battery commander, a "territorial" detailed with the *crapouillots* and in civil life an inspector for an insurance company, was a very active man, with some "pull."

It was not long before he had all the boards and tar paper necessary for his command.

. . . . Fifteen days later, all our horses were eating out of regular troughs, in a sort of hangar consisting chiefly of a roof, and built in the shape of a horseshoe. The stables were completed by large store-rooms for feed and a beautiful portable saddle-room, an object of especial pride for our *adjutant*. . . .

The latter is a kind of battery sergeant major, ranking above the first sergeant. The care of saddles, harnesses, etc., is one of his duties.

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Some people could not reconcile themselves at all with that achievement. I allude to our neighbors in that cantonment: the field batteries.

They were turning yellow with envy at seeing our horses get fatter and stronger every day, while their goat-like mounts were still "drying up" at the horse line.

The "top veterinarian"⁴ set us as an example all over the country for twenty leagues around; and from a distance of twenty leagues people came to see the *crapouillots'* stable. . . .

But said *crapouillots* were reckoning without the major of the neighboring field artillery battalion, whose visits to the stable became too frequent not to be, finally, alarming.

One morning an order came, explaining that the artillery cantonment had become suddenly too cramped, and, to remedy this situation, the trench mortar battery was to move out into the open fields, to some earthen hovels, half destroyed by rain water and which, vacated for about six months, were alive with rats and lice.

The battery commander did not allow himself to be crestfallen at this news. He went, on the sly, to the general who had created the new branch of the arm, and, after the interview, came back smiling in a strange manner.

At about 16 o'clock, the major, happening to meet our captain . . . said to him something like this: "By the way, you are leaving to-morrow. I need that cantonment of yours by 8 A.M. As I have no great confidence in your *crapouillots*, and as, on account of the general, I want to have a very clean cantonment, you will please satisfy yourself personally that not the slightest bit of horse dung remains there—you understand me: not a bit."

Here ends the drama and the comedy begins, for, taking advantage of a dark, rainy night, the French cannoneers took the stables to pieces, while the drivers, in many hurried trips, carried boards and all material to the new cantonment's site.

⁴ This refers evidently to the Veterinarian Inspector. The author's expression is: "La grosse huile vétérinaire." *Huile* (oil) in army slang means any high officer. A *grosse huile* (big oil) is generally an army corps or army commander. There are many shades of meaning in the slangy terms which are lavishly used by the author.

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When at 8 o'clock, the two hundred horses of a field battery came to occupy their ill-gotten shelters, it was impossible, even with the help of glasses, to find the smallest trace of manure—no more, for all that, than any vestiges of stables.

Trench artillery, being compelled to fire at close range, must expect to perform duties which seem, at first, absolutely foreign to the functions of the arm. For instance, such batteries may have to advance, and therefore to carry guns and ammunition to places where shelters are not yet half built, and even to trenches just wrested from the enemy.

An order just came, that takes us away suddenly from the much-needed rest which we had been enjoying for 24 hours after a month's continual labor.

While my two fellow officers are making a reconnaissance, I get everything ready. I patch up the pieces and gather the torpedoes.

When they come back all is in readiness. We consult hurriedly together. Our orders are: to go to position, with 10 mortars and 700 torpedoes, 200 mètres from the last German trench, and to be able to open fire to-morrow at dawn.

This means eight days' work to be done within eight hours with an exhausted personnel. And it is a foolhardy undertaking, for the only access to the place is by the highway, enfiladed, for four kilomètres, by hostile artillery.

But they are relying upon us: consequently we are going to try an almost desperate method: instead of carrying ammunition and guns on men's backs, as it is usually done during the last and most dangerous part of the advance, we shall go all the way with our 16 transport wagons. Some of these may be blown up, but the others will reach the goal.

I shall lead the column, while the captain and the other lieutenant will go ahead and prepare the position.

Les gradés sur moi! (noncoms., assemble around me).⁵ Sergeants and corporals come to me; the orders are plain: each one to take care of his own wagon; every one for himself; one must reach the position at any cost.

The night is as black as ink. A fine, icy rain is beating us. At times white flashes disclose the distant crests. Back of me, separated

⁵ *Gradé* generally refers to noncommissioned officers only, while *cadres*—literally: frame—(always used in the plural) include often officers.

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by intervals of 20 mètres, the wagons are rolling, jerked by the shell holes with which the road is riddled. The torpedo wings, by striking against one another, are making a dull rattling noise which must be heard from far.

The *chariots de parc* (familiarily called *prolonges*), which are used by trench mortar battery, are old-fashioned, rather crude affairs, springless and very noisy, even when they are empty.⁶

Reports of guns and *marmites'* bursts are now heard.⁷ I see two or three shells percussing on the white line which indicates the road we had just been following; others whistle alongside of us and burst right and left in the fields.

The column goes through a hamlet, or rather the ruins of it. Many men, wounded during the day, are there, in the rain and under fire, still awaiting the ambulances. Soon the battery enters the zone recently taken from the enemy. The road is becoming still worse and the rattling of the wagons dangerously loud.

Truly, only we *crapouillots* can start on such a venture. I notice shadows in front of me: "Who goes there?" Vehicles are standing in the middle of the road. They are three *caissons de ravitaillement*.⁸ a noncom. is near by and seems to be in a quandary.

I call to him roughly: "What in . . . are you doing here?" His voice sounds almost toneless. He stammers out that he cannot go on, because there are too many shell holes on the highway.

I shrug my shoulders and hustle his horse about. "I guess ye, p'rhaps, are a-thinkin' ye'll find the *Boul' Mich*⁹ here!" says with contempt the leader's driver of my first wagon.

The column goes on, past an infantry post, where it is cheered in the dark by some men who are eating near rolling kitchens. Finally it is ordered to stop at a place where a tree, knocked down by a shell, bars the road. A talus rises to the

⁶ That colloquial word "prolonge" should not be confounded with the other artillery term which means "gun ropes."

⁷ *Marmite*, in army slang, means a large German or Austrian shell.

⁸ Not belonging, of course, to the trench mortar battery.

⁹ Slangy abbreviation for *Boulevard Saint Michel*, the main thoroughfare of the Latin Quarter in Paris.

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right; to the left is a *boyau*.¹⁰ Hostile projectiles are falling every five or six minutes. The author states that they strike the road in the intervals between the wagons. As they do not do any damage, we must infer that either they never bursted, or else the cone of dispersion was extremely narrow. It is to be regretted that Lieutenant Arnould has not deemed it necessary to give here, as well as in many other pages of his book, any explanation concerning the apparent harmlessness of German shells on that front.

"Dismount!" How enervating this halt is! I go from one wagon to the other, chatting here and there. No casualties; the morale is good. Some of the men are joking. . . . Suddenly, with a sonorous "Good morning, boys!" the first lieutenant, smiling, appears on the talus. "Everything is all right," he says. "The work is progressing. The infantry is helping us. But the column must go over that tree or by the side of it, at once, for the captain is waiting for us."

It is then decided not to try to remove the fallen tree, but to cut out a passage, on the left of the road, across the trench and the *boyau*. The cannoneers, who had gone ahead to prepare the mortar's sites, are called back and, with picks and shovels, they soon make an opening wide enough for the wagons.

"Forward!" I place myself at the turning-point to show the way to the drivers, and as they come up to me I catch the leaders by the bridle to help them. It would never do for a wagon to upset or to get stuck there, for that would bottle us up.

The first wagon passes through without any trouble. Things will be all right in so far as this is concerned; but what a jolting! And what rattling and banging! If the Boches do not hear it, they are stone deaf!

The wagons are following one another.

Well, here it comes! Here is the *arrosage*!¹¹ Fortunately the Boches are shelling the part of the road stretching between them and the fallen tree; that is to say, the one we decided to avoid. If only they do not increase their range!

¹⁰ Narrow passage or gallery for communication in the trenches.

¹¹ Literally "sprinkling." *Arrosage* is to search an area.

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The wagons are trotting. A *marmite* bursts close to one of them, which is driven with reins. The driver, on his box, is surrounded with splinters. Unhurt, he goes on into the darkness, remarking: "What do you know about that?"

The enemy realizes evidently that something is taking place near by. Shells become more numerous. A little gun especially is very annoying, although projectiles are very small, and not powerful.

We are now in an open field, gliding along German trenches recently abandoned. The men are getting more nervous.

At last, here is the foot of the last crest. The Boches are only 300 mètres distant. With all their might the men unload the wagons. No *marmites* any more; but the little gun is more active than ever.

Our escape is truly miraculous, for not a soldier is hit. My horse alone has been struck by tiny fragments.

Ouf! the last wagon is emptied; it goes away at a trot. Our captain, meanwhile, had been doing wonders. So did the infantrymen who have lent a hand to our cannoneers. The new trenches are almost ready, even though they are not very deep.

At six o'clock, as scheduled, our ten mortars are in position with their seven hundred torpedoes.

A trench mortar battery may consist of, say, ten or twelve guns; but very often, in its sector—which is that of the infantry division—it has to be fractioned according to the requirements of the moment, each one of the three officers taking charge of a certain number of mortars and adjusting his fire separately, and establishing his own observation station. As a rule, this station is very near the pieces; but it is always connected with the latter by the telephone—although the different fractions are not necessarily connected with the battery commander. At any rate, communications, either by telephone or messenger, are not easy in that branch of artillery on the firing line. It happens that a chief of platoon is so completely cut off from his mortars that he loses all control upon them. One must notice, in that connection, that the interruption of communication is not always due to hostile fire: the mortars are so far ahead and, at times, so

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near the enemy's line that the battery may be much endangered by "shorts" from the friendly heavier guns—and even by shots fired by other fractions of the same trench mortar battery. Moreover, the range is so short that observers are liable to be handicapped by the bursts of their own torpedoes, even when the latter are falling upon the objective. The extracts that follow are dealing with this subject.

"Here is the firing map." The lieutenant spreads out on a table a map of German trenches upon which marks of different colors show, according to calibres, the respective objectives.

"You see, that will be fine, right there; so much the more so because our *crapouillots* are going to help on that salient and on this one, too. Humph!" With his nail he pressed on the salient, mauve colored.

"Unwholesome, this part of the landscape!" said he. "Some heavy ones, 155 short—and the two trenches are not even 25 mètres apart! Certainly some projectiles from these guns, just back of us, will fall short, right on our mortars. To adjust our fire in the first line of trenches, we shall have to be extraordinarily prompt!"

"Well," said I, "the only way is to divide the work between us two"¹² Each will take two pieces and act independently. The adjustment, therefore, will be done in a few minutes. We should be very unlucky indeed if an ill-adjusted shot from our heavy batteries were to hit us just during that time."

. In the functions of a *crapouillot* there is a period which always seems very impressive to me. It is the few moments immediately preceding the opening of fire. The pieces have been carefully given the needed elevation; their platforms have been reinforced. The telephone operator, crouching close to the talus, verifies his apparatus, while near him, under the trajectory of my own projectiles, I am seeking a convenient place from which I can see the objective. Nearly every one in the trench is hidden in the dugouts. A few watchers alone have remained at their posts. Watch in hand, I look at the little hand which, very slowly, goes toward the specified time.

"Attention! Fire!" Two snapping reports indicate my *départs*.¹³ The eye can follow both torpedoes, very high in the sky. They seem to fall back upon me. The torpedoes strike the

¹² The captain was then on a leave of absence.

¹³ In the up-to-date trench artillery vernacular of the French *départ* (start) means a gun's discharge.

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ground together, so near us that the operator and myself have to get under cover. One of them appears to be in the German trench; the other one is a trifle short. One must hurry, for the smoke begins to hide the objective:

"Hello! First piece: all right.

"Second: 45 degrees, good in direction. Fire as soon as ready.

"Hurry up!"

The lieutenant faces the objective, while the operator looks toward the mortars, ready to shout a warning to the officer if a torpedo seems short during its flight. In the next salvo the first shot is on the target; the second, not seen. But just then the dreaded "short" of the friendly 155 falls about 5 mètres from the observation station.

The operator shouts to me laughingly: "The next shot will be for us, lieutenant!"

Now the Boches, too, are shelling us.

"Gracious! Let us hurry with the adjustment. Why don't these blamed torpedoes come? Hello, hello! Hurry up! Fire!"

But the wire has been cut; suddenly a deafening report is heard: the lieutenant and his telephone operator, both wounded, are almost buried in the crumbling talus. At that moment the torpedoes from his own mortars begin to fall around him.

Obviously, my mortars are out of adjustment, and as I am unable to make any correction in the firing, they are going to destroy our own trench. We must warn them at any price.

Bleeding and dizzy, the officer, compelled to leave his wounded operator under fire, tries to find his way to the mortars. But, although he is separated from them only by a few mètres as the crow flies, such is the damage done during the last fifteen or twenty minutes to the trenches and *boyaux* that he loses his way. After much wandering, he is picked up by some infantrymen, as he is just fainting from exhaustion and pain. He masters, however, enough strength to mutter:

An agent of communication, quick! Go to the torpedoes; tell the men to stop; that I am wounded.

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To make sure, send another, at the same time, to the sector's commanding officer: he knows where the *crapouillots* are; he will notify them.

Then he falls back unconscious. Fortunately, in the meantime, the first lieutenant of the battery had seen, from his position, the erratic fire of his comrade's mortars. Running, in spite of the shells, on the top of the talus to save time, he had reached the two harmful mortars, corrected the firing, and achieved the work.

It is hardly necessary to add that since this book was written trench mortars have been perfected in many ways. It seems that, on the Allies' side, the greatest progress has been accomplished, in that line, by the Belgian Artillery. It is not known, at the time of this writing, whether the name of the inventor of the Belgian mortar may be made public: it was not allowed last August.

The mortar in question is very small; it cannot be seen at 50 mètres. Four men are sufficient to carry and to serve it. When the fire is adjusted, it generally remains so. As regards range, the greatest variation between the bursts of successive shots is hardly 3 mètres. Therefore, as soon as one has got the range and the objective has been hit by a torpedo, one may proceed with the firing without any correction for elevation: any projectile will be effective. This steadiness, which does not interfere with the rapidity of adjustment, is obtained through an apparatus whose description cannot be given here, for obvious reasons.

This mortar fires two kinds of projectiles, weighing respectively 19 and 36 kilogrammes (about 38 and 72 pounds). At the extreme range of one kilomètre the lateral deviation does not exceed 3 mètres. It is easily and cheaply manufactured in any plant out of 3-inch steel bars.

Accurate Shooting in Trench Warfare

BY MAJOR GEORGE H. PAINE, 17TH FIELD ARTILLERY

THE methods of fire laid down in our Drill Regulations and heretofore taught at the School of Fire are the methods which are applicable to field artillery warfare in its broadest and general sense—*i.e.*, maneuver warfare, which is the only method of warfare by which a complete and decisive victory can be obtained. These methods are the basis of all field artillery firing and should be thoroughly understood by all field artillery officers before they take up the study of the special methods used in trench warfare. It should constantly be impressed upon every field artilleryman that ultimate victory must usually be decided on the open field, and that by their ability to accurately and swiftly deliver effective fire, under any and all conditions, they may bring such a victory to our armies in the present war or in some future war. Having once mastered the above-mentioned basic elements of firing, the methods used in the specialized trench warfare on the Western Front in Europe will be easily understood and applied.

As the trench fighting in Europe has developed, it has called for more and more accurate delivery of field artillery fire, with less time and facilities for observation and adjustment and more desire for instantaneous fire for effect. This condition has arisen from the following causes:

(a) The front-line trenches are pushed so close to each other that our own trenches are very often well within the 100 per cent. rectangle of our own fire on the enemy's line, so that very careful firing is necessary in order to prevent dropping some projectile in our own trenches.

(b) The necessity of delivering barrage fire so accurately adjusted that our infantry can follow right behind it without the fear of being hit by our own projectiles.

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(c) The necessity of delivering immediate and instantaneous fire for effect on certain designated points at any time in the day or night in answer to S. O. S. calls, etc.

(d) The necessity of firing by map on targets which cannot be easily identified.

(e) The necessity of having all elements of fire as nearly correct as possible in order to facilitate aerial observation.

In order to deliver a fire as accurate as the above conditions demand, the following methods must be followed:

1. An accurate fighting map must be prepared for each battery and kept absolutely up to date.

2. The gun ranges and deflections of all targets in the sector must be reduced to range table or normal conditions and registered on prepared forms. The normal conditions in our service are:

Temperature	59° F.
Barometer	29.52"
Temperature of powder	70° F.
Wind	<i>Nil</i>

3. Before firing, the map range or registered normal range must be corrected for the following local conditions at time of firing:

(a) Temperature of air.

(b) Barometric pressure.

(c) Temperature of charge.

(d) Wind.

