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Command*

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I AM going to discuss with you this morning what is usually spoken of as "Command." The word *command* is defined, as a verb, in several ways, among which are: to order with authority; to require; to be in authority; to have power or influence. These definitions fit certain conditions but do not fully satisfy the idea of command, as I conceive it, in its broadest sense. The definition carries the thought of authority or power, due in the main to superior rank. Definitions, as such, are often too narrow and restricted, and this is especially true in military definitions. As soon as a definition is formulated, it is subjected to such a barrage of explanations regarding exceptions that one quickly sees that the meaning of many words, as used in the military vocabulary, is governed to a great extent by the context or by the way the word is used. I shall not attempt to lay down a rigid definition of command, but will attempt to create a conception—something flexible, rather than a fixed, rigid rule. I shall attempt to show that a commander should have, besides his power and authority, as per the definition, certain other qualifications which enable him to maintain, by his own ability and personality, that prestige which his military rank confers upon him.

Command has a still further meaning. It carries with it not only personal and other qualities which enable a commander to maintain his prestige, size up the situation and arrive at proper and logical conclusions; but it involves also a knowledge of the workings of the several subdivisions comprising the organization, as well as ability to make the greatest possible use of this organization.

We all admire leaders, but command goes beyond that, and while including leadership as a very necessary part of command, includes also organizational, administrative, and executive capacity.

Many men who are good advisers lack the necessary qualities to reach proper decisions. Others, while making good decisions, forget

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that they have subordinates and try to attend to all the details themselves. Still others conceive, but fail to have necessary details worked out. These are failings which command must avoid.

In our service, in the past, much stress has been laid on general staff work. Some people have been led to believe that the staff was everything and that the commander was a man of straw. This idea was more or less prevalent in some localities during the World War. It is a condition of affairs which should not exist. Still other people say that the staff consists of several types or species of minds, each type being the commander's mind for a particular kind of work. The staff is *not* the commander's mind. If he is a real commander, he has his own mind, but uses his staff as conditions require, all in a certain systematized manner. Any proposition of building up a general staff to serve a straw-man-commander is basically wrong in the American service. It may have its proper place in other services, but not in ours. It should be remembered that general staff officers, as such, have no control or authority over troops and services. Orders which they prepare should be promulgated in the name of the commander and through the channels prescribed by him. The promulgation then assumes that the commander has exercised such supervision as he deems necessary under the circumstances. Unless the commander has previously authorized the use of his name in the promulgation of orders, a staff officer should not assume that power. Naturally circumstances will arise where it is necessary for someone to do something, and in such cases a staff officer, if present, might take the situation in hand, but this should be the exception and not the rule and will be governed by the location of the master mind. The normal procedure should be that the staff officer, knowing the wishes of the higher commander but without specific authority, may and should fully advise the local commander as to what he, the staff officer, believes are the wishes, plans, etc., of the higher commander. But the responsibility and authority rests, and should rest, with the commander on the spot. This does not mean that the general staff officer is or should be a nonentity. Far from it. It is merely a question of the location, duty, responsibility and authority of the several persons, so determined as to secure proper teamwork. The local commander has certain duties, certain responsibilities, certain authority, within his sphere of action. He is placed in his position by the higher command. His responsibility and authority should be equal, co-existent and fixed, and it is not the province or the right of the unauthorized staff officer to assume authority without responsibility. We have all seen staff officers with a modicum of sense—a plethora of gall.

In any time of stress, whether in a large or small force, in an army or a squad, the master mind will come to the front.

Proper command presupposes a condition of affairs wherein the legal commander is the master mind.

We all recognize the great value of staff work. We know it to be indispensable, but it has and must have its specific sphere. Within this sphere, using command in its broad sense, staff work is a part of command.

General staff officers, within their own limits, do and should exercise command functions. A general staff officer should possess the qualities of a commander. He is a part of the command and should make himself a part of the commander. He may, on his own initiative, have to act for the commander, and hence he must possess the same attitude as the commander. In carrying out his duties, the staff officer is and must be bound by the limitations which are properly placed upon his authority.

A commander, in order to use his staff properly, must understand its workings, its powers and limitations, what to expect from the staff and how to use it to the best advantage. This knowledge and its use, with other qualities, constitute command.

Admitting all that may be advanced as to the value and necessity for a staff, the fundamental fact remains and must be recognized that it is the commander, who, making logical use of all available information, makes the necessary decisions. He may seek his information from various sources. He may ask for advice or not. He may consult whom he desires, but in the last analysis he is the deciding authority.

“In war, the leader alone understands the importance of certain things and he may alone of his own will and superior wisdom, conquer and overcome all difficulties.”

Having arrived at his decisions, the commander gives to his chief of staff, or to his assembled staff, such directives as are necessary to enable the staff to visualize his ideas and work out the details, each in his own section, all coordinated by the chief of staff. Should the detailed study show that the decision of the commander is not possible of accomplishment, it is then necessary for the commander, with his new knowledge, to make a modified or a new decision.

The decision arrived at should be concise and positive. The directions resulting therefrom must be clear, distinct, authoritative and so worded as to contain no ambiguity nor leave the recipient in doubt as to his particular duties. These instructions should carry with them the feeling that success is unquestioned.