(e) Change in muzzle velocity, due to wear in gun and variation in powder lots.

We will now discuss these corrections in the above order:

(a) As the temperature of the air rises, the air becomes less dense and therefore offers less resistance to the passage of the projectile. This gives an increase in range, due to a higher average velocity in a given time of flight. On the other hand, as the air becomes colder it becomes more dense and thus brings

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about a decrease in range. Changes in temperature of the air produce at short ranges small range changes, while at long ranges considerable range changes are produced.

(b) When the barometer is low the air pressure is decreased and the air becomes less dense and therefore gives an increase in range, while when the barometer is higher the air becomes more dense and decreases the range. We thus see that the temperature of the air and the height of the barometer working together produce changes in the density of the air, which in turn produce a change in the range.

In the formula for calculating the range of any given projectile under given conditions, we find an element called the ballistic coefficient and commonly called large C , which is expressed as follows: $C = \delta/\delta \times \frac{W}{BCd^2}$

δ_1 = the standard or range table density of the air.

δ = the density at the time considered.

We thus see that the principal variations in C , and therefore the range, are due to variations in δ . It will thus be seen that as the density of the air decreases the value of C increases, and as the range varies with the value of C , the range increases.

The table marked A gives values of per cent. of change in C for different temperature and barometer readings.

The table marked B gives changes in range for plus and minus per cent. change in C for Zone 3, 6-inch howitzer.

Example

Map range 6500, temperature 100°, barometer 28 inches.

Entering table A with temperature and barometer as arguments, we get plus 0.157 per cent. change in C , or, in round numbers, plus 16. Entering table B under 16 - 6500, we get 176.8 yards which the projectile would travel beyond normal range. Therefore the range to be given the guns would be 6500 - 176.8 = 6323.2, or, in round numbers, 6325 yards. Interpolation in the table should be used when necessary.

(c) The temperature of the propelling charge varies slowly

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for a sudden change of air temperature and is usually taken as the average day or night temperature of the magazine in which the powder is stored. If more accurate work is required, the temperature must be taken by a thermometer inserted into the cartridge case. A rise in temperature above normal, or 70° , increases the muzzle velocity and therefore the range. A fall in temperature below normal lowers the muzzle velocity and the range.

Table C gives values for increase or decrease in range for various temperatures of powder charge at the different ranges for Zone 3, 6-inch howitzer.

Example

Map range 6000, temperature charge 20° F.

Entering the table, we get the value 324.7, which means that the projectile will fall that far short of the target, due to decrease in muzzle velocity. Therefore the range to be sent to the guns would be $6000 + 324.7 = 6324.7$, or, in round numbers, 6325.

(d) Wind, in addition to deflecting a projectile from its course, also changes the range. A head wind retards the projectile and decreases the range. A rear wind accelerates the projectile and increases the range. A wind across the range must be divided into its components in order to find the force of that portion acting in the direction of the trajectory. This may be accomplished by a scale, as shown in Fig. 1, where the concentric circles represent the strength of the wind in miles per hour.

Always assuming 12 o'clock is the direction of the target, then a wind from any point of the clock may be graphically divided into its components. Thus a 2 o'clock, 20-mile wind would give a component of 10 miles acting against the projectile. Table D gives the range changes for a head or rear wind of 10 miles per hour at the different ranges for Zone 3, 6-inch howitzer. Thus a 20-mile head wind at 6000 yards would

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retard the projectile 114.8 yards, and therefore the range to be sent to the guns would be 6000 plus 114.8 = 6114.8, or 6125, in round numbers.

It must be remembered that the direction and velocity of the wind in the higher stratum of air in which the projectile travels are often very different from those closer to the ground, and that the measurements of the anemometer close to the ground must not be relied upon. Data with regard to the wind should be obtained from the air service whenever possible.

(e) When a new gun is placed in service it is theoretically supposed to fire at the range table muzzle velocity. As the gun continues in service the rifling becomes more or less worn, and some erosion of the metal, due to the heat of combustion, takes place at the beginning of the rifling. This tends to increase the powder chamber and slightly lessen the pressure and muzzle velocity. The wear will be different for each of the four guns of the battery, and after they have been in the service some time they will all be shooting with muzzle velocities differing from each other and from the normal muzzle velocity. In addition, although all our powder charges are supposed to be adjusted charges, giving the same velocity, still in service it will be found that the different lots of powder give different muzzle velocities.

For accurate shooting it is essential that all the guns shall fire as nearly alike as possible, and therefore the above inaccuracies must be corrected. The method of doing this is called "Calibration," and the error in muzzle velocity is called the "Calibration error." The correction necessary at any range to counteract this error is called the "Gun correction." It must be remembered that guns must be calibrated for the different lots of powder to be used, and also that howitzers must be calibrated in all their zones. The following methods of calibration are suggested:

GENERAL CONDITIONS

(a) Choose a day as near the normal as possible, with wind steady and not over 15 or 20 miles per hour.

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- (b) Carefully adjust all sights, quadrants, and instruments.
- (c) Choose a target as nearly on the normal to the battery front as possible and near the mid range of the guns.
- (d) Accurately locate the positions of guns and target on the map and measure with great accuracy the range to the target.
- (e) Have readings taken on barometer, thermometer, velocity and direction of wind, and temperature of powder charges.

Having completed the above preliminaries, you can calibrate by the following methods:

Correct the measured range to your target for barometer, temperature of the air, wind, and temperature of charge. Fire at your target with corrected range, and by bracketing obtain the range at which you have 6 overs and 6 shorts. Reduce obtained range to normal conditions. Take difference between map range and obtained normal range, which will be the range error due to change in muzzle velocity. Enter range table and obtain the value of the change in muzzle velocity which was necessary to produce the obtained range error. Apply this in the appropriate sense to normal muzzle velocity, and you will have the muzzle velocity of the guns. Construct a table showing the range changes necessary for this muzzle velocity every 1000 yards in range.

Example

Range to target 4000, barometer 30 inches, temperature 20° F.,
temperature charge 30° F., wind 10 miles against

Entering table A with barometer and temperature, we get	-9 per cent. change in C.
Entering table B with 9 per cent for 4000, we get	+ 37.5 yards
Entering table C with 30° for 4000, we get	+ 201.5 yards
Entering table D for 4000, we get.....	+ 21.1 yards
Total correction	+ 260.4 yards

The range to be given gun would be 4000 plus 260.4 = 4250, in round numbers.

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Start firing at that range and assume that when you have obtained a bracketing range with 6 shorts and 6 overs your guns are laid at 4100.

Reduce this to normal conditions by subtracting the correction you added above, $4100 - 260.4 = 3839.6$, which is the normal gun range obtained from firing. Subtracting this from the measured range, $4000 - 3839.6 = 160.4$ yards, error due to change in muzzle velocity under normal conditions.

From column 4, Zone 3, in the 6-inch howitzer range table, we see that for the range in round numbers 3850 a range change of 71 yards would result from a change in M. V. of 10 feet per second. Therefore $\frac{160.4 \times 10}{71} = 22.6$ f.s. change in M. V. or 25 in round numbers.

Therefore $900 - 25 = 875$ M. V. of gun.

Table E is an extract from column 4 of the range table, 6-inch howitzer, Zone 3. From it we can construct the following table of range changes to be added to all ranges sent to the guns:

	Add		Add		Add	Add
1000	42	:	50	4000	:	175
2000	84	:	100	5000	:	200
3000	125	:	125	6000	:	225

The changes should be tabulated to the nearest round number as shown in the last column in order to be easily applied to the guns.

The muzzle velocity of the gun should be painted on the shield, and the chief of section should have a card tabulated as above.

If no calibration target is available or you have very little ammunition for calibrating, the following method may be used:

Run an accurately measured base line (1000 yards if possible) in continuation of battery front, with battery as near middle of base as practicable. Place an observer with telescope at each end of base line. Fire five shots from gun at mean range, and by means of double observation calculate the range to the mean point of impact for the group. Reduce this range

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to normal and take the difference between the normal range and that fired at. You will then have the range error due to change in muzzle velocity. From here proceed as in the first case.

Example

Take same data as in previous example. Assume that gun has been laid at 4000 yards and fired five shots, and that the calculated mean range of the shots is 4100 yards. Reduce this to normal by subtracting the calculated correction.

$4100 - 260.4 = 3839.6$, which is the range at which the gun should have been laid with normal conditions to produce the same results. Subtracting this from the range at which the gun was actually laid gives us: $4000 - 3839.6 = 160.4$ yards, error due to change in muzzle velocity under normal conditions.

We have now considered all of the corrections which have to be made in error to deliver as accurate fire as possible.

The following example will show how these corrections are applied:

Example

Map range 5000 yards, temperature air 90° F., barometer 30 inches, temperature of charge 80° F., wind 20 miles against.

From table A, under 90°, 30 inches, we have plus 5 per cent.

From table B, under 5 per cent., 5000 yards, we have 31.3 yards, the projectile will fall beyond target.

From table C, under 80°, 5000 yards, we have 102.6 yards, the projectile will fall beyond the target.

From table D we have 69.2 yards, the projectile will fall short of target. Therefore we would have the following total correction to make:

Density	- 31.3	
Temperature of powder	-102.6	
Wind	+69.2	
Total	+69.2	-133.9 = -64.7

Therefore the range sent to the guns would be $5000 - 64.7 = 4935.3$, say 4925 yards. On receipt of the above range, the chief of section would refer to his table and add 200 yards, laying the gun at 5125 yards.

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TABLE A

F.	28"	29"	30"	31"
-10	-0.088	-0.120	-0.150	-0.176
0	- .068	- .101	- .130	- .158
10	- .048	- .081	- .111	- .140
20	- .027	- .061	- .091	- .121
30	- .006	- .040	- .072	- .102
40	+ .015	- .020	- .051	- .083
50	+ .037	+ .002	- .032	- .063
60	+ .059	+ .022	- .012	- .044
70	+ .082	+ .044	+ .009	- .023
80	+ .106	+ .066	+ .031	- .002
90	+ .131	+ .092	+ .055	+ .020
100	+ .157	+ .117	+ .079	+ .042

Per cent. of change in C. for different temperature and barometer readings.

TABLE B

Range Change for Plus or Minus Per Cent. Change in C.

Range	ZONE 3										
	20	17	16	14	12	10	8	6	4	2	0
1000	8.1	7.4	6.8	6.2	5.6	5.	4.	3.	2.	1.	0
2000	26.4	23.6	21.	18.3	15.7	13.1	10.4	7.8	5.2	2.6	0
3000	55.	49.1	43.2	37.3	31.4	25.6	20.4	15.3	10.2	5.1	0
4000	91.9	81.9	71.9	62.	52.	42.1	33.6	25.2	16.8	8.4	0
5000	134.2	111.8	99.5	87.2	74.9	62.6	50.	37.5	25.	12.5	0
6000	183.5	164.6	145.8	127.	108.2	89.4	71.5	53.6	35.7	17.8	0
6500	221.1	198.9	176.8	154.6	132.5	110.4	88.3	66.2	44.1	22.	0

TABLE C

ZONE 3

	1000	2000	3000	4000	5000	6000	6500
100	+ 83.6	167.3	248.8	323.2	392.	456.4	484.
90	+ 49.3	98.7	146.8	190.8	231.3	269.4	285.6
80	+ 21.8	43.7	65.1	84.5	102.6	119.4	126.6
70	0	0	0	0	0	0	0
60	- 17.7	35.4	52.7	68.5	83.1	96.8	102.6
50	- 31.8	63.7	94.8	123.2	149.4	173.9	184.4
40	- 43.1	86.3	128.4	166.8	202.3	235.6	249.8
30	- 52.1	104.3	155.1	201.5	244.3	284.5	301.7
20	- 59.5	119.	177.	229.9	278.9	324.7	344.2
10	- 65.3	130.7	194.3	252.5	300.2	356.5	378.
0	- 88.7	177.5	263.9	342.9	415.8	484.1	513.4
-10	-112.1	224.3	333.5	433.3	515.6	611.8	648.8

TABLE D

AX for Wind 10 Miles per Hour

ZONE 3

1000.....	1.4
2000.....	4.4
3000.....	11.
4000.....	21.1
5000.....	34.6
6000.....	57.4
6500.....	79.3

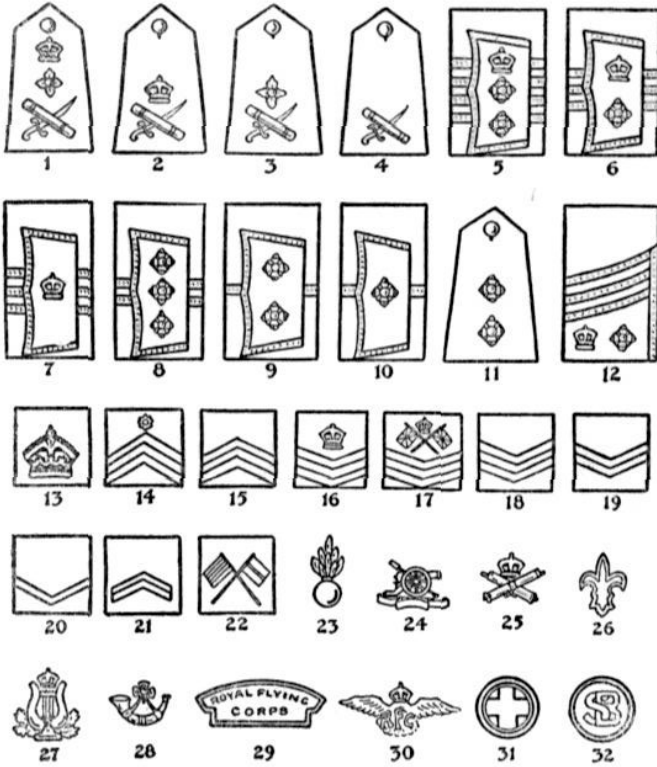
TABLE E

Range Change for 10 f. s. Change M. V.

Range	Yards. Change
1000.....	19.1
2000.....	28.2
3000.....	56.8
4000.....	73.8
5000.....	89.5
6000.....	104.2
6500.....	110.5

Insignia of Foreign Armies

INSIGNIA—BRITISH ARMY



Insignia. *Worn on shoulder straps.*

1. General.
2. Lieutenant-General
3. Major-General.
4. Brigadier-General.

Insignia. *Worn by all other officers on sleeve, except as noted under 11 and 12.*

5. Colonel.
6. Lieutenant-Colonel.
7. Major.
8. Captain.
9. First Lieutenant.
10. Second Lieutenant.
11. Shoulder Strap as Worn by Officers of the Guards, and on All Officers' Overcoats. *Rank is shown by the same insignia as is worn on cuff.*
12. Cuff as Worn by Officers in Scotch Regiments. *Rank is shown by same insignia as is worn on other cuffs.*

Chevrons. *Worn by non-commissioned officers.*

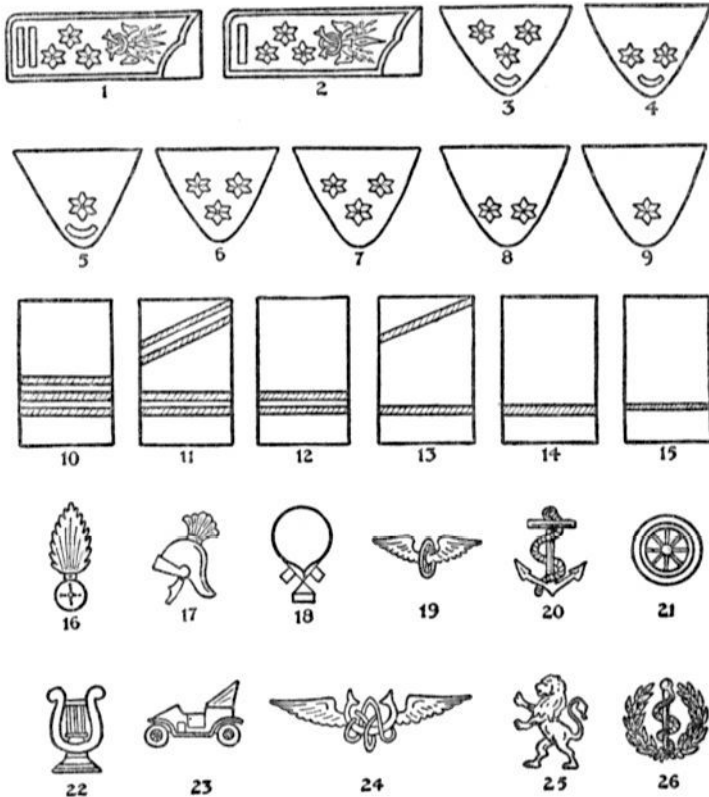
13. Staff Sergeant Major.
14. Regimental Quartermaster Sergeant.
15. Quartermaster Sergeant.
16. Company, Battery, or Troup Sergeant Major.
17. Color Sergeant.
18. Sergeant.
19. Corporal.
20. Lance Corporal.
21. Good Conduct Badge.
22. Signalman.

Devices of Branches of the Service.

23. Engineer.
24. Artillery.
25. Machine-gun Corps.
26. Scout.
27. Bandsman.
28. Bugler.
29. Flying Corps.
30. Qualified Pilot, Flying Corps.
31. Army Medical Corps.
32. Stretcher Bearer.

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INSIGNIA—BELGIAN ARMY



Insignia. *Worn on collars.*

1. General of Division.
2. General of Brigade.
3. Colonel.
4. Lieutenant-Colonel.
5. Major.
6. Commandant. *Three stars gold.*
7. Captain. *Two stars gold, one silver.*
8. First Lieutenant.
9. Second Lieutenant. *Star in gold.* Adjutant. *One star in silver.*

Chevrons. *Worn by non-commissioned officers.*

10. First Sergeant Major.
11. Sergeant Major.
12. First Sergeant.

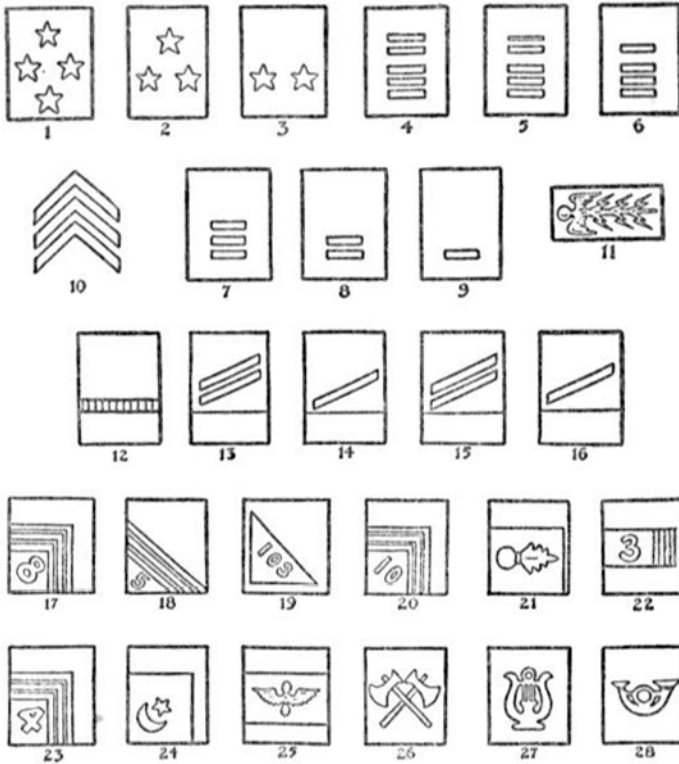
13. Quartermaster Sergeant.
14. Sergeant.
15. Corporal.

Devices. *Worn on collar or arm.*

16. Grenadier.
17. Engineer.
18. Balloonist.
19. Railway Regiment.
20. Pontoonier.
21. Cyclist.
22. Bandsman.
23. Motor Corps.
24. Aviator.
25. Interpreter.
26. Medical Service.

INSIGNIA OF FOREIGN ARMIES

INSIGNIA—FRENCH ARMY



Insignia. *Worn on arm just above cuff.*

1. General.
2. General of Division.
3. General of Brigade.
4. Colonel.
5. Lieutenant-Colonel.
6. Major.
7. Captain.
8. Lieutenant.
9. Sous Lieutenant.
10. Trench Chevrons. *Worn by both officers and men on the arm above the elbow. One chevron denotes a year's service at the front, each additional chevron six months' additional service.*
11. Collar Device of General Staff.

Chevrons. *Worn by non-commissioned officers.*

12. Adjutant. *Band of black and gold braid.*
13. Sergeant Major. *Chevron of gold braid.*
14. Sergeant, *Chevron of gold braid.*

15. Corporal or Brigadier. *Chevrons of colored cloth.*
16. First Class Private. *Chevrons of colored cloth.*

Collar Patches of Branches of Service. *Braid and number of regimental color.*

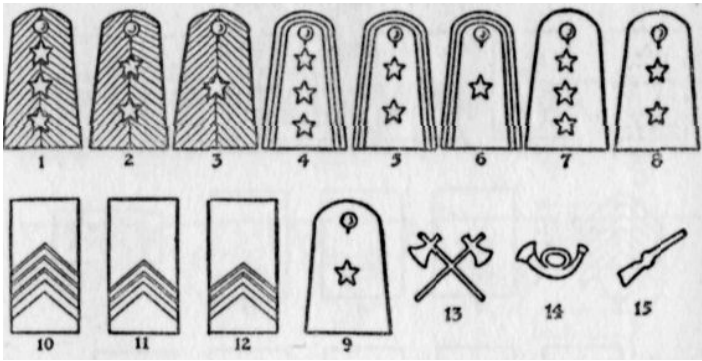
17. Cuirassiers and Dragoons.
18. Hussars and Horse Chasseurs.
19. Infantry.
20. Foot Chasseurs.
21. Artillery.
22. Aviation Corps.
23. Zouaves. *Wear khaki instead of blue.*
24. Spahis. *Wear khaki instead of blue.*

Arm Devices.

25. Aviation Corps.
26. Pioneer.
27. Bandsman.
28. Trumpeter.

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INSIGNIA—ITALIAN ARMY



Italian Officer's Shoulder Straps.

1. General.
2. Lieutenant-General.
3. Major-General.
4. Colonel.
5. Lieutenant-Colonel.
6. Major.
7. Captain.
8. Lieutenant.
9. Under Lieutenant.

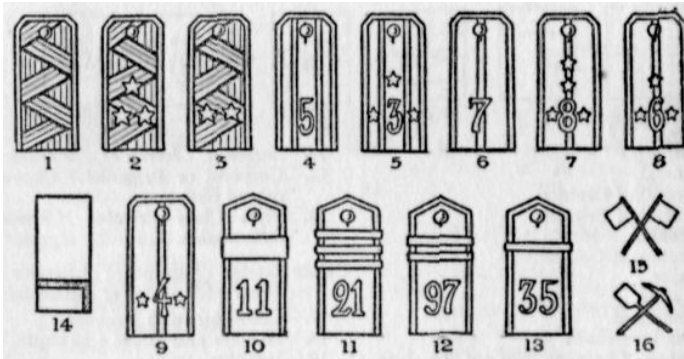
Enlisted Men, Sleeve Devices.

10. Staff Sergeant.
11. Sergeant. *Braiding in white.*
12. Corporal. *Braiding in red.*

Italian Arm Devices.

13. Pioneer.
14. Trumpeter.
15. Sharpshooter.

INSIGNIA—RUSSIAN ARMY



Russian Officer's Shoulder Straps.

1. General.
2. Lieutenant-General.
3. Major-General.
4. Colonel. *The number designates the regiment to which the wearer belongs.*
5. Lieutenant-Colonel.
6. Captain.
7. Captain on the Staff.
8. Over Lieutenant.
9. Lieutenant.

Enlisted Men, Shoulder Straps.

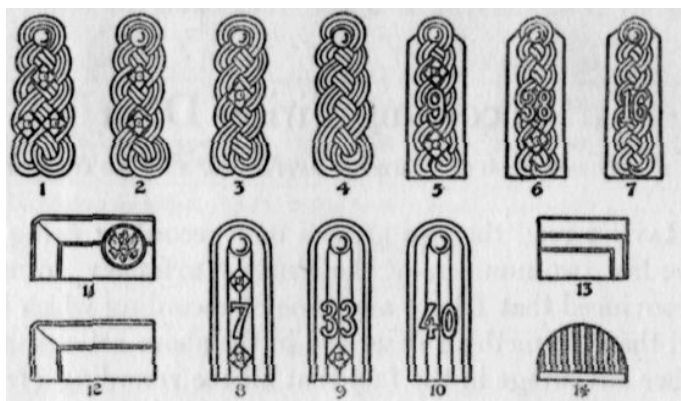
10. Staff Sergeant (Feldwebel).
11. Sergeant Major.
12. Sergeant.
13. Corporal.
14. Sleeve Braiding. *Worn by all non-commissioned officers.*

Russian Arm Devices.

15. Signalman.
16. Pioneer.

INSIGNIA OF FOREIGN ARMIES

INSIGNIA—GERMAN ARMY



German Insignia of Rank.

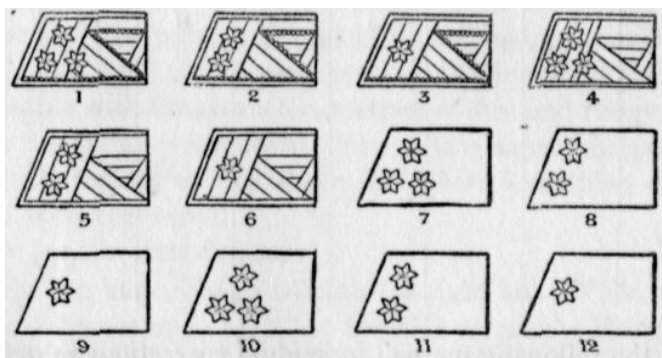
Shoulder Knots for all Officers.

1. Colonel General.
2. General of Infantry, Cavalry, or Artillery.
3. Lieutenant-General.
4. Major-General.
5. Colonel.
6. Lieutenant-Colonel.
7. Major.
8. Captain.
9. First Lieutenant.
10. Second Lieutenant.

Collar Devices. Worn by non-commissioned officers.

11. Staff Sergeant (Feldwebel).
12. Other Non-commissioned or Under-officers.
13. Sleeve Braiding Non-commissioned or Under-officers.
14. Shoulder Piece Bandsman or Trumpeter.

INSIGNIA—AUSTRIAN ARMY



Austrian Insignia of Rank.

All worn on the collar.

Stars of silver or gold embroidery.

1. Corps Commander.
2. Division General.
3. Brigade General.
4. Colonel.
5. Lieutenant-Colonel.
6. Major.
7. Captain.
8. First Lieutenant.
9. Second Lieutenant.

Stars of cotton embroidery.

10. Staff Sergeant.
11. Sergeant.
12. Corporal.

Some special staff departments wear markings in the form of an embroidered rose instead of the star. The number and the arrangement to show rank are the same.

Recording Firing Data

BY SERGEANT ARNO R. G. FRITSCH, BATTERY "B," 2D FIELD ARTILLERY

HAVING read the two articles on "recording firing data" in the last two numbers of the FIELD ARTILLERY JOURNAL, I am convinced that I have a scheme of recording which is more rapid than the methods described in the above articles, and has another advantage in the fact that all the recording (from the deflection down to and including the range) is done by one man on one page of a pocket note-book.

Scout No. 1 is the logical man, and incidentally the one required to do the recording at the battery; while the Instrument Sergeant, or, if he is too busy, Scout No. 2 will do the recording at the B. C. Station.

The recorders' data book is ruled in the following manner:

D	DD	AS	KR	M	RN

In the following method individual corrections in deflection are kept in the DD column, encircled, as in the method outlined by Captain Dunn (the first of the two articles above mentioned). Another column could be ruled for such individual corrections, but the ordinary note-book is not quite large enough to permit this; so, for the want of a better place, keep such corrections in the DD column.

RECORDING FIRING DATA

The following is an example of data as sent and as recorded:

AS SENT	AS RECORDED					
	D	DD	AS	KR	M	RN
Deflection 2680. On 1st piece open by 10. Site 300. Corrector 30. Right right. 3400.	2680	F+10	500	30	RR	3400
Right 40. On 2d piece open by 5. Up 10. 3600.	-40	S+5	....	+10	....	3600
	2640 -5	F+15		40		
	2635					
Left 10. On 4th piece close by 5. Down 5. 3600.	+10	L-5	....	-5	....	5600
	2645 +15	F+10		35		
	2660					
Left 120. On 3d piece close by 15. Site 10 higher. Battery 2 rounds. 3500.	+120	T-15	+10	....	B2	3500
	2780 +30	F-5	310			
	2810					

The following is a detailed explanation of the above:

Take the first salvo. Set 2680 under column marked D. Then F + 10, for "On 1st piece open by 10," in the DD column. Do the same with the corrector, method of fire and range. As soon as the range is set down, draw a line across the page so that all the figures will be above it. There is nothing else to be done with this salvo.

Now for the second salvo:

Write -40 under the D column for right 40. Write S + 5 for "On 2d piece open by 5," in the DD column. Place +10 in the KR column for "Up 10" and 3600 in the range column. The range having been announced, you know there are no more data for this salvo, so go back to the D column and subtract the -40, leaving a deflection of 2640. Add the +5 in the DD column to the +10 already there. The 2d piece being once removed from the right piece, place a 5 in the D column, with the opposite sign to that which you have before the announced

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deflection difference in the DD column before it. In this case you have + in the DD column, so it will be - in the D column. Subtract this 5 from the deflection. This gives deflection 2635, on 1st piece open by 15. Now go to the corrector column and add the 10 to the 30 already there. Draw a line across the page so that all the figures of the second salvo will be between it and the line above. Keeping all the figures pertaining to a salvo between two lines facilitates checking the record in case of an error.

The third salvo:

Write + 10 under D, L-5 under DD, -5 under KR, 3600 under RN. Now go to the D column and add the 10 to the deflection. This gives us 2645. Under DD we have -5. Subtract this from the +15 already there, leaving +10. The last or fourth piece is thrice removed from the first or right piece, so 3 times 5 (the DD announced in the salvo) equals 15. Place +15 under the deflection and add, giving a total of 2660. It is plus 15 because the sign before the announced DD is minus. Subtract the 5 in the KR column from the 40 already there, leaving a corrector of 35. Now underline the salvo. The D and DD now is 2660, on 1st piece open by 10.

Fourth salvo:

Write +120 under D, T-15 under DD, +10 under AS, B2 under M, and 3500 under RN. Go back to the D column. Add the 120 to the deflection. In the DD column subtract -15 from the +10 already there, leaving -5. The third piece is twice removed from the first or right piece, so twice 15 (the announced DD) equals 30. Place 30 in the D column with the opposite sign to the one announced in the DD, which will make it plus 30, and add to the deflection, giving a deflection of 2810, on 1st piece close by 5. Add the +10 under AS to the 300 already there, giving AS 310. Underline the salvo.

The advantage of keeping data in this manner lies in the fact that, were the "Executive" to ask "What is the deflection?" Scout No. 1 would say "Deflection 2810, on 1st piece close by 5," or whatever it may be; the DD is always on the

RECORDING FIRING DATA

1st piece, although the B.C. may have announced the DD on an interior piece. This accelerates checking and is much easier to remember than the deflections for the four different pieces as you would have to do were the DD record kept so as to read on an interior piece.

I, as instrument sergeant, have used the above method in the battery detail for about a year now, including a whole target season, and have yet to run into the problem that I or any man in the detail could not keep up with. The entire detail is trained in keeping data. Should Scout No. 1 make an error, there is another record at the B.C. Station by which Scout No. 1's record can easily be corrected.

Were we ever to attain such speed in our firing that the above method be found too slow, all that is necessary is to make all changes mentally and record the results only. The only reason for recording the changes as given is to help in checking the record.

The point I mean most to emphasize is this: Were the B.C. to announce "Deflection 1680, on 3d piece open by 10," the recorder's record would appear thus:

D	DD	
1680	T + 10	
	<hr style="width: 50px; margin: 0 auto;"/>	
-20	F + 10	Or deflection 1660, on 1st piece by 10.
<hr style="width: 50px; margin: 0 auto;"/>		
1660		

The results on the recorder's record will show the DD as being on the right piece; and that the last figures, or the figures nearest the bottom of the page in each column, are the net results, or the data up to date, as you might say. Whether the range is changed or not, I always record it anew in each salvo so as to keep it before me, for an officer firing often forgets his range, and the instrument sergeant will know just where to look for it if he does not remember it, and is asked for it.