Command is an art. Art makes use of rules but it also transcends all rules. It is governed, however, by principles. Science is knowledge reduced to law and combined in a system. Art relates to something to be done; science to something to be known. Science is the servant of art and is inspired by it.

Command, in a large sense, may be compared to the painting of a picture wherein the commander, at the outset, with only slight or meagre knowledge of events and things, makes a mental sketch, which is his first, perhaps tentative, decision. After receiving the work of his staff, relatively exact information, he is able to complete his picture by a proper use of the staff information. This picture is his final decision. If any colors of his mental picture are faulty, or missing, or not as he had anticipated, his picture will then be faulty or changed, and he must either change his previous conception or secure other colors. As no two artists will produce exactly the same picture though using exactly the same paint, so no two commanders will produce the same results though using the same staff.

Having given a decision, the commander's mind is free to conceive other things and make further decisions as occasions arise. If events so develop that the decision upon which the staff is working has to be changed, the commander must make the necessary changes in his decision, and the staff then must work in accordance with these changes.

A proper coordination by the commander, with cheerful cooperation of the staff is essential in a command. Authority, organization, decision, and supervision constitute command. Supervision and direction by the commander does not interfere with the subordinates' initiative if they are properly used. Their proper handling is command. At certain times, precise control or direction of the initiative of subordinates is necessary. This is particularly true when the subordinates are but little known to the commander or before full indoctrination. Precise control in the early steps of an operation may also be necessary in order that the proper and intended direction and impulses may be assured. The handling of this precise control involves the Art of Command.

It is an axiom that orders should not be projected too far into the future. But no limit should be placed on the foresightedness of a commander. It has been said that of the three things the enemy may do, he will usually choose the fourth. It is, therefore, necessary for the commander to be prepared for all conceivable contingencies. The staff must be cognizant and appreciative of all conditions in order that their work may be based on solid foundations, not on the shifting sands of ignorance or self-deceit.

With a staff well trained in the technique of the various sections, loyal to the chief and to the cause, possessed of proper teamwork, there can be no objection to considering the future. It must be done. There will be no loss of morale due to change of plans (provided it is not vacillation) on the part of the commander, and when the fourth of the three contingencies arises, the commander and his staff—the command—will face the new situation with a fixed determination to meet the new crisis with extra vigor.

It is not intended to imply that the commander has been waiting for the enemy to act. We all know that—to paraphrase—“He who waits is lost.” While one may temporarily adopt a waiting attitude—to win, to annihilate, one must move. What is here meant is the various reactions by the enemy that may result from our own action.

In this—the new directive to counter the reaction of the enemy, the line of action to be taken—the *decision*—must be made by the commander. On his “say so” to go right or left, forward or back, attack, hold, or retreat, all must depend; and upon his decision as a foundation, all the work of the various sections of the staff must be based. It may not be the best, but it is bound to be better than a scattering of everything under innumerable decisions.

A football team composed of individuals of medium ability, indoctrinated in teamwork and led by a real leader, will beat a team of hastily assembled stars, all wanting to carry the ball individually and in eleven different directions. What is desired in command is this same team of stars, individually well trained, thoroughly indoctrinated in teamwork and led by a field captain whose signals (decisions) normally will be the best; but whether or not considered by all as the very best under the circumstances, the play signalled must be pushed to the limit by all until the ball is down.

Having given the directive, the commander then has his mind clear to meet the next situation which may develop. If events so happen that a change in plans must be made, to take advantage of fleeting opportunities or to meet unforeseen reactions of the enemy, the commander’s mind is the master mind to determine the line of action, to render the decisions which will govern the new movements of his command.

In the directive—the memorandum which he gives his chief of staff—the commander, assuming a competent staff, should be careful not to go so much into detail as to do the work of his staff. This staff is presumed to know how to work out these details and the members of the staff are entitled to and should be allowed the same initiative

within their several spheres as the commander expects that his superiors will permit to him.

To use again the analogy of the football team, the commander is the one who gives the signal. The signal in itself tells each member of the team (the staff) what he is to do. No time is taken to tell each lineman of a team how he is to handle his man for the play called for, nor is each interfeerer told how to take out his man. Each player is presumed to be competent, else he would not be on the team. It should be the same with the staff.

Again, every one on a football team should at all times keep the field captain informed as to whether his opponent is hard to handle, so that plays may be intelligently selected. In the same way, staff officers should keep their chief constantly informed as to the possibilities, favorable or unfavorable, of their several sections in order that the commander may intelligently estimate the situation and arrive at reasonable, workable, sound decisions.

This is team work in its highest form. It is command.

Teamwork means making a workable machine out of different parts. As the members of the team vary, so must the particular methods for making the team vary; but the general principles apply in each case. The organization and proper functioning of a team involves the understanding of the Art of Command.

Personal qualifications of a commander are important and manifold. He must, first of all, have character. With this character must go many other qualities. Among these may be mentioned knowledge of his profession, with a proper amount of intelligence to enable him to utilize this knowledge. All of us have seen men who were educated beyond their intelligence, sometimes known as "bright damn fools." These are not commanders.

One of the best known sayings of the late Colonel Henderson is that "The Art of Command, whether the force be large or small, is the art of dealing with human nature." In his book *The Science of War*, Colonel Henderson reminds us that we have to deal in war not so much with numbers and arms and maneuvers, as with human nature.

Napoleon said that he found in the study of the great campaigns not merely a record of marches and maneuvers, and the use of intrenchments, but a complete study of human nature under the conditions that exist in war; human nature affected by discipline, by fear, by need of food, by the weight of responsibility and by patriotism.

Commanders whose daily work it is to govern men, must realize and be guided by this axiom: soldiers, when organized in companies

and battalions, think and act differently than they think and act as isolated individuals. For the essential distinction between a body of soldiers and a crowd of men is that the former are trained together to act under one leader, so that the group—it may be a platoon, it may be a battalion—develops a vitality of its own and has mind and spirit separate and different from those of its members. The psychology of the platoon or battalion must no more be neglected than the psychology of the individual soldier.

“Who knows the art of impressing the imagination,” said Napoleon, “knows the art of ruling.” A wise commander has more power over his command as a whole than he has over the individuals composing it. For the mind of the commander acts directly on the spirit of the group, whose members are animated by a common purpose, whose collective action the commander guides towards a single end.

The collective spirit of a group is not merely the sum or resultant, of the minds of the men composing it. Its life is far longer, its memory more retentive, its imagination more vivid. Consequently, it is more responsive to the appeals of tradition and of history, and more responsive to the guidance of its leaders. Therefore, those who would study the Art of Command must also bear in mind this second axiom, “The collective life of a group attains a far higher level, intellectually and morally, than the average of its members.”

Those who pay no heed to these two axioms limit their power of command in two ways: they make no appeal to that which is most responsive in the mind of their command, and they exercise no influence over what is best and highest in the spirit of their men.

No one can dispute the importance of the Art of Command, but by inaction we imply that it is not only a subject which we cannot teach, but also that it is a subject which cannot be taught—and so, to comfort ourselves, we say that a man is either a born leader or a born fool, and that is the end of it. But that is not the whole truth. There are some men, it is true, who are born supremely gifted in this way, but many of us can only learn by our own efforts and through the experience of others, the principles of this, as of any other art.

It is said that all men, and indeed all animals, may be divided into two classes—those who instinctively seek to lead and those who by nature are content to be led. It is obvious that either by nature or by training, all officers, to be effective commanders, must belong to the former class.

Of the qualities which fit for command, none is more essential to inspire confidence than strength and vigor, and a commander, whether he leads a pack of dogs or a company of men, must not only possess vigor, but he must also show that he possesses it. A commander whose orders, once given, are not invariably obeyed is soon despised by his command, because the command, like a pack of wild dogs, instinctively demands those qualities in their leader, which are needed for the safety of the pack, or, for the well-being of the command. He may consult freely and often with his subordinates, but a decision once given there must be no further discussion. An army is happy under a strong commander, but not under a soviet committee.

If a commander has no faith in himself, he may feel perfectly sure that his doubts will be universally shared by all under him. Knowledge breeds self-confidence. If his mind is filled with doubts and hesitations, it is best for him to hide them from himself if possible, but most certainly from his men.

A loyal commander can count on loyalty in others. Although it is a fact not always remembered, a *commander* who is disloyal can count most surely on being the direct cause of disloyalty in others. A *disloyal commander* will infect his whole command with the same fatal spirit, for it is indeed the spirit of ruin and disaster. "When the salt has lost its savor wherewith shall it be salted?"

A sense of justice is perhaps a quality equally as important as vigor in a commander. If it be not universally felt that a spirit of justice animates all commanders, then discipline, good spirit, and real cohesion vanish. We all make mistakes at times. Soldiers forgive and excuse many mistakes in their officers. But if a command, rightly or wrongly, convicts its commander of injustice, then God help that commander in peace and in war, for most certainly his men will pardon him nothing.

A commander must be direct and simple or his men will not understand what he is driving at. *Individually*, we may tolerate and laugh at a humbug, but we do not do so *collectively*. Humbug in a leader is too great a danger to an army for the army to put up with sham. Whatever a commander says or does, let him say or do it in all sincerity. A man who has no faith in his own actions, no belief in what he preaches, may deceive some individuals, but never the collective mind of his command.

The commander must have a great supply of common sense. As I have stated previously, I was once impressed by a statement that the successful commander was a man who "had seven parts common sense and one part *dope*." The best the educational system of the Army can do for a man is to give him the *dope* with the opportunity

to practice utilizing it with common sense. Only the Lord himself can supply the common sense.

There is an adage, "You can't put temper in an axe by filing the edge." We may say that the proper kind of a commander is the axe with proper temper; that is, character. Having this sort of an axe, its value may be much increased by the proper use of a file—education. Carrying the analogy still further; that use of education which produces dogmatism, bigotry, pedantry, may be compared to that use of a file which takes the edge off the best tempered axe.