Improved Methods of Instruction Employed in National Army Camps

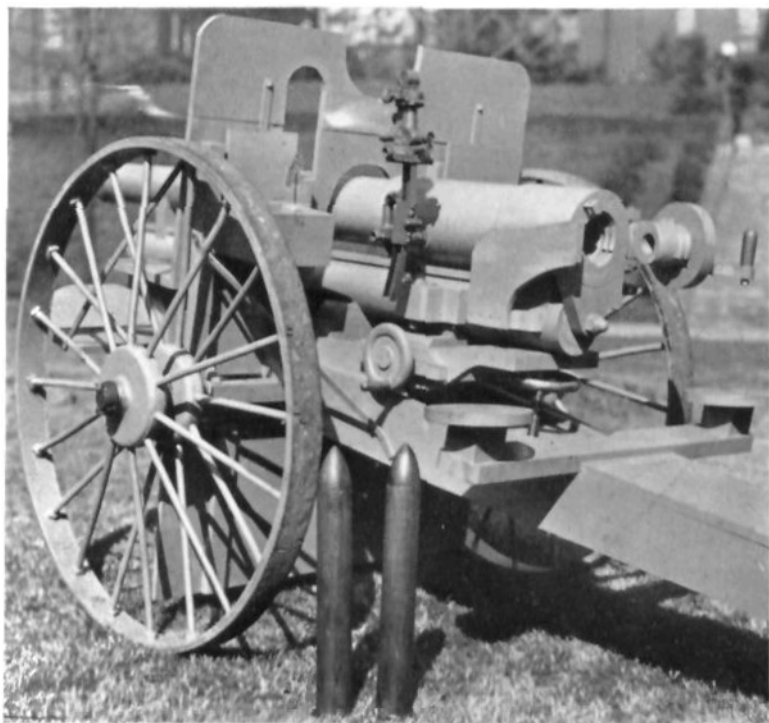
THE WOODEN GUN

BY CAPTAIN JAMES L. FORT, 321ST FIELD ARTILLERY

WITH only four guns to eighteen batteries it was exceedingly difficult in our cantonment to give the recruits assigned to the artillery the necessary training to fit them as gunners and cannoneers, as the schedule allowed each battery the use of the guns only every three days, and then only for an hour and a half. It was, of course, desirable that the recruits be advanced as much and as quickly as possible.

Near our cantonment is the Georgia School of Technology, which has been made a "military college" since the declaration of war. The college has very complete wood and machine shops and a good foundry. Upon my request Dr. J. S. Coon, Superintendent of Shops, agreed to build a wooden three-inch piece for the use of my battery in drill. With the battery we were using a spare panoramic sight and a spare quadrant were available, and with these and four iron wheels which I was able to secure the college agreed to build the gun, using the students in the college in the work. Under this agreement the students received their shop instruction and the battery got a gun. Just how successful were the efforts of the college is shown by the accompanying pictures.

The gun they made can be elevated and traversed, and every part of the firing drill can be executed with the wooden gun. It has a top shield and apron, both of which are on hinges. The drill in preparing for action and march order can be gone through with in detail, and, as the tube has a three-inch bore, the wooden drill cartridges can be placed in it. The breech is practically a complete dummy of that of our three-inch piece.



IMPROVISED METHODS OF INSTRUCTION

The gun has inspired great enthusiasm on the part of the men and is proving to be of considerable value in their training.

I offer this statement for the benefit of other organizations which have not yet received their matériel as a suggestion of a plan by which drill matériel may be secured, with small expense.

THE ARTILLERY CHART

PURPOSES FOR WHICH IT IS USED

The artillery chart is intended for use in instruction in deflection, the laying of the gun, topography, map reading and map making, panoramic sketching, conventional signs, the description of targets and aiming points, and the selection of aiming points. Its particular use is for indoor instruction and for instruction when material is not available. Its greatest value is in training the battery commander's detail and noncommissioned officers, though it is available for use in instructing privates. It is an effort to combine theory and practice.

MOUNTING THE CHART

The chart is mounted up on beaver board or some other thick, stiff paper. The mil circle is mounted on a thin, durable cardboard. A thumb tack is then used to mount the circle on the centre of the chart. Map tacks and a heavy black thread are used in the operation of the chart. Five duplicate charts compose the required set.

HOW THE CHART IS USED

For Explanation and Practice in Indirect Laying

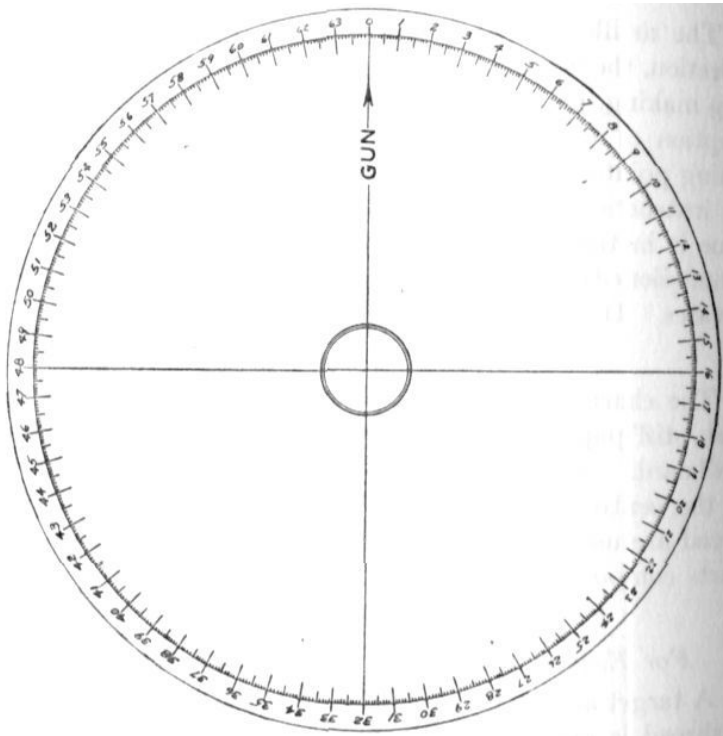
A target and an aiming point are chosen by the instructor. A thread is extended from the centre thumb tack to a map tack on the border of the chart, across the target. Another thread is then extended across the aiming point in the same manner. The line on the circle marked *gun* is then brought in line with the thread going to the target and the student is then asked to give the deflection. In choosing the target one is found behind one of the hills indicated by the topographic maps immediately around the circle. After this is understood

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by the student, then an aiming point is selected and he is given a deflection and told to lay the gun. The instructor has one chart before him, and the others are operated by four students.

For Figuring Deflection

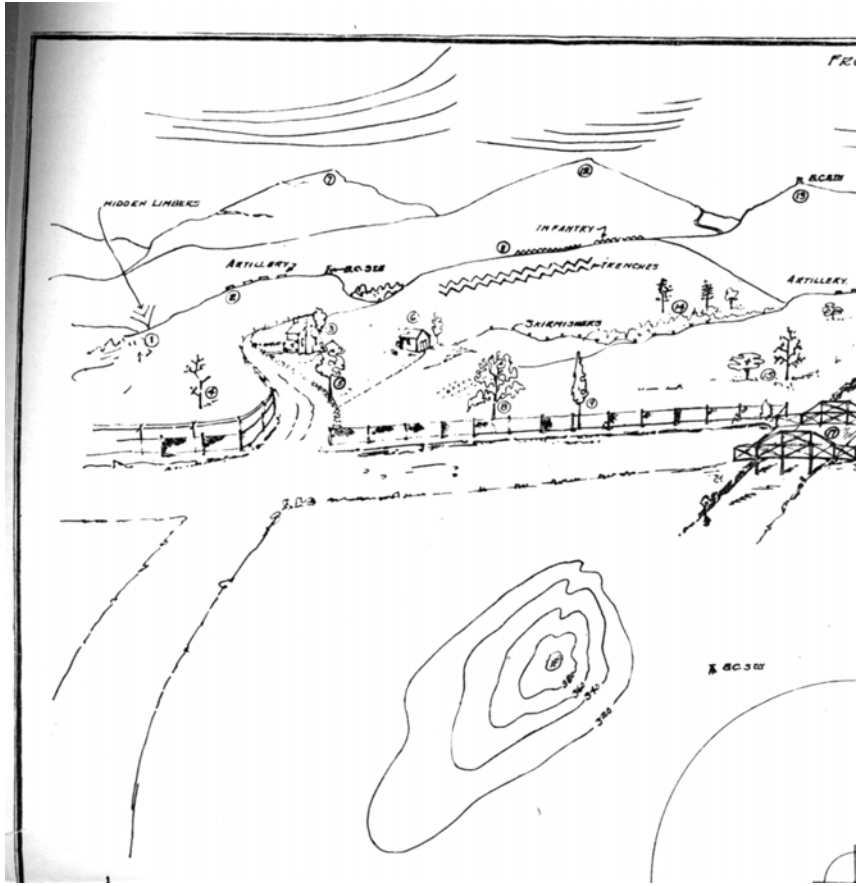
By placing tacks in the B. C. stations immediately around the circle and extending threads from them the angles necessary in the explanation of the methods for figuring the

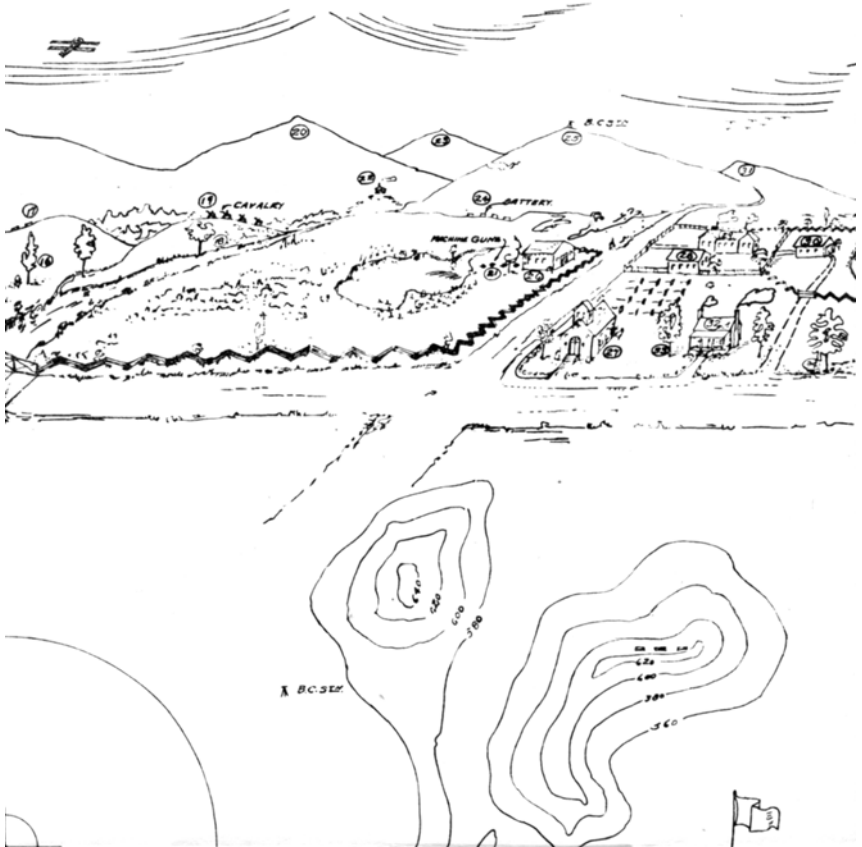


deflection can be presented on the chart, and these, with the upper and lower sketches, will enable the student to visualize the method and help him to a quicker understanding of it than is possible with the usual blackboard method.

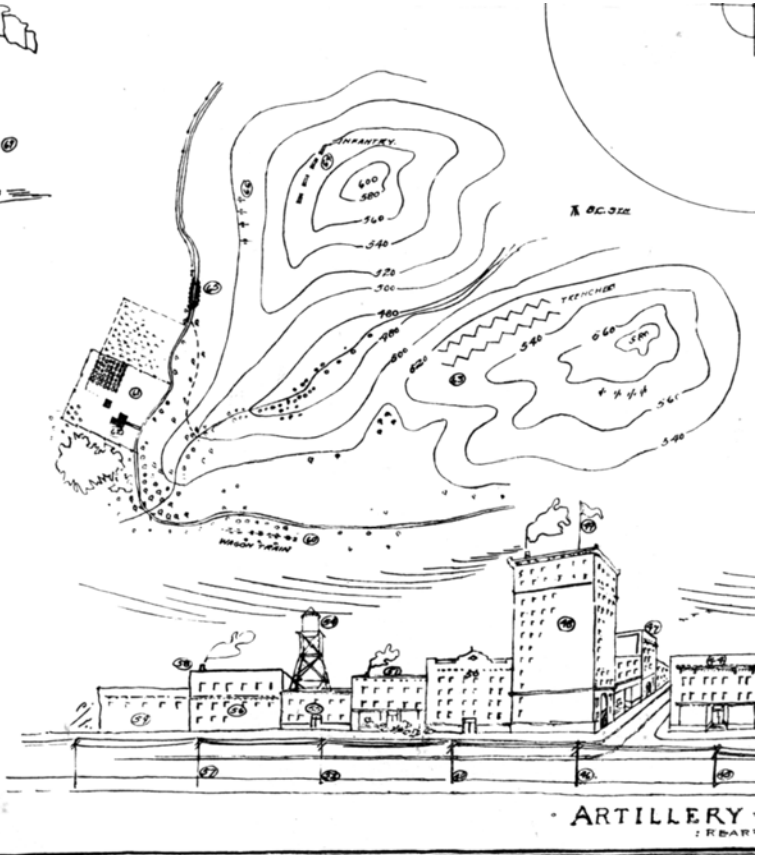
For Topography

The sketches and maps are both available for the study of topography.

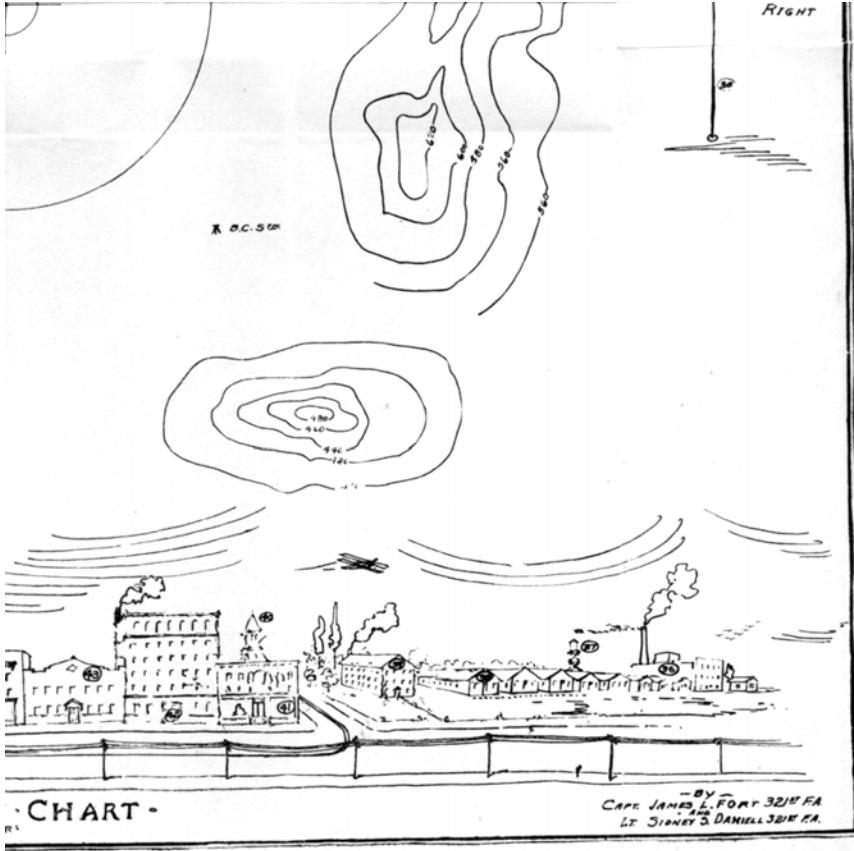




LEFT



ARTILLERY REAR



IMPROVISED METHODS OF INSTRUCTION

For Map Reading, Map Making, and Conventional Signs

The topographical maps which surround the circle are available for the above purposes.

For Panoramic Sketching

The upper sketch can be used as a sector and the necessary lines in the construction of a sketch pointed out. The method used in drawing a picture can be explained and the students required to make copies of it and compare with the original. Vital points about the sketch can be indicated to the student, and objects of particular interest to the artilleryman pointed out. The lower sketch also can be used in the same way.

Description of Targets and Aiming Points and the Selection of the Latter

The two sketches can be used for the above purposes in the same manner as the landscape would be used, treating the upper portion of the chart as the front, the lower part as the rear. It has been found that by coloring the two sketches this instruction is more complete and satisfactory. A light wash of water-color is all that is necessary for this coloring.

Computing Firing Data

BY NOLAND BLASS, CAPTAIN F. A. R. C.

THE following method of computing firing data was taught the students of the First Officers' Training Camp, at Fort Logan H. Roots, and of the Second Officers' Training Camp, at Leon Springs. It was introduced at both camps by Major Richard Burleson, who was the senior instructor of artillery at these two camps.