General Sherman has indicated that a successful commander must be a man of action and certainly his record carries out this idea. He says, "Of course knowledge is power, we all know that; but mere knowledge is not power, it is simply possibility. Action is power and its highest manifestation is action with knowledge. 'Tis not the man who *knows* most, but the one who *does best*, that wins. Grant, and Meade, and Sheridan at the close of the war could have been taught many lessons by our learned professors, but none of these could have guided the forces to victory as did Grant at Chattanooga, defended his position as Meade did at Gettysburg, or hurled his masses as Sheridan did at Winchester. Action guided by knowledge is what is demanded of the modern general. He must know as much of the school of the soldier as any man in the ranks; he must know what men can do, and what they cannot do; he must foresee and forereach to provide in advance the food, clothing, ammunition, and supplies of every nature and kind necessary for the maintenance of the command; and moreover, he must gain the confidence and affection of the men committed to his care."

Command carries with it the idea of personal direction. For instance, a captain commands a company; Napoleon commanded his armies. In both cases the commander was able, due to the size and position of the forces, to exercise direct and personal influence. With the larger armies and the more extended formations of the present, personal contact is not so close, nor the effects so direct. This *must* be and *can* be overcome by correct indoctrination of all ranks. The feeling of moral cohesion is more than ever needed. This feeling of solidarity can only exist on the widely extended front of a modern battlefield when men have been trained to rely on the support of their comrades and of their commanders; when they know, that to be out of sight is *not* to be out of mind.

"Close order," said General Maud'huy, "is the guarantee given by discipline in the presence of danger. The sense of moral solidarity must, in these days, take the place of close physical contact." This sense of solidarity can only be inspired by a commander who

is in perfect sympathy with the men of his command—whose men are moved by the same emotions and impulses as himself. The commander, although he is the directing brain, is not *separate from*, but the most vital *part* of his own command.

Study the capacities, character, and mind of the individual; pay every heed to the private rights of the private soldier, but remember that a commander's duty is to his command as a whole. He is a useless commander who has a kind heart and no high sense of duty. Even though individuals may suffer, a commander must never hesitate to make whatever demands are needed for the collective good of his command. Soft-hearted commanders are responsible for more crime in an army and more casualties in war than are hard-hearted men.

A commander must have prestige. An officer gains prestige—or is it only the reflection of the real article?—from his rank, from his uniform, and from the power and the authority which are given him by the Regulations. But true prestige is not acquired by passing an examination or by receiving a commission. When Napoleon said he hated unlucky commanders, he expressed the feelings of all who serve under them. But continuous success is not necessary to acquire prestige. No commanders were ever more trusted by their armies than were Stonewall Jackson and Lee. A commander who demands much of his men must give much; he can only inspire confidence when he shows knowledge, respect when he proves himself just, good order when he shows himself resolute.

That commander is most skilled in the art of command who has so trained his men that in the hours of stress and crisis they continue obedient to the impulse which bids them, regardless of themselves, do their duty by their regiment, fight for the flag, and, if need be, die for their country.

The good is the enemy of the best. Look after the morals of the company and the scamps will need to look after themselves. Create a strong collective spirit and even the most unruly men must need conform to its will.

It is instructive to consider how closely the qualities of armies correspond with the qualities of their commanders. Dash, or *élan vital*, is the first quality, most of us would say, that marks the French Army; and the kindred qualities of energy and imagination are what have chiefly distinguished, and still distinguish, its commanders—Napoleon and many of his marshals, Foch and some of his principal generals.

Marshal Foch, in speaking at the War College, said it was hard to get orders executed. Training in a "common language"—indoctri-

nation which leads to teamwork, will be a long step in the proper direction.

Besides command as exemplified in the person of the commander, and command as related to the commander and his staff with the commander as the head, the relation of commander to his subordinate tactical commanders is important. When actions are contemplated or orders are received to carry out any designated operation, it is conceivable that the commander would discuss the affair with his chief of staff and give the latter, as the head of the staff, such directions as may be pertinent. Either before or after receiving from his staff any desired detailed information, the commander may well gather his immediate subordinate tactical commanders and also, and better still, those tactical commanders next to the immediate subordinates, and go over matters with them. No council of war is here intended, but a conference wherein the commander elaborates on formal orders, clears away fogs and otherwise assures perfect understanding and teamwork. In this way command in its usually accepted meaning may be exercised.

Naval history furnishes one of the best illustrations of this sort of action. While Lord Nelson was *en route* to the scene of the Battle of the Nile, it was his custom to assemble his captains on his flagship almost daily and with them go over the possibilities of the future, explain his ideas in principle and detail and otherwise impress his personality upon his subordinates. He thus indoctrinated his captains, and in the best possible manner, exercised command. As a result, the Battle of the Nile was fought to a successful issue *contrary* to the *specific plan* but in *strict accordance* with *Nelson principles*. Nelson was a *commander* and exercised command in its highest degree.

This sort of command may be further increased by frequent visits on the part of the commander to the units of his command. Instructions in the American Expeditionary Force that division commanders must know the location of battalion command posts is indicative of the ideas of the American High Command upon this subject. In this and in other ways the commander will be able to impress his personality upon the members of his command.