Although the computation by this method requires a slightly longer time, the more accurate deflection thus secured is surely worth the two or three extra minutes, especially when the battery is to be in one position some time. This method is commonly called the "Sine Method," because of the employment of the natural sines of known angles in finding unknown distances. This method is a step further toward accuracy than is any previous well-known method.

Always remember that the sine of any angle X equals the side opposite the angle (OP) divided by the hypotenuse ($Hyp.$)—*i.e.*,

$$\text{Sine } X = \frac{OP}{Hyp} \text{ or}$$

$$\text{Sine } X \times \text{Hyp} = OP.$$

In Fig. 1, let angle A , which is used to designate the angle at the Battery Commander's Station (B), measured from the aiming point (P) to the target (T), equal 2440 mils. Let angle G , which is used to designate the angle at B , measured from P to the guns G , equal 650 mils.

Let range to T be 3500 yards

Let range to P be 10,000 yards

Let range to G be 1100 yards

COMPUTING FIRING DATA

To solve, drop a perpendicular from G to line PB extended. Call this point where the perpendicular cuts the line, M . Similarly, drop a perpendicular from G to line TB , or TB extended, and call the point of intersection N . Thus, two right triangles are formed, BMG and BNG . In triangle BMG we know that the angle GBM equals 650 mils (measured).

Sine of 650 mils \times 1100 yds. (hypotenuse) = GM (opposite side).

Sine of 650 is 0.5955.

0.5955×1100 yds. = 655.05 yds.

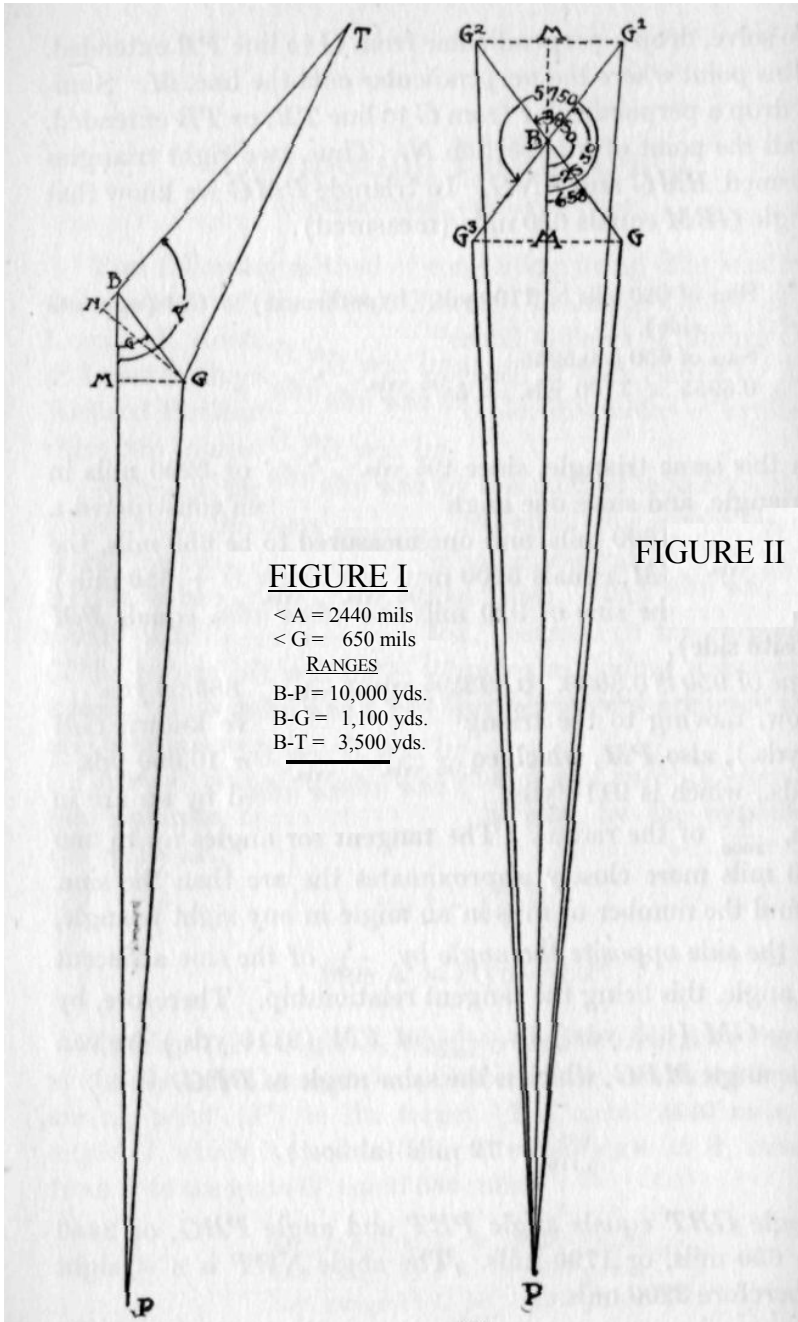
In this same triangle, since there are 180° or 3200 mils in any triangle, and since one angle BMG has been constructed a right angle, or 1600 mils, and one measured to be 650 mils, the other angle, BGM , equals 3200 mils $-$ (1600 mils $+$ 650 mils) = 950 mils. The sine of 950 mils \times 1100 yards. equals BM (opposite side).

Sine of 950 is 0.8033. 0.8033×1100 yds. = 883.63 yds.

Now, moving to the triangle MPG , we have known GM (655 yds.), also PM , which equals $PB - MB$, or 10,000 yds. $-$ 884 yds., which is 9116 yds. A mil is measured by an arc in length, $\frac{1}{1000}$ of the radius. The tangent for angles up to 300 or 400 mils more closely approximates the arc than the sine, so to find the number of mils in an angle in any right triangle, divide the side opposite the angle by $\frac{1}{1000}$ of the sine adjacent to the angle, this being the tangent relationship. Therefore, by dividing GM (655 yds.) by $\frac{1}{1000}$ of PM (9116 yds.) we can find the angle MPG , which is the same angle as BPG .

$$\frac{655}{9.116} = 72 \text{ mils (almost).}$$

Angle GBT equals angle PBT and angle PBG , or 2440 mils $-$ 650 mils, or 1790 mils. The angle NBT is a straight line, therefore 3200 mils.



COMPUTING FIRING DATA

In the triangle BNG angle $NBT - \text{angle } GBT = \text{angle } NBG$.

$$3200 - 1790 = 1410 \text{ mils.}$$

Sine of 1410 mils is 0.9827.

$$0.9827 \times 1100 \text{ yds.} = 1080.97 \text{ yds. (GN).}$$

$3200 \text{ mils} - (1600 \text{ mils} + 1410 \text{ mils}) = 190 \text{ mils (angle } NBG\text{).}$

Sine of 190 mils is 0.1854.

$$0.1854 \times 1100 \text{ yds.} = 203.94 \text{ yds. (BN).}$$

Although the means of arriving at the size of angles MBG and NBG are similar in all deflection problems, there are minor differences of procedure. By working one or two of these problems with the four cardinal points, P , T , B , and G , in various relations to each other any one can so familiarize himself with this method of computing firing data as to be able to solve a problem in three to five minutes.

In order, however, to shorten the time required for solutions after this much is understood, there is suggested the following:

In any right triangle the sine of any acute angle $A = \frac{OP}{Hyp} = \frac{a}{c}$

$$\text{Sine of the other acute angle } B = \frac{OP}{Hyp} = \frac{b}{c}$$

The cosine of an angle equals the side adjacent over the hypotenuse.

$$\text{Cosine } A = \frac{b}{c}$$

$$\therefore \text{Sine } B = \text{cosine } A.$$

Instead of using the sines of two different angles, MBG and MGB or NBG and NGB , we use the sine and cosine of the same angle MBG in the one triangle and NBG in the other.

Thus we have:

$$1100 \text{ yds.} \times \text{sine } 650 \text{ mils} = MG.$$

$$1100 \text{ yds.} \times \text{cosine } 650 \text{ mils} = MB.$$

$$1100 \text{ yds.} \times \text{sine } 1410 \text{ mils} = NG.$$

$$1100 \text{ yds.} \times \text{cosine } 1410 \text{ mils} = NB.$$

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This shortens the process slightly, but it is of chief advantage only when used in conjunction with this following short cut.

From trigonometry we learn that we should divide a circumference up into quadrants; we find for every acute angle in the first quadrant an angle in each of the higher quadrants whose functions, in absolute value, are equal to those of acute angles of the first quadrants. That is another way of saying that there are four angles in every circumference whose sine functions are identical and whose cosine functions are identical. For example:

The sine of 10 mils, 3190 mils, 3210 mils, and 6390 is 0.0098.

The cosine of 10 mils, 3190 mils, 3210 mils, and 6390 is 0.9999.

The sine of 450 mils, 2750 mils, 3650 mils, and 5950 is 0.4273.

The cosine of 450 mils, 2750 mils, 3650 mils, and 5950 is 0.9041.

This is a fact we must all agree to before going further. Then, no matter what the size of the angle G , we can definitely give it sine function identical with the sine function that it would have were it of the corresponding size and located in any of the other three quadrants.

In the problem shown in Fig. 1, angle G is 650 mils and the sine is 0.5955; were angle G 2550 mils, 3850 mils, or 5750 mils, the sine would be the same and the perpendicular distance GM^1 , GM^2 , GM^3 would all be the same. The range corrections BM would likewise all be the same (see Fig. 2).

With this understood, we can state positively that in finding the number of mils in the angle BPG the sine of the measured angle G , no matter what its size, multiplied by the measured range BG (hypotenuse), gives the perpendicular distance. By multiplying the cosine by the measured range, the correction for the range B to P is found. From this point the value of angle BPG is found as in the explanation of the problem above. By subtracting the smaller of the measured angles (angle A and

COMPUTING FIRING DATA

angle G) from the larger, the difference will be an angle whose sine and cosine will be identical with the sine and cosine of the angle required for obtaining the perpendicular distance GN and

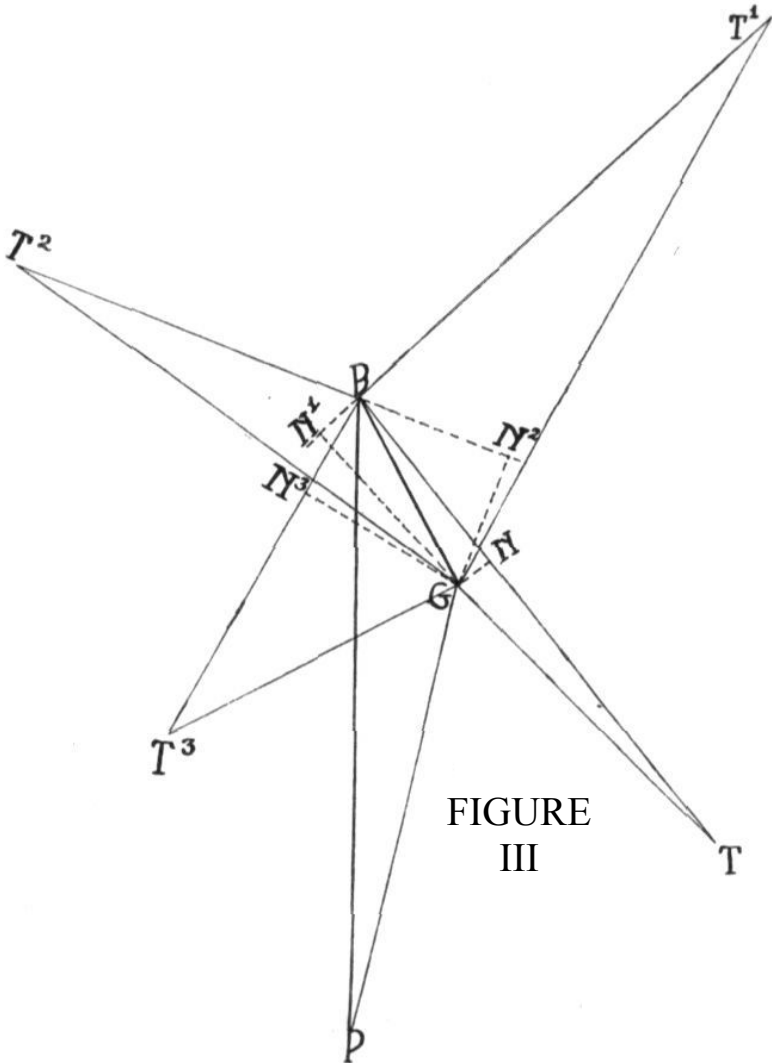


FIGURE
III

the correction of the range, which distance you will require for determining the size of the angle BTG .

To show graphically that this is true, in Fig. 3 let angle

THE FIELD ARTILLERY JOURNAL

PBG be any angle G . Let PBT^1 , PBT^2 , PBT^3 each represent a different angle A , each larger than angle (G) and each in a different quadrant measured from P ; then by subtracting graphically angle G from any of the angles A you will find that the resultant angle is either the actual angle required in the triangle BNG , its supplement, the exact angle + 3200 mils, or the supplement + 3200 mils. As all of these angles have the same functions, one can state that subtracting angle G from A , if the latter be larger, will produce an angle whose sine and cosine are the same as the sine and cosine of the angle GBN .

(See Fig. 4.) Let PBT equal any angle A . Let PBG , PBG^1 , PBG^2 , PBG^3 each represent a different angle G , each larger than angle A . By subtracting graphically angle A from angle G will give either the exact angle, GBN , its supplement, the exact angle + 3200 mils, or its supplement + 3200 mils. One can also state, therefore, that subtracting angle A from angle G will produce an angle whose sine and cosine are the same as the sine and cosine of angle GBN .

From the two paragraphs next above it is evident that no figures need be drawn and no attention need be paid to any angles except the two measured angles A and G . Always use the sine and cosine of the measured angle G to obtain the data for the angle at P and for the data for the angle at T , the functions of the angle which is the difference between the larger and the smaller of the two angles A and G .

$$TN - TB = BN. 3500 \text{ yds.} - 1012 \text{ yds.} = 3703.94 \text{ yds.}$$

In triangle TNG the angle $NTG = NG$ divided by $\frac{1}{1000}$ of TN , or 3703.94 yds.

$$\frac{1080.97}{3.704} = 292 \text{ mils (almost).}$$

The original angle A was measured as 3440 mils. Both corrections are additive.

72 mils + 291 mils = 363 mils. 363 mils + 2440 mils = 2803 mils, which is the correct deflection.

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Stating all that goes before in a few words, the angle BPG can be found exactly by dividing the perpendicular distance

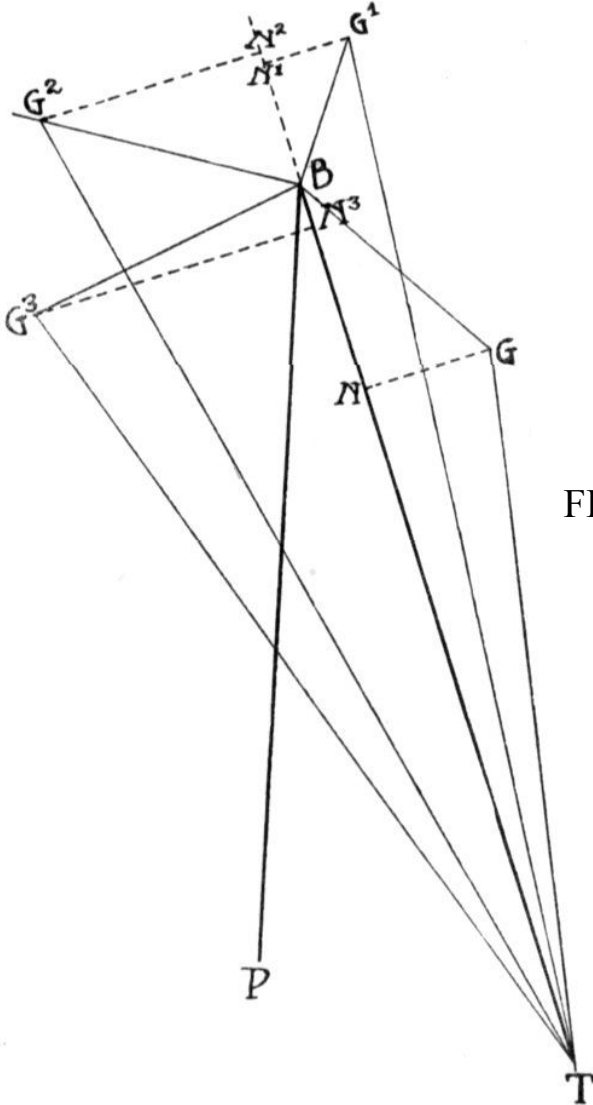


FIGURE IV

GM (found by multiplying the sine of angle G by the measured range) by $\frac{1}{1000}$ of the corrected range MP (found by subtracting

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from or adding to BP the correction, which in turn was found by multiplying the measured range BG by the cosine of the angle G).

The angle BTG can be found accurately by subtracting angle A from G , or *vice versa*, and using the sine and cosine of the resulting angle, which has the same functions as the angle GBN , used in the problem solved above.

Now comes the question of whether BM is to be added to or subtracted from BP and whether BN is to be added to or subtracted from BT . By looking again at Figs. 2, 3, and 4 you can formulate this rule. If the angle dealt with, angle G in triangle GMB , or the difference between angle A and angle G or angle G and angle A is more than 1600 mils or less than 4800 mils, BM is to be added to BP and BN to BT ; if more than 4800 mils or less than 1600 mils, BM is to be subtracted from BP or BN from BT .

For convenience and speed in solving these problems, the following form is suggested for the actual work of the problem. The first thing to put down on the paper or pad is the range from B to G ; this is written down four times (see accompanying plan). The first two are to be used always for the angle BPG and will be multiplied always by the sine and cosine of the angle G . Write down to the left the number of mils in angle G , then under the 1100 to the left place the sine, and underneath the 1100 to the right place the cosine. Multiply both, and the product of the multiplication on the right is added to or subtracted from the range BP . Divide that answer by 1000 by pointing off three places, and use that as the divisor, with the product of the left-hand multiplication as the dividend. The quotient is the angle BPG , and is set off from the rest by a heavy circle or box. Similarly place to the left of two lower 1100's the angle found by subtracting angle A from angle G , or angle G from angle A . Place the sine under the 1100 to the left and the cosine under the 1100 to the right and proceed as above. The figures in the circle or square are the angle BTG .

COMPUTING FIRING DATA

Angle G = 650
 Range to G = 1100
 Range AP = 10,000

A. P.

1100 .5955 (sin 650) <hr style="width: 100%;"/> 5500 5500 9900	+	1100 .8033 (cos 650) <hr style="width: 100%;"/> 3300 3300 8800
5500		883.6300 -
9.116 655.0500 + 71.8 (72)		
63812		
16930		10000.0
9116		883.6
78140		9116.4 (corrected range to AP)

A-G = 1790
 Range T = 3500

T

1100 .9827 (sin 1790) 7700 2200 8800 9900	+	1100 .1854 (cos 1790) 4400 5500 8800 1100
3.704 1080.9700 + 291		203.9400 +
7408		3500.
34017		3703.94
33336		
6810		
3704		
+ 291		
+ 72		
Angle <u>A</u> 2440		
2803 = Deflection		

After determining whether the correction for angle *A* is to be increased or diminished by the amounts of angles *BPG* and *BTG*, place opposite the circle or square containing the figures showing the sizes of the angles the sign + or -.

The sine method with this arrangement on paper is speedy, accurate, and simple. It needs only three or four trials to master the principles.

For convenience here is appended a combined sine and cosine table. Note that one may read down to the foot of the first column to 1600 mils and then from foot to head of second column to 3200 and so on to 6400 mils. These functions, though differently arranged, were taken from Danford & Moretti, "Notes on Training Field Artillery Details."

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Sin	Angles in mils				Cos	Sin	Angles in mils				Cos
0.0000	0	3200	3200	6400	1.0000	0.4713	500	2700	3700	5900	0.8820
.0098	10	3190	3210	6390	.9999	.4800	510	2690	3710	5890	.8773
.0194	20	3180	3220	6380	.9997	.4886	520	2680	3720	5880	.8725
.0293	30	3170	3230	6370	.9995	.4970	530	2670	3730	5870	.8678
.0392	40	3160	3240	6360	.9993	.5056	540	2660	3740	5860	.8628
.0491	50	3150	3250	6350	.9988	.5141	550	2650	3750	5850	.8578
.0586	60	3140	3260	6340	.9982	.5225	560	2640	3760	5840	.8527
.0685	70	3130	3270	6330	.9975	.5307	570	2630	3770	5830	.8476
.0784	80	3120	3280	6320	.9968	.5390	580	2620	3780	5820	.8423
.0882	90	3110	3290	6310	.9960	.5473	590	2610	3790	5810	.8369
.0978	100	3100	3300	6300	.9951	.5556	600	2600	3800	5800	.8315
.1077	110	3090	3310	6290	.9942	.5635	610	2590	3810	5790	.8261
.1176	120	3080	3320	6280	.9930	.5717	620	2580	3820	5780	.8204
.1271	130	3070	3330	6270	.9919	.5797	630	2570	3830	5770	.8148
.1369	140	3060	3340	6260	.9906	.5878	640	2560	3840	5760	.8090
.1467	150	3050	3350	6250	.9892	.5955	650	2550	3850	5750	.8033
.1564	160	3040	3360	6240	.9877	.6034	660	2540	3860	5740	.7974
.1662	170	3030	3370	6230	.9861	.6113	670	2530	3870	5730	.7914
.1756	180	3020	3380	6220	.9845	.6191	680	2520	3880	5720	.7853
.1854	190	3010	3390	6210	.9827	.6266	690	2510	3890	5710	.7793
.1951	200	3000	3400	6200	.9808	.6343	700	2500	3900	5700	.7731
.2045	210	2990	3410	6190	.9789	.6419	710	2490	3910	5690	.7668
.2142	220	2980	3420	6180	.9768	.6495	720	2480	3920	5680	.7604
.2238	230	2970	3430	6170	.9746	.6567	730	2470	3930	5670	.7543
.2335	240	2960	3440	6160	.9724	.6641	740	2460	3940	5660	.7476
.2428	250	2950	3450	6150	.9701	.6715	750	2450	3950	5650	.7410
.2525	260	2940	3460	6140	.9676	.6788	760	2440	3960	5640	.7342
.2619	270	2930	3470	6130	.9651	.6858	770	2430	3970	5630	.7278
.2715	280	2920	3480	6120	.9625	.6930	780	2420	3980	5620	.7210
.2807	290	2910	3490	6110	.9598	.7001	790	2410	3990	5610	.7141
.2901	300	2900	3500	6100	.9569	.7071	800	2400	4000	5600	.7071
.2996	310	2890	3510	6090	.9541	.7141	810	2390	4010	5590	.7001
.3090	320	2880	3520	6080	.9511	.7210	820	2380	4020	5580	.6930
.3181	330	2870	3530	6070	.9480	.7278	830	2370	4030	5570	.6858
.3275	340	2860	3540	6060	.9448	.7342	840	2360	4040	5560	.6788
.3368	350	2850	3550	6050	.9415	.7410	850	2350	4050	5550	.6715
.3461	360	2840	3560	6040	.9379	.7476	860	2340	4060	5540	.6641
.3551	370	2830	3570	6030	.9348	.7543	870	2330	4070	5530	.6567
.3643	380	2820	3580	6020	.9313	.7604	880	2320	4080	5520	.6495
.3735	390	2810	3590	6010	.9276	.7668	890	2310	4090	5510	.6419
.3827	400	2800	3600	6000	.9239	.7731	900	2300	4100	5500	.6343
.3915	410	2790	3610	5990	.9202	.7793	910	2290	4110	5490	.6266
.4006	420	2780	3620	5980	.9162	.7853	920	2280	4120	5480	.6191
.4097	430	2770	3630	5970	.9122	.7914	930	2270	4130	5470	.6113
.4187	440	2760	3640	5960	.9081	.7974	940	2260	4140	5460	.6034
.4273	450	2750	3650	5950	.9041	.8033	950	2250	4150	5450	.5955
.4363	460	2740	3660	5940	.8998	.8090	960	2240	4160	5440	.5878
.4452	470	2730	3670	5930	.8955	.8148	970	2230	4170	5430	.5797
.4540	480	2720	3680	5920	.8910	.8204	980	2220	4180	5420	.5717
.4625	490	2710	3690	5910	.8864	.8261	990	2210	4190	5410	.5633

COMPUTING FIRING DATA

Sin	Angles in mils				Cos	Sin	Angles in mils				Cos
0.8315	1000	2200	4200	5400	.5556	0.9569	1300	1900	4500	5100	.2901
.8369	1010	2190	4210	5390	.5473	.9598	1310	1890	4510	5090	.2807
.8423	1020	2180	4220	5380	.5390	.9625	1320	1880	4520	5080	.2715
.8476	1030	2170	4230	5370	.5307	.9651	1330	1870	4530	5070	.2619
.8527	1040	2160	4240	5360	.5225	.9676	1340	1860	4540	5060	.2525
.8578	1050	2150	4250	5350	.5141	.9701	1350	1850	4550	5050	.2428
.8628	1060	2140	4260	5340	.5056	.9724	1360	1840	4560	5040	.2335
.8678	1070	2130	4270	5330	.4970	.9746	1370	1830	4570	5030	.2238
.8725	1080	2120	4280	5320	.4886	.9768	1380	1820	4580	5020	.2142
.8773	1090	2110	4290	5310	.4800	.9789	1390	1810	4590	5010	.2045
.8820	1100	2100	4300	5300	.4713	.9808	1400	1800	4600	5000	.1951
.8864	1110	2090	4310	5290	.4625	.9827	1410	1790	4610	4990	.1854
.8910	1120	2080	4320	5280	.4540	.9845	1420	1780	4620	4980	.1756
.8955	1130	2070	4330	5270	.4452	.9861	1430	1770	4630	4970	.1662
.8998	1140	2060	4340	5260	.4363	.9877	1440	1760	4640	4960	.1564
.9041	1150	2050	4350	5250	.4273	.9892	1450	1750	4650	4950	.1467
.9081	1160	2040	4360	5240	.4187	.9906	1460	1740	4660	4940	.1369
.9122	1170	2030	4370	5230	.4097	.9919	1470	1730	4670	4930	.1271
.9162	1180	2020	4380	5220	.4006	.9930	1480	1720	4680	4920	.1176
.9202	1190	2010	4390	5210	.3915	.9942	1490	1710	4690	4910	.1077
.9239	1200	2000	4400	5200	.3827	.9951	1500	1700	4700	4900	.0978
.9276	1210	1990	4410	5190	.3735	.9960	1510	1690	4710	4890	.0882
.9313	1220	1980	4420	5180	.3643	.9968	1520	1680	4720	4880	.0784
.9348	1230	1970	4430	5170	.3551	.9975	1530	1670	4730	4870	.0685
.9379	1240	1960	4440	5160	.3461	.9982	1540	1660	4740	4860	.0586
.9415	1250	1950	4450	5150	.3368	.9988	1550	1650	4750	4850	.0491
.9448	1260	1940	4460	5140	.3275	.9993	1560	1640	4760	4840	.0392
.9480	1270	1930	4470	5130	.3181	.9995	1570	1630	4770	4830	.0293
.9511	1280	1920	4480	5120	.3090	.9997	1580	1620	4780	4820	.0194
.9541	1290	1910	4490	5110	.2996	.9999	1590	1610	4790	4810	.0098

Compilation of Orders

No. }
Changes, }

WAR DEPARTMENT,
Washington, December , 1917.

Paragraph 176, Compilation of Orders, 1881–1915, is rescinded and the following substituted therefor:

176. (Page 407.) Documents and maps marked "Secret," "Confidential" or "For official use only."—1. A document or map marked "Secret" is for the personal information of the individual to whom it is officially entrusted, and of those officers under him whose duties it affects. The officer to whom it is entrusted is personally responsible for its safe custody, and that its contents are disclosed to those officers mentioned above, and to them only. The existence of such a document or map will not be disclosed by the officer to whom it is entrusted, nor by his officers, without the sanction of superior military authority. No document or map marked "Secret" will be taken into the front-line trenches in the theatre of war. A document or map marked "Secret," even though it may bear other classifying marks, such as "Confidential" or "For official use only," will, nevertheless, be regarded as "Secret" within the meaning of this paragraph.

2. A document or map marked "Confidential" is of less secret a nature than one marked "Secret," but its contents will be disclosed only to persons known to be authorized to receive them or when it is obviously in the interest of the public service that they receive them.

3. The information contained in a document or map marked "For official use only" will not be communicated to the public or to the press, but may be communicated to any person known to be in the service of the United States, simply by virtue of his official position.

4. Documents and maps classed as "Secret" or "Confidential" will not be referred to in any catalogue or publication which is not itself a document marked "Secret" or "Confidential," as the case may be. An officer or soldier who communicates information contained in a document or map marked "Secret" or "Confidential" or "For official use only" will, at the same time inform the person or persons to whom he communicates the information that it is "Secret" or "Confidential" or "For official use only," as the case may be. The only legitimate use an officer or soldier may make of documents or information of which he

COMPILATION OF ORDERS

becomes possessed in his official capacity is for the furtherance of the public service in the performance of his duty. Publishing official documents or information, or using them for personal controversy, or for any private purpose without due authority, will be treated as a breach of official trust, and may be punished under the Articles of War, or under Section 1, Title I, of the espionage act approved June 15, 1917. (Bulletin No. 43, War Department, 1917.)

(000.72, A.G.O.)

By order of the Secretary of War:

JOHN BIDDLE,

Major General, Acting Chief of Staff.

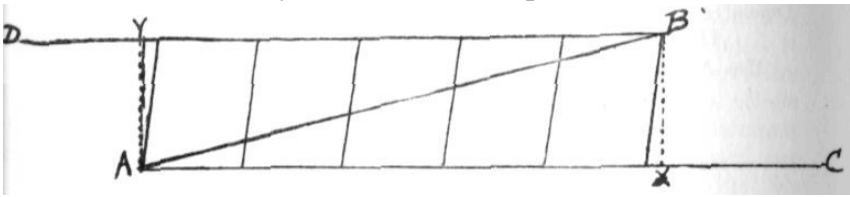
Official:

H. P. MCCAIN,
The Adjutant General.

NOTES

A Method for Dividing a Line into a Given Number of Equal Parts

IN constructing scales for use in sketching, the division of a line into a given number of equal parts is ordinarily done by means of triangles, parallel rulers, or dividers. In the method set forth below, for which originality is not claimed, the only instruments necessary are a ruler and a pencil.



Let AB be a line, four inches long, to be divided into five equal parts.

Draw AC , making any convenient angle with AB .

Lay off from A , perpendicular to AC , the distance AY (equal to BX).

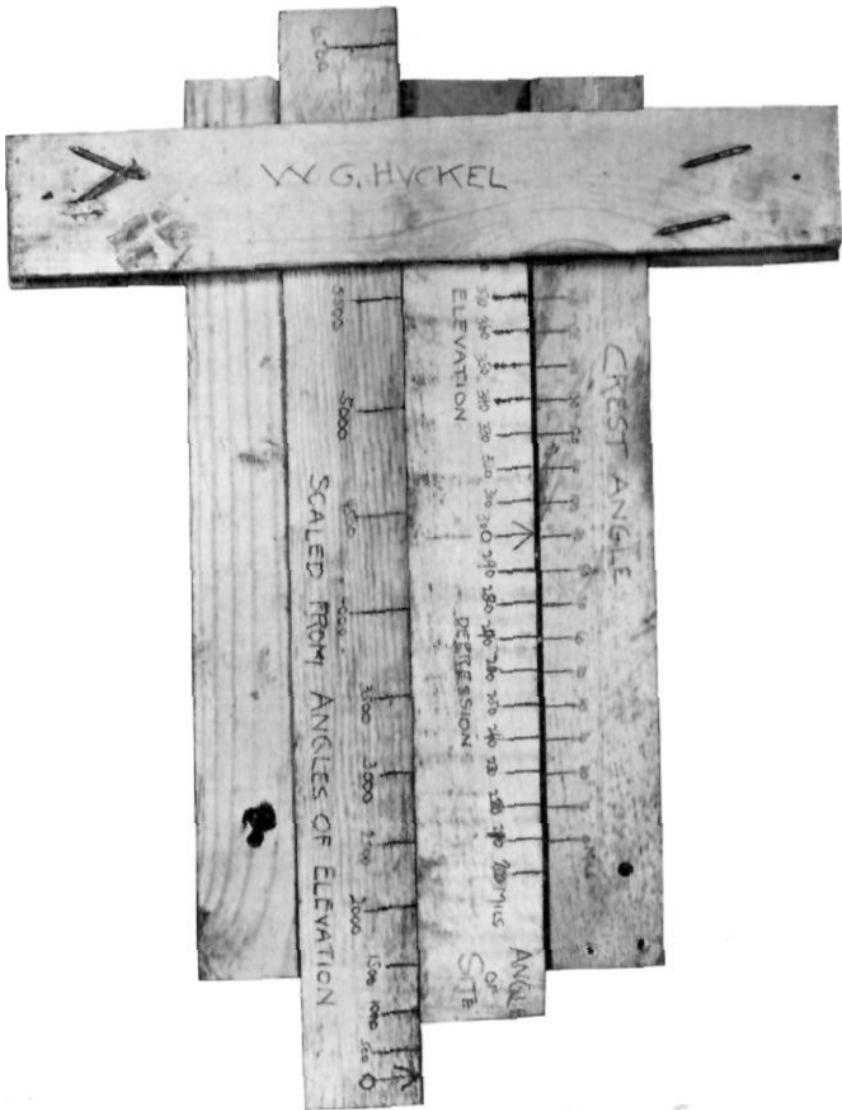
Draw DB through Y . On AC , commencing at A , lay off any convenient distance, say $\frac{3}{4}$ inch, five times. Lay off same distance five times on DB , commencing at B . Connect the divisions as shown in sketch.