Free intercourse between the commander and his next tactical subordinates should be a governing principle, carrying with it, of course, such teamwork on the part of the commander as will result in keeping his staff informed as to all developments. Details as to methods will vary with men and conditions, but the net result will be the elimination of what we may call staff interference and staff control and the aggrandizement of command in its true sense.

In an American force, it is especially true that this feature of command must be emphasized. The psychology of the American soldier—the type of person, both commissioned and enlisted personnel, of which our armies will be composed—requires this sort of command to insure the best results.

The commander must have an understanding of men, both as individuals and as a crowd, with the administrative ability to utilize this appreciation of the human elements; and to these may be added the physique necessary to maintain himself at his maximum mental limit, and such personal qualities as will enable him to maintain, on personal contact, that prestige which his position warrants him in expecting.

It may be said, and very properly, that the commander as here pictured is impossible of attainment by any one person—that a superman is shown. Indeed, Napoleon says in one of his maxims, "It is rare, and difficult, to possess, at one time, all the qualities of a great general. What is desirable is to maintain an equilibrium between his mind and abilities, and his will and courage. If courage prevails more in his composition, the general will undertake designs, the whole possibility of the attainment of which he has not thought out; on the other hand he will not dare to carry his ideas into execution, if his will or courage is inferior to his abilities." It is highly probable that a few men have possessed all of the necessary qualities in a superlative degree. But this is the sort of man that is desirable as a commander. Our efforts, therefore, should be to arrive as near this goal as is possible.

Many great commanders have had with them a man who possessed the qualities that they themselves probably lacked in some degree. Napoleon and Berthier, Blucher and Gneisenau, Grant and Rawlins, Foch and Weygand, Hindenburg and Ludendorff, are a few examples.

It may be well for all of us to take careful inventory of our own qualifications and when placed in a position of command, seek for a man who possesses in a high degree the qualities we know ourselves to lack. At the headquarters of a high command, it is highly probable that there will be found men who possess one or more of such qualities as the commander may lack, and if he is frank with himself, he will search for these men and make use of them to supply the deficiencies his study of himself has shown to be lacking.

An honest evaluation of one's own qualities with proper appreciation and use of the qualities of others make for proper command.

Preparations for the Second Battle of the Marne

By COLONEL CONRAD H. LANZA, *Field Artillery*

EDITOR'S NOTE: With the collapse of Russia in the winter of 1917-18, Germany began the transfer of troops to the western front in preparation for a decisive campaign against the Allies. Attacking on March 21 on a fifty-mile front between Croisilles and the Oise, the Germans advanced some thirty miles in the center and made a tremendous salient in the St. Quentin area. Brought to a standstill on April 16, Ludendorff turned to the north and attacked on April 9, on a twelve-mile front from La Basse to the Lys, with a view to breaking through to Bethune and on to Hazebrouck. This attack created another, but smaller, salient in the area about Armentieres, but it was finally brought to a stop on April 29. Finding the effort to reach Hazebrouck too costly, Ludendorff again shifted the scene of battle, attacking on May 27 on the line southeast of Laon to secure the line of the Vesle river and the railroad from Soissons to Rheims, involving an advance of from five to ten miles. The initial results so exceeded anticipations that Ludendorff changed his plans and continued his drive on this front. By May 30 he had reached the Marne from a point three miles east of Dormans to a point four miles east of Chateau-Thierry, creating a salient thirty miles deep and thirty-five miles wide at its base. In the succeeding days he attempted to widen the salient, but met with no considerable success. Finally, on June 9, the Germans began an advance on the line from Montdidier to Noyon, where, in two days fighting, they gained some six miles on a narrow front. This advance was stopped in the fighting preceding June 15, leaving the Germans in possession of a line from the vicinity of Rheims through St. Agnan and Vaux to Ambleny, west of Soissons. This marked the turning point of the war, and in the following interesting article the author discusses the preparations made on both sides for continuing the campaign.

ON June 15, 1918, after the German advance which had started on May 27 had stopped, the Allied armies in the sector involved in the German attack, which included the line along the Marne, were as follows:¹

Reserve Group of Armies (French), General Fayolle:

First French Army, from the Somme to Montdidier;

Third French Army, from Montdidier to the high ground between the Oise and the Aisne;

Tenth French Army, from the right of the Third Army to the Ourcq, General Maistne (later General Mangin).

Center Group of Armies (French):

Sixth French Army, from the Ourcq to Dormans on the Marne, General DeGoutte;

Fifth French Army, from Dormans to the Vesle, General Barthelot;

Fourth French Army, from the Vesle to the Argonne, General Gouraud.

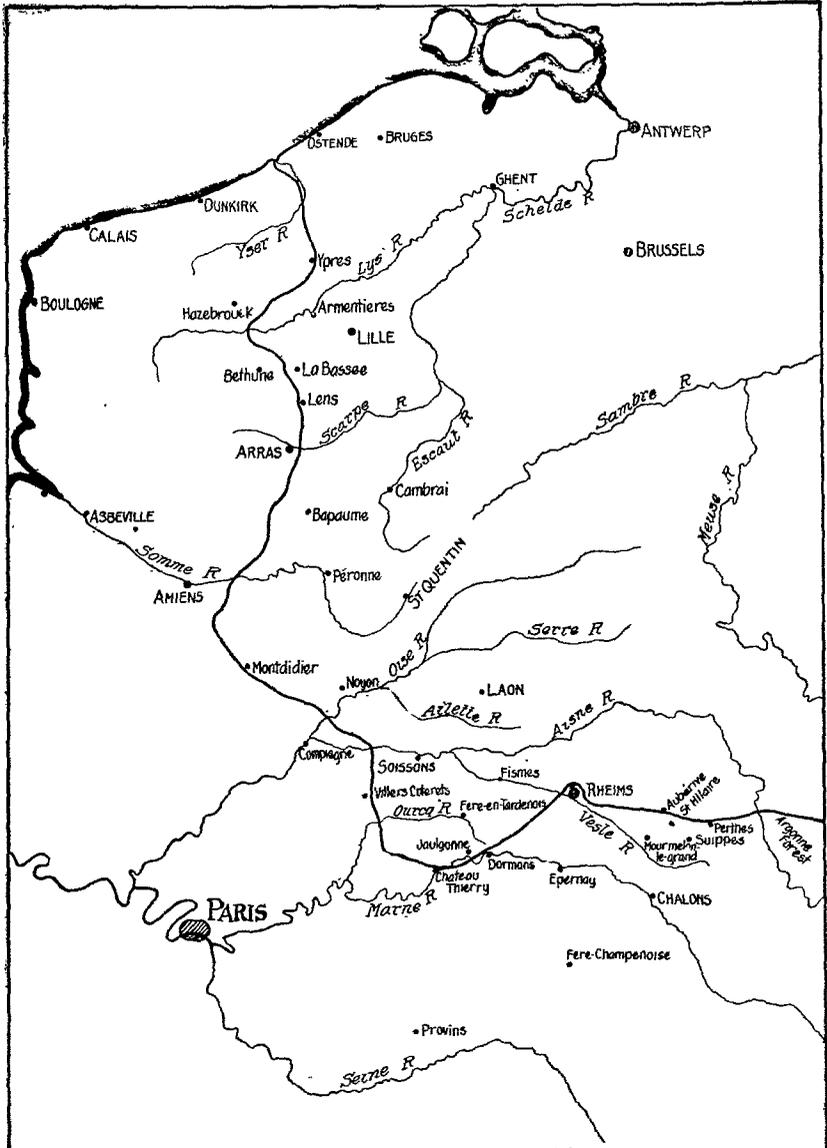
Opposite these forces, covering the Marne salient, was the German Group of Armies, under the Crown Prince, including:²

¹ *Guerre de 1914-1918, Ecole Supérieure de Guerre, 1919-1920*, p. 43. French Order of Battle, June, 1918.

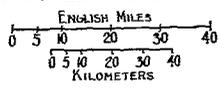
² War Diary, Army Group, German Crown Prince.

War Diaries, Seventh and First German Armies.

General von Zuehl. *The Battles of the Summer of 1918 on the Western Front*, (Berlin, 1921).



THE SECOND BATTLE OF THE MARNE
 SHOWING BATTLE LINE OF JULY 14, 1918.



Seventh German Army, from north of the Oise and the line Fismes-Gueux (just west of Rheims), General von Boehn;
First German Army, east of the line Fismes-Gueux to St. Hilaire, General von Mudra;
Third German Army, east of the First Army to the Argonne, General von Einem.

The Seventh Army, which held most of the Marne salient, contained eight corps. Including divisions in reserve, there were about forty divisions within the Marne salient.³ To supply these divisions there was only one standard-gauge railroad, leading through the vicinity of Soissons (twenty kilometers from the front) to Fere-en-Tardenois (twenty-five kilometers from the front). Roads supplemented the railroad, but the railroad was probably the main dependence for supplies. Of the roads, one excellent highway, extending south from Soissons, was very close to the front; and another extending south from Fismes was as close to the front as the railroad, while the railhead at Fere-en-Tardenois was nearly at the center of the salient.⁴ This salient was so narrow that any advance from the flanks toward Fismes would threaten the existence of the German forces along the Marne. The precariousness of German communications was pointed out in a bulletin issued by the Tenth French Army on June 5.⁵

On June 7, Marshal Foch directed General Petain, commanding the French forces in France, to prepare for an attack to be made against the east flank of the salient by the Fifth French Army, and on June 14 and 16 this order was supplemented by additional ones directing that the Tenth French Army prepare to make the main attack on the west side of the salient.⁶

To carry out these instructions, General Petain issued orders to the Fifth Army on June 8 and to the Tenth Army on June 16. Additional orders were issued on June 20.⁷ These orders required thorough concealment of preparations and bringing up infantry during the night preceding the commencement of the attack, which was to be preceded by a short, violent artillery preparation. The infantry attack was to start at daybreak.

³ *Op. cit.*

Guerre de 1914-1918, p. 44.

Operation Orders, Seventh Army.

⁴ Current maps.