Improvised Battery Commander's Rule

THIS slide rule was scaled for a 3-inch gun, and was made in forty minutes out of the sides of a box, and in the simplest manner possible, a saw, hammer, nails, lead-pencil, ruler graduated in twentieths, compass, piece of string, and a button being used.

The smallest graduations used were ten mils in the "*Crest Angle*" scale, ten mils in the "*Angle of Site*" scale, and five hundred yards in the "*Range*" scale.

A series of problems has demonstrated the rule to be very accurate, the greatest variation, either from the range tables or by formula, being about twenty-five yards.



IMPROVED BATTERY COMMANDER'S RULE

NOTES

The scale has a solid back, upon the back of which is a slope scale in mils, such as is made upon the back of a drawing-board.

Fixed to the face of the back at the top is the "*Crest Angle*" scale, graduations pointing downward. Directly below is the "*Angle of Site*" scale (movable), graduations pointing upward. Below the "*Angle of Site*" scale is a movable "*Range*" scale. All three scales are, of course, scaled with the same unit of measurement, and the "*Range*" scale is computed from the angles of elevation for the various ranges.

Fixed to the face of the back at the bottom is a cleat to hold the scales in position. Out of the same materials a cursor or straightedge is made to facilitate reading the rule.

To use the rule: Measure the angle to the crest with the slope scale on the back. Estimate the distance to the crest. Knowing your angle of site to the target, place the angle of site value on your "*Angle of Site*" scale under the crest angle value on the "*Crest Angle*" scale; place the value of the range to the crest on your "*Range*" scale under the zero point of the "*Crest Angle*" scale. Read the minimum range to clear the crest on the "*Range*" scale directly under the zero point on the "*Angle of Site*" scale. Dead space is a matter of subtraction.

The rule can be adapted for any gun by scaling the "*Range*" scale from the corresponding range table.

EXAMPLE

Range to crest	700 yards
Angle to crest	80 mils
Angle of Site.....	310

Scale shows a minimum range of 2800 yards.

Verification by formula:

C

$$MR = K + ADC-si$$

MR = minimum range.

C = height of crest above observer in yards.

K = 1/1000 of range to crest in yards.

si = Site to target-300.

ADC = angle of departure for range to the crest.

$$= \frac{56}{.7} + 13.8 - (+ 10)$$

$$= 80 + 3.8 = 83.8 = \text{Angle of Departure for } MR.$$

MR = 2800 yards (from 3-inch gun range table).

THE UNITED STATES FIELD ARTILLERY ASSOCIATION

Annual Meeting

THE annual meeting of the Association was held in Washington, December 21, 1917, at the Army and Navy Club. A quorum for the transaction of business was present in person or by written proxy. The minutes of the last meeting were approved. The Treasurer presented his financial statements, and a committee composed of Major Sherman Miles and Major Roger S. Parrott was appointed to audit the Treasurer's books. The Secretary-Editor submitted his annual report. Col. Alfred A. Starbird was elected a member of the Executive Council, to succeed General Menoher, whose term of office had expired. There was an informal discussion of the affairs of the Association, after which the meeting adjourned.

REPORT OF THE SECRETARY-EDITOR

There was a very large increase in the business of the Association during its fiscal year ended November 30, 1917, due, of course, to the growth of the Army and the increased interest in military subjects throughout the country, combined with the unremitting efforts of the management to introduce THE FIELD ARTILLERY JOURNAL where its work seemed most needed. The total business of the Association amounted to \$12,441.91, including \$268.78 in bills which had not been paid at the close of the fiscal year. The total cash income was \$12,173.13, not including the \$712.56 on hand at the beginning of the year. The total expenditures for the year amounted to \$4205.88, leaving a cash balance on hand at the close of the year of \$7967.25. The transactions are shown in detail in the following tabulated statement:

RECEIPTS	
Balance on hand, December 1, 1916	\$ 712.56
Subscriptions, copies sold, books, etc	10,463.16
Advertisements, net.....	990.19
Interest on deposits	7.22
	\$12,173.13
EXPENDITURES	
Printing, engraving, postage, stationery, etc.....	\$ 3,460.10
Telegrams, express, freight.....	4.38
Personal services	583.00
Books, subscriptions, etc., for members.....	32.25
Refunds and miscellaneous expenses	126.15
	4,205.88
Balance on hand, November 30, 1917.....	\$ 7,967.25
Bills due and payable.....	268.78
	\$ 8,256.05
Total assets	\$ 8,256.05

THE U. S. FIELD ARTILLERY ASSOCIATION

More than half of the increase in the business occurred during the last half of the year, and the consequent increased cost of operations must in part be borne during the following year. It will not, therefore, be possible to maintain during the coming year the great difference between income and expenses which appears in the business of the past year. THE FIELD ARTILLERY JOURNAL now has a paid circulation of over 4300, and the list is steadily growing. While the expenses of the Association will necessarily be greater during the coming year than during the past year, the income, with reasonably good management, will be amply sufficient in the future to meet all expenses; and thus, after seven years of self-sacrificing effort on the part of the management, THE FIELD ARTILLERY JOURNAL is a safely established institution.

The number of members of the Association in the Field Artillery of the Regular Army increased during the year by about one-half. The greatest increase has been among officers of the Reserve Corps and of the National Army, and the sincere thanks of the Association are due to the instructors of field artillery at the training camps and to the commanding officers of regiments of Field Artillery in the National Army for the work they have done in introducing THE JOURNAL.

EDITORIAL DEPARTMENT

Where Money Spent is Life Saved

WE quote entire an editorial under this heading from the *Boston Evening Transcript* of September 15, 1917, that should be widely read, because it is a timely effort on the part of the editor to bring home to those outside the military service the vital necessity of spreading as rapidly as possible, throughout our growing armies, correct ideas concerning the use of field artillery in modern war. This is, in reality, a stupendous task, the successful accomplishment of which requires continuous and well-directed effort on the part of our field artillery experts, backed by liberal appropriations by Congress. We firmly believe that the great body of our taxpayers will never grudge the cost when it is made clear to them, as this newspaper seeks to do, that every dollar spent for such special training means the saving of life in our fighting forces in Europe—but let the *Transcript* speak for itself:

"From an American field artillery commander on service 'beyond the seas' the last mail brings the following:

"We are well aware here of the deep interest of the *Transcript* in the efficiency of the Army, and I therefore take the liberty to suggest a topic of vital importance to the country at this time. The topic is as follows:

"Each division of the National Army should have a school of fire for field artillery similar to the School of Fire at Fort Sill, Oklahoma. This is the fall of the year, and plenty of ground can be leased for artillery ranges and due precautions can be taken against danger from artillery fire. These schools should be established as soon as possible and the course should last about three months. Afternoons and evenings can be devoted to school work. In the mornings all officers can be used for training the new personnel. The artillery brigade commander with each division should be the commandant. He should have a staff of instructors, preferably men who have been at the School of Fire at Fort Sill, and who know the methods in use there.

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"Our division and infantry brigade commanders, as a rule, are engineers, cavalrymen, or infantrymen, and, not due to any fault or neglect of their own, are unfamiliar with artillery work. The brigade school will give them a familiarity with artillery and enable them to use it to the best advantage on the battlefield. For the sake of national security and for the good of the service it is hoped that this important need may be publicly agitated and soon applied.

"It ought not to be necessary for the fathers and mothers of the nation to agitate the necessity of expert instruction in field artillery for the officers who will command their sons under fire, but the above plea indicates that not all has been done in that direction that the needs of the army demand. The School of Fire at Fort Sill was opened in September, 1911. It was closed in May, 1916, at the time of the make-believe mobilization on the American border, and reopened only a short time ago. The school has done more to develop an *esprit* and efficiency in the field artillery than any other factor. It has always been handicapped by the limited funds and insufficient staff and personnel at its disposal. At no time were more than about twenty-five students from the Regular Army in attendance. With a hundred students there at the present time, only that number, at the end of three months, will have received modern and thorough training in the handling of artillery. Each of the artillery brigade schools proposed could turn out a hundred students in the same period of time. Their establishment would mean system and uniformity in training and artillery efficiency. For them the Fort Sill School of Fire should be the mother school. Its printing establishment should be enlarged so that it can readily supply field artillery literature in sufficient quantities to the brigade schools. Each brigade school should have a small printing establishment for statistical purposes. The course of instruction should be prescribed from Fort Sill and each student officer allowed at least one hundred rounds of ammunition.

"Every dollar spent on ammunition and equipment for an artillery brigade school of fire at every cantonment in the

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country will save the Government a hundred dollars on the battlefields of Europe. Furthermore and foremost in point of importance, here is an opportunity to spend money that will save life. The agitation for it may come from the people, but we must look to Washington for action. Here is an opportunity for the foresight and commonsense of Senator Weeks to be exercised with timely effect. As a member of the Senate Committee on Military Affairs he has identified himself constantly and consistently with the upbuilding of military efficiency, and we venture that the needs of the Fort Sill School of Fire and its extension schools will not escape his notice."

Commenting upon this editorial, it is only fair to say that the War Department has been for some time fully aware of the necessities of the case and had already taken steps to accomplish everything contended for by the *Boston Transcript* and more. This is made clear elsewhere in this number in an article on "The Mission of the School of Fire for Field Artillery," to which the attention of our readers is especially invited.

THERE will be found in another part of this issue a copy of an order to be issued with reference to the extreme necessity of maintaining the secrecy of confidential pamphlets.

AGAIN, within the year, a change in the editors of the JOURNAL must be announced. The requirements of service having removed the previous editor from Washington, it was necessary for him to turn over the work to some one stationed here in order to carry out the provisions of the present constitution of the Association, which provides that THE JOURNAL must be edited by an officer on active duty stationed in Washington.

These are conditions which should be immediately corrected, as the length of stay in Washington of any officer on the active list is a thing most uncertain, especially at the present time. Without a deliberate violation of the constitution, there is a

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possibility of a different editor for every issue during this war.

The provisions which require that the editor be an officer on the active list and stationed in Washington were probably well founded in the days of peace, when there were plenty of capable officers on duty in Washington who had a considerable amount of leisure time on their hands. Then it was necessary to remain in Washington to keep in touch with what was going on. But such uncertainty as has taken place during these past months was never contemplated—men shifted here and there, with an entire reorganization of the School of Fire, and the centre of information regarding Field Artillery possibly shifted there.

The constitution should be immediately made flexible enough to cover all emergencies, not by a shift of editors and possible change of editorial policy, but by some means that will enable the editorial policy to continue and to enable the editorial head to be shifted to the point which is the centre of Field Artillery information.

Field Artillery and the Staff Departments

THE first steps in organizing the new army brought to light the appalling shortage of trained Field Artillery officers when the necessity came for expanding nine regiments of regular Field Artillery, three of which were brand-new, into twenty-one. This was again emphasized by the organization of sixteen National Army Field Artillery Brigades, each of which required its quota of regular Field Artillery officers. Added to the above came a readjustment within the Field Artillery itself, by the introduction of new matériel and new methods of training.

To meet the demand for officers, incident to these changes, the expedient of relieving all Field Artillery officers on duty in the staff departments was resorted to. For a short time it looked as though all questions regarding Field Artillery arising in these departments and requiring immediate attention would have to be decided by officers not familiar with the service which their decisions affected. Fortunately, this was recognized almost

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at once, and officers were ordered to duty in some of the departments where the need was most urgent. Short as the interval was, a large number of questions of importance came up during this period for decision requiring the technical knowledge of the thoroughly trained Field Artillery officer to pass upon them properly.

The Field Artillery will probably be called upon more and more to give up its regular officers to the staff departments, as the new officers become sufficiently proficient to relieve them from duty with troops. The needs of the staff departments for experts are quite as pressing as those of the line, insomuch as they must have officers of the various branches to pass properly upon technical questions affecting their respective arms. When called upon, the Field Artillery should give of its best, even though the individual preference may be for a line command. The general good of the service must govern rather than personal ambition.

The Military Service Institute

SHORTLY after the appearance of the July–September number of the JOURNAL, an appeal was received from the Military Service Institute for help, in an endeavor to continue the publication of its journal, which will discontinue on January 1st. This is due to the failure of members to keep up their interest in the institution, and, with their interest, their subscriptions. It is very much to be regretted that this publication must cease, as it has been the medium through which the various branches discuss the subjects common to all.

As their appeal has been printed in all service papers, it is sincerely hoped that the Field Artillery officers have shown themselves interested in the preservation of that journal.

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MICHELIN GUIDES FOR VISITING FIELDS OF BATTLE: Battle of the Marne, vol. i, Battle of the Ourcq. 19 maps, 12 portraits, 175 illustrations, 118 pages, flexible cloth. Price, 3.50 fr. (70 cents). Publishers, Berger-Levrault, Paris.

"We have tried to create for tourists who wish to visit our fields of battle and our devastated towns a work which will be both a practical guide and a history." Such is the purpose of this book. The first twelve pages give in detail the first stages of the battle of the Marne, known as the Battle of the Ourcq, and covering the period from September 1 to September 13, inclusive. Sketch maps show the position of the Allies, the 6th French Army and the English, and Von Klück's army. We can follow the entire battle with all the movements of the different units up to the beginning of the German retreat, which marks the second stage of the battle. This detailed information is all given from the layman's point of view.

Being a tourist's guide, the main body of the work is devoted to the usual information as to roads, hotels, and chief points of interest. But throughout all this there is a wealth of incident and intimate detail which, along with the numerous excellent illustrations, cannot fail to make the "Miracle of the Marne" a living event.

Though of small scientific value for an army officer, the book is well worth the time given it, if merely to make us understand and appreciate in some small way the valor, the patriotism, and the unequalled heroism of the French soldiery.

GLOSSARY OF AVIATION TERMS—Termes d'Aviation. English-French, French-English. Compiled by Lieut. Victor W. Pagé and Lieut. Paul Montariel, of Signal Corps Aviation School, Mineola, Long Island. 94 pp., 12 illustrations. Price, \$1. N. W. Henley Publishing Company, New York.

This book, as its name indicates, gives a complete glossary in both English-French and French-English of all terms used in aviation. The lists are divided into: 1, Flying Field Terms; 2, The Airplane; 3, The Engine; 4, Tools and Shop Terms.

It is not intended in any manner to be used as a book from which a conversation in French could be carried on, but to be a source of information to which one already familiar with conversational French

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can go to get the necessary technical terms used in aviation. The illustrations throughout the book are excellent; they show in detail all of the construction with the various parts named in both French and English, so that one not familiar with the usual terms in his own language has but to look at the illustrations to find them. It is a most valuable addition to the rapidly increasing store of military technical information necessary for service in France.

RAPID TRAINING OF RECRUITS. M. V. Campbell, Late Lieutenant, U. S. Marines. Frederick A. Stokes Company, New York. 16mo, 180 pages.

The publishers' note, "A practical scheme for quick results in training the national army, based on the definite record of what has been actually accomplished by England. The aim is to give the recruit instructor in American cantonments a thoroughly tested plan for whipping his men into shape speedily. A typical day's work is minutely outlined, lectures are suggested—in fact, every detail necessary to an intensive program is fully treated. The book is fully as useful to the recruit himself as to his instructor. Any intelligent enlisted man, eager for advancement, will find it of incalculable value in his efforts to get ahead," is quite well borne out in the book. It deals quite simply with the arrival of the recruit, his reception and first work, with general rules for his first training. At considerable length the various training courses which a recruit must be put through are discussed and allotted to proper time by schedule.

This book, while good in itself, is only one of many that have been brought out at this time on this or similar subjects.

GUNNERS' HANDBOOK FOR FIELD ARTILLERY. By Captains John S. Hammond and Dawson Olmstead, Field Artillery, U. S. Army. E. P. Dutton & Co., 681 Fifth Avenue, New York, 142 pages.