⁵ See extract copy (translated) in Summary of Information, GHQ, A. E. F., No. 71, June 10, 1918.

⁶ *Guerre de 1914-1918*, p. 44.

Letter to French C-in-C, No. 1,454, June 16, 1918.

⁷ Letter to Fifth Army, No. 8,861, June 8, 1918.

Letter to Tenth Army, No. 13,982, June 16, 1918.

Letter to Fifth Army, No. 24,540, June 20, 1918.

The Tenth Army completed its plan for the attack on June 26, within four days. As its attack was to be the principal one, it was to receive the greater assistance. The Tenth Army plan provided for:

Preliminary Operations — Attacks, with limited objectives, to obtain a good line of departure for the main attack.

Main Operation—Attack with entire army, toward the Soissons-Chateau-Thierry road, to seize the high ground between the Aisne and the Ourcq.

This plan was approved June 27, and the preliminary operations were carried out, as planned, on June 28 and on July 8, 12, and 13, resulting in securing the desired line of departure east of the Conevres ravine and in the edge of the Villers-Cotterets forest.⁸

In the meantime the Germans themselves from early June planned to resume the offensive. Hindenburg states that he felt the semi-circle composing the Marne salient to be an insecure position, and that he realized the poor line of communication on which the salient depended and the danger to which the Germans were exposed by remaining quietly in the sector until the enemy attacked. The situation could be improved only by the capture of Rheims, orders for which operation were issued June 19.⁹

The Germans seem to have believed that the mass of allied reserves were in the vicinity of Compiègne and Villers-Cotterets, that there were no large bodies of troops south of the Marne. Strong forces, French, English and Italian, were identified about Rheims. East of Rheims the situation seemed to be the same as had existed for a long time. There was little information as to American troops, but it was believed these would soon be available in large and increasing numbers, so that an early offensive by the Germans was desirable.¹⁰

No direct attack on Rheims was intended. Instead, the high ground between Rheims and Epernay was to be seized by a surprise attack about July 20, and, the better to enable this to be done, a part of the Seventh and First Armies were to cross the Marne on both sides of Dormans, and then attack toward Epernay.¹¹ To protect

⁸ Official Communiqué.

Intelligence Reports, Seventh German Army, June 28, July 12, July 13.

Intelligence Reports, Ninth German Army, July 8, 9, and 12.

⁹ Von Hindenburg, *Out of My Life*, p. 370.

Intelligence Reports, Army Group, German Crown Prince, June 13, *et seq.*

Letter, German GHQ, la 2608, June 19, 1918, to Seventh Army, states in part: "Herewith plans of the attack of the Seventh Army. The mission of the attack is to cause the fall of the hostile positions on the Rheims plateau by taking the crossings at Epernay."

¹⁰ Intelligence Reports, German GHQ for Western Front, June, 1918.

Out of My Life, pp. 371-2.

¹¹ *Ibid.*, p. 313.

Ludendorff's *Own Story*, II, 305.

Battles of 1918, von Zuehl, *cit.*

Orders la 8685, German GHQ, June 14, 1918.

Orders la 2610, First German Army, June 15, 1918.

Orders la 844, Seventh German Army, June 25, 1918.

this attack on the west side of the Marne salient, the Seventh Army was relieved from watching the greater part of this side by the Ninth Army, under General von Eben, brought from Rumania, and which took over the three Army Corps of the Seventh Army between the Oise and the Ourcq.¹²

This change was completed by July 5.¹³ Ludendorff states in his memoirs that an allied offensive toward Soissons was expected and prepared for,¹⁴ and this is confirmed by the German Intelligence Reports, particularly those from the Ninth German Army.¹⁵

After making preparations for the capture of Rheims, the German plan was later extended, as the result of various conferences, by extending the attack eastwards to the Argonne with a view to cutting off Rheims from the southeast and possibly reaching Chalons-sur-Marne.¹⁶ This extension of the attack was desirable from a strategical standpoint, but was justified only so far as the number of men and guns available were sufficient to afford a reasonable chance of success. Later events showed that the German attacking forces on the Marne alone were too weak, weaker than the forces being attacked, and this weakness was one of the prime causes of failure.¹⁷ The extension of the attack east of Rheims was not, in fact, justified.

For the proposed attack, the German Seventh Army, under General von Boehm, had available:¹⁸

¹²Ludendorff's *Own Story*, II, 307.

War Diary, Ninth Army.

War Diary, Seventh Army.

War Diary, Army Group, German Crown Prince.

Orders, First Army, la 2740, June 28, 1918.

Orders, Army Group, German Crown Prince, la 2622, June 21, 1918, and la 844, June 25, 1918.

¹³War Diary, Ninth German Army.

Orders la 6023. Army Group, German Crown Prince, July 3, 1918.

¹⁴Ludendorff's *Own Story*, II, 307.