At irregular intervals our authorities have a way of issuing a new order which upsets prior exactions necessary to be met for gunners' qualifications. Each time this is done some officer usually gets up a gunners' pamphlet which contains the requirements relating to these examinations, together with advice as to how to proceed in order to secure qualification. Such booklets have been written by various officers in the different regiments and sold to the men without profit to the writers, since the idea is to place in the hands of the enlisted man something to assist him in his qualification, and, at the same time, save him expense. Since this relates to training which is required to bring candidates to a standard not only desired but actually needed, it seems

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that these pamphlets should be prepared by a committee of Field Artillery officers and distributed by our Government, *gratis*, as is the "Manual for Noncommissioned Officers and Privates of Field Artillery"; in fact, it should be incorporated as a part of the latter. As but the first volume of this last-named book has so far been distributed, it is hoped that an authoritative manual for our candidates for gunners will appear in the second volume, thus giving the subject official recognition.

The booklet published by Hammond and Olmstead is about what is desired for the enlisted man and covers the ground quite well. A large portion of it is necessarily taken up with extracts from the Drill Regulations and parts gleaned from the 3-inch Handbook.

The book can be improved by taking up a more thorough discussion of the calculation of firing data for the enlisted man's special education, as this is the one subject on which there are more failures among the candidates than all the rest of the subjects combined.

The little portion touching on the theory and use of telephones is particularly valuable, and the sketches are simple and should be easily understood even by a man of limited education.

Unfortunately, in a book appearing as late as September of 1917, we find that it still has data relating to semaphore signalling which are out of date, the 1914 chart (which is reproduced) having been superseded by the 1916 publication, which introduced certain changes.

This is one book that we believe should be published in such form that the enlisted man may easily carry in his pocket. The present edition in size is a little too large for such convenient adaptation.

To date it is the best compilation of data that has come to us for the use of candidates, and it is recommended.

HOW TO LIVE AT THE FRONT. By Hector MacQuarrie, A.B., Cantab.; 2nd Lieutenant, Royal Field Artillery. 12 photographic illustrations. 12mo. \$1.25 net. J. B. Lippincott Company, Publishers, Philadelphia, Pa.

Were the writer of this review a captain in the National Army and knew the contents of this volume, he would buy several copies for the use of his noncommissioned officers with a view to having them study most earnestly this book. While delightful reading for a layman, it is remarkable from a military standpoint in that it is written in a language that any man, no matter how "green," must understand. The value of this work lies in the fact that the experience of the author by association with others or actual, personal participation in numerous wartime events is used so frequently in descriptive incidents which serve to carry his point; its value, too, lies in the informality with which the

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author talks directly to his reader with assurance and impressive simplicity.

With sincerity the author writes of the menace of venereal disease, and the few direct words containing advice on that matter would be received by any one with kindness and interest. MacQuarrie's ideals will convince a man that he is a "rotter" who goes to the front to fight for his country and returns with a curse for his descendants and fellows.

The very informality of the book gives it a tremendous drive, since the slightest analysis convinces the reader that if he is looking for advice, it is there, and, furthermore, it is good advice. So, if you have a friend who is going across the waters, to live in "dug-outs," and you wish to give him something of interest and value for his sea voyage—something that, after it has served its purpose to him, may be transmitted to others and bring them some information and pleasure too—present this volume to him just before he departs for his overseas trip.

GRENADÉ FIGHTING: THE TRAINING AND TACTICS OF GRENADIERS, Lieut. G. Dyson, Brigade Grenadier Officer, B. E. F. 51 pages, 7 cuts. Price, 50 cents. George H. Doran Company, publishers, New York.

This little book contains a wealth of valuable information, designed in the main as a manual for instructors in grenade fighting. Part I contains preliminary notes on subjects of instructions, materials, equipment, and general recommendations and rules as to the training of grenadier squads. To lay proper stress on the importance of developing a high degree of skill in the practical exercises, the following division of time is suggested:

Lectures and bomb-making	10 per cent.
Throwing and observing	35 per cent.
Bayonet fighting	20 per cent.
Barricading	10 per cent.
Tactics	25 per cent.

Part II, on Training and Organization, deals in a very general way with explosives, detonators, and fuzes in use in grenades. In more detail, the tactics of the Grenadier Storming Party are described. The author emphasizes strongly the importance of bayonet and accurate grenade throwing and of barrier and barricade making, with stress on the idea that the storming party must act as a unit in which every man has a particular and definite part to play.

Finally, the operations of night patrol and night storming parties are taken up.

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The book is clear and concise; information is given in brief and intelligible language. It has numerous tables dealing with grenade and bayonet practice. It should render valuable service, both to the grenadier and to the instructor.

THE PRINCIPLES OF MILITARY ART. For Officers of All Ranks. By Major Sir Francis Fletcher-Vane, Bart. E. P. Dutton & Co., New York City. 183 pages.

Touching very lightly, in short chapters, on the subjects of Drill, Tactics, Musketry, Sketching and Map Reading, Discipline, *Esprit de Corps*, Military Law, Command, Service, Supply, Observation, Courage, and Chivalry, this book attempts to place before young officers and men interested in the military service only principles of military art. Elements only are discussed. Essentially it is not a book for a man of extended military experience, because its object is to reach "subalterns in the new army, men drawn from almost every profession and trade. . . . to obtain a grasp of the principles, so that they might afterwards be able to fit into the Chinese puzzle of their brains the various details which they would learn on the barrack square and on maneuvers."

Except for the fact that the reading of all authors on military subjects is advised for every officer in the profession of arms, since every one capable of expressing his original thoughts in book form must have some good and new idea to spread abroad, it would be ordinarily with a feeling of reserve that a foreign writer on basic principles would be recommended, because the atmosphere which surrounds an army is as different for each country as the customs of the nations themselves. But in this case a material difference is noted. The writer recognizes that in the British Army the *esprit de corps* has been carried to such extremes that the system has become narrowing, and, further, he analyzes the situation and tells the reader why it has become so. Such an author gains the confidence of an American, especially as the plea throughout the volume is rather for Military Brotherhood and an abolition of "army swank."

Any one, soldier or otherwise, may read this book with interest, because it is very human in the treatment of the subject and lacks absolutely the terse, severe style of the works which are usually written on this matter. As Clausewitz said, in effect, that the souls of men who are called upon to lay down their lives for their friends have to be fed as well as their bodies, so throughout Major Fletcher-Vane's book we recognize that he too has tried to incorporate this idea in every chapter which properly touches upon this thought.

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ARMY AND NAVY INFORMATION. By Major De Witt Clinton Falls, N. G. N. Y. Illustrated by six color plates and thirty line cuts by the author. Published by E. P. Dutton & Co., New York City. 192 pages. Net, \$1.

This book has been prepared, according to the foreword of the author, in order to present certain important information concerning the military and naval services in so simple a form that it can be readily understood by the lay reader.

It is significant that in a recent letter from the Western Front an army man asked that advertisements issued by a certain manufacturing concern be sent to him, to the number of five hundred, for distribution in the trenches. The advertisement referred to showed the insignia of rank of our different services and was in great demand by the allied troops, since it solved a perplexing problem for them. Not long ago, in one of the theatres of a large city, a young lady found an officer of colonel's rank seated next to her and, noting the silver eagle on his uniform, made the natural inquiry as to whether or not he was a member of the Aviation Corps. These incidents show the need of such a publication as that which Major Falls has just placed in print.

An attractive feature is that of the plates in color, which illustrate Army and Navy flags and signals, details of uniform of both services, uniforms and decorations of foreign armies, also various medals and badges.

Unfortunately there is a great lack of accuracy in details; for instance, under the description of the fighting force of the Army of the United States, we find the following:

"BATTERY FIELD ARTILLERY

"As prescribed for a line company of infantry. Privates are sometimes called drivers and cannoneers. In addition, 1 Guidon Sergeant, who carries the battery flag."

"LIGHT ARTILLERY

"Armed with 3 point 2 (3.2 inch) guns";
and

"Colt's Automatic Pistols, Caliber 45. Cartridges in magazine, 10."

The field artillery device shown in an illustration is one that was abandoned ten years ago.

Altogether, one feels that a book which might have filled a useful place has, very unfortunately, been thrown together in such a hurry

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that its reliability is so greatly impaired as to cause it to be a source of adverse comment on the part of a military critic.

A proper editing, coupled with corrections as to fact, should make this volume a handy reference book for civilians.

SOLDIERS' SPOKEN FRENCH. By Hélène Cross. Published by E. P. Dutton Company. New York. 128 pages.

French has become indispensable to our soldiers, for the reason that much of their training will be in France, and they will do their fighting in that country, too. Not only will a knowledge of that language be a necessity for true efficiency, but it will be needed for their hours of relaxation when duties no longer bind. Times will come when they are permitted to associate with French troops, French families, and perhaps French civilian officials. At these times even a little knowledge of French will pave the way for greater pleasure. So, from any point of view, we are justified in saying that some knowledge of this tongue should be acquired by every soldier.

It seems that several courses of French have recently been devised for our soldiers. It would be difficult to say which one is the best. All of them seem to have their good points. That the work in question has attained its end seems to be indicated by the fact that the fifth printing was accomplished in September. The lessons in this book were first devised for teaching a class of soldiers in New Zealand.

A minimum of time is devoted to grammar and a maximum of effort given to trying to teach French in the same manner as children learn their own language. The book is written in a simple manner, is clear, and contains sufficient repetition to insure the student learning what is set before him without unduly boring him.

Of small size, the volume is handy for a soldier to carry, but it contains a sufficient number of useful phrases, combined with quite a large vocabulary, to meet the ordinary circumstances that our men in uniform are liable to encounter.

UNDER FIRE (*Le Feu*). The Story of a Squad. By Henri Barbusse. Translated by Fitzwater Wray. E. P. Dutton & Co., New York City. 358 pages.

Too frequently we obtain impressions of military life from the viewpoint of one who fills a position of command and of responsibility relating to units as a whole. Seldom do we have the opportunity to be admitted to the intimate family life of a small group of men during war, who eat together, complain together, march together, fight together, suffer and even die together, as do some of the squad about which this story (if it

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may be called such) is woven. The conversation of the enlisted men reflects in a detailed manner the life which they endure, far more than pages of description might do. Vulgarities of real life in the trenches, the weariness of it all, and the prodigious horrors are represented, together with touches of tenderness and pathos.

Have you dear ones in France fighting on that soil for the honor of this, our great country? If so, a better understanding of their temporary life will come with the reading of this book, which can hardly be called a novel or a diary. It may be said to be rather the impressions of army life as observed by a private of the French Army.

This book is surely one of the great works of the year. Some time ago more than one hundred and twenty-six thousand copies had been sold in France; it received the prize awarded yearly in Paris by the Académie Goncourt for the best work written during the year.

Vivid word-pictures, whether of the individuals who live in this squad, whether of their experiences, or whether of their very thoughts in their moralizings, bring such an air of realism to the reader that he seems to be in the midst of this little military colony, and living with them, and absorbing their viewpoint as influenced by the surroundings.

THE AMERICAN SOLDIER IN FRANCE. A Military Guide-book to the French Language, Army and Nation. By George Nestler Tricoche. Edward Miller Company, Columbus, Ohio. 105 pages, in flexible cloth binding. Price, 50 cents.

A small book of handy size, containing a considerable number of the principal words and phrases that will be necessary for a soldier to make his way around without great difficulty. The words are the words of the soldier's everyday vocabulary, with the addition of the names of the necessities of clothing, etc., which he might want to purchase. The phrases are an elaboration of the words, in that they are simple combinations of the daily words used in the conversation necessary for travelling.

In addition, there is considerable useful information regarding the French Army—its organization, uniform, badges, flags, etc.

The especial value of the book lies in the fact that the author has been an officer of the French Army and therefore thoroughly knows the subject which he is covering.

Index to Current Field Artillery Literature

Compiled from monthly list of military information carded from books, periodicals and other sources furnished by the War College Division, General Staff.

Allowances—United States.—Allotments and allowances granted by the Insurance Act. Compensation for death or disability. (Congressional Record, September 7, 1917, p. 7365.)

Allowances—United States.—Analysis of allotments and compensations. (Congressional Record, September 6, 1917, p. 7307.)

Ammunition, manufacture of, Great Britain. Lessons from British experience as to methods for obtaining maximum output in manufacture of munitions. (Machinery, August, 1917, p. 1124.)

Ammunition expended in battle. Data on amount of ammunition expended in various historic battles and detailed account of weights, kinds, sizes, and amounts used in European war. (Revista Militar, August, 1917, p. 550.)

Ammunition.—Expenditure in battle, European war. Figures showing the rate of consumption of artillery ammunition. (Collier's Weekly, September 15, 1917, p. 46.)

Ammunition.—Small arms. Table giving measurements of cartridges and weight of charges for infantry rifles used by various countries. (Revista Militar, August, 1917, p. 572.)

Ammunition Supply—Great Britain.—British methods for supply of artillery ammunition by men carriers, illustrated. (The Illustrated War News, August 29, 1917, p. 23.)

Anti-aircraft Guns.—Anti-aircraft gun and crew disguised by camouflage methods. (L'Illustration, July 28, 1917, p. 88, Illus. p. 81.)

Armament, European war. "Tactics and Armament, an Evolution." (The Atlantic Monthly, August, 1917, p. 179.)

Armies.—Professional and scientific type of army coming in again. Why universal military service is out of date. (The Atlantic Monthly, September, 1917, p. 413.)

Armies—China.—Description of Chinese army in which average Chinese soldier is said to be "a bandit seeking occupation while the bandit business is dull." (Saturday Evening Post, July 28, 1917.)

Armies—France.—"Some Lessons of the War." Strength and organization of the French army at the beginning of the European war and after mobilization. Organization of a half platoon under a bomb-sergeant or fusilier-sergeant. (Journal of the Military Service Institution, September-October, 1917, p. 182.)

Artillery.—"What the gun means in this war." By Col. C. DeW. Willcox. (Collier's Weekly, September 15, 1917, p. 14.)

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Declaration of War, United States.—Pledges of United States in different wars. Declarations and comments. (Congressional Record, September 10, 1917, p. 7543.)

Depots.—Depots essential to efficiency in war. United States' experience in Civil and Spanish-American wars. (The United Service, July, 1903.)

Equipment, United States.—Field equipment and clothing recommended for France. Based on experience in France. (Journal of the Military Service Institution, September-October, 1917, p. 139.)

Field Artillery Fire—France.—French methods of regulation and control of artillery fire in European war. (Revue des Deux Mondes, July 15, 1917, p. 457.)

Field Guns—France.—Description and illustration of the French 37-mm. quick-firing cannon. (Scientific American, August 4, 1917, p. 79.)

Grenades.—Description of Mill's hand grenade, with illustration. Hint that the Allies are in possession of a powerful new war engine. (Collier's Weekly, August 25, 1917, p. 11.)

Insignia—France.—French chevrons and our own. What the French chevrons mean and why we should change them. (Infantry Journal, September, 1917, p. 213.)

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- Laws of War.*—Tinkering of British Foreign Office with laws of war. Results in 1914. (The Candid Quarterly Review, No. 4, November, 1914, p. 869.)
- Machine Guns.*—"The Vickers machine gun model of 1915." Technical description of gun. (The American Machinist, August 23, 1917, p. 309.) (Drawings.)
- Machine Guns.*—"The war of specialists—the machine gunner. How the machine gun has influenced modern military tactics." (Scientific American, August 25, 1917, p. 136.)
- Military Service—Germany.*—Good effect of universal service in Germany; a German view. (Harper's Magazine, September, 1917, p. 478.)
- Military Service—Great Britain, exemptions.*—"Committee on employment of conscientious objectors." London, 1917. (Filed Envelope Case—Military Service—G. B.—Exemptions.)
- Military Service—United States.*—Universal service in war and the taxation to support it, by General W. H. Carter, U. S. A. (Journal of the Military Service Institution, September-October, 1917, p. 127.)
- Periscopes—Germany.*—German periscopie mast for military observation. (La Science et la Vie, July, 1917, p. 177.)
- Range Finders—Great Britain.*—Cut of Hanks anti-aircraft range finder, British invention. (United Service Gazette, Aeronautical supplement, June 21, 1917, p. 1.)
- Rangefinders.*—Hanks type of rangefinders for anti-aircraft guns. (United Service Gazette, August 2, 1917, p. 43.)
- Star Shells.*—Star shells or illuminant projectiles for night operations; history, description and use of means of lighting battlefield at night. (Revista Militar, April, 1917, p. 282.)
- Tanks—Great Britain.*—"The 'tanks.' The powerful, armed, ballet-proof engine. Origin and development of the British type." (The World's Work, September, 1917, p. 569.)
- Tanks.*—List of references to current periodical literature on the subject of "tank" military tractors. (Professional Memoirs, Corps of Engineers, July-August, 1917, p. 499.)
- Transportation, Guns.*—"Tractors for hauling artillery." Illustrations. (Motor Age, August 23, 1917, p. 20.)