¹⁵Urgent telephone message, Army Group, German Crown Prince, 12:36 p. m., July 11, 1918, to the Seventh and Ninth Armies stated: "Deserters taken by Ninth and Seventh Armies speak of strong concentrations of troops in the woods of Villers-Cotterets and of an impending attack on a large scale. * * * Reconnaissance service should be increased to the utmost, and arrangements must be made to have, at the beginning of the hostile attack, sufficient security detachments with the artillery, in readiness, in positions in rear. * * *"

On the same date, another telephone message was made by this Army Group to German GHQ (No. la 6079), in part: "According to the statements of deserters, a hostile attack is imminent against Corps Watter and the two Corps sectors adjoining. It may be expected that the attack will be made not later than July 15, if not made before then."

On the same date, par. 1 of Ninth Army orders (la 287. op) reads: "According to statements of prisoners and deserters at least one fresh French division has been inserted in line opposite the left of Corps Staabs and the center of Corps Watter. Strong reserves are in the woods in rear of the hostile front, among them British, American and black troops. The hostile artillery has been materially reinforced, and portions of it are far in front. Tanks and cavalry are being held in readiness. We must reckon on an imminent hostile attack on a large scale."

The Seventh German Army orders of July 11 (la 187) also states: "* * * the situation on the front Nouvron-Troesnes is acute, and we must reckon on hostile attack intentions * * *"

In a letter to German GHQ, No. la-II 9038, July 1, 1918, Ludendorff called the attention of the Crown Prince that numerous tank squadrons must be reckoned with in case of large scale attacks.

Orders la 8720, German GHQ, June 17, 1918.

¹⁶Hindenburg, *Out of My Life*, p. 373.

¹⁷To be discussed later.

¹⁸Instructions, Seventh German Army, la 797, June 19, 1918, *et seq.*

- XXIII Reserve Corps, opposite Mezy, General Kathen;
 VIII Reserve Corps, east to Dormans, General Wichura;
 IV Reserve Corps, north to Athenay, General Conta;
 55th General Command, north to Chambrecy, General Schmettow.

The number of divisions appears to have been thirty for the entire army.¹⁹

For the same offensive, the First and Third German Armies seem to have had about fourteen and ten divisions respectively, or a total of twenty-four east of Rheims²⁰ for the attack in Champagne.

These figures seem to indicate the relative importance placed by the Germans on the two attacks. The east attack, while desirable, was not essential to the assigned mission of capturing Rheims in order to safeguard the Marne salient. But extending their efforts too far, the German resources were unable successfully to undertake either offensive, and both failed.

The Seventh German Army had a difficult task. It had a river crossing in the right sector of its attack and the extensive forests of Enghien and Vassy in the left Sector. These two forests contained numerous lakes and swamps, and the country around them was hilly. They constituted a formidable obstacle.²¹

East of Rheims the terrain did not offer special difficulties, but the opposing lines had held the same positions so long that they were strongly fortified. The XV Corps, of the First German Army, encircled Rheims and was to support the attack with fire, while the three adjoining corps to the east,—the VII Reserve, the XIV, and the XXIV Reserve, were to penetrate the hostile positions between Prunay and Auberive, inclusive, and to push forward—with proper security against Rheims and the wooded hills there—with strong forces on both banks of the Marne against Epernay, and force a junction with the Seventh Army. Three Corps, the XII, I Bavarian, and XVI, of the Third German Army, occupied the front from Mourmelon-le-Grand eastward, and were to seize the line hills east of St. Etienne—Somme Suippes—hills southeast of Perthes. A fur-

¹⁹German strength reports, July 13, 1918, (for detailed list see page 14). The identifications published in Summaries of Information, GHQ, AEF, do not agree exactly with the German reports. The identifications were: 1st Guard, 2d Guard, 4th Guard, 5th Guard, 1st, 22d, 23d, 26th, 33d, 36th, 37th, 40th, 50th, 87th, 103d, 113th, 123d, 195th, 200th, 201st, 10th Bavarian, 12th Bavarian, 19th Reserve, 24th Reserve, 28th Reserve, 78th Reserve, 6th Bavarian Reserve, 10th Landwehr, 4th Ersatz, Bavarian Ersatz—30 divisions in all.

²⁰Summary of Information, GHQ, A. E. F., reported identifications as follows: *First Army*: 3d Guard, 1st, 26th, 86th, 208d, 238th, 239t h, 242d, 15th Bavarian, 19th Reserve, 80th Reserve, Guard Ersatz.
Third Army: 7th, 30th, 88th, 228th, 1st Bavarian, 2d Bavarian, 7th Reserve, 33d Reserve, Guard Cavalry.

Note that the 1st Division was also reported with the Seventh Army, and that the list does not entirely agree with the German strength report, given later.

²¹See Map.

ther extension toward the east was contemplated should the attack turn out favorably.²²

During the period of German preparation, Marshal Foch, while preparing for an offensive by the allies, undertook also to oppose further German attacks. In letters sent June 2, during the Aisne battle, and June 17, after the battle, to American GHQ, he asked that five American divisions then with the British army be placed at the disposal of the French C-in-C (General Petain) to relieve French divisions in quiet sectors in east France. On June 19, Marshal Foch directed the British C-in-C to release six French divisions with considerable French Artillery, then with the British Army in Flanders. The French divisions thus obtained formed the allied strategic reserve.²³

On the 27th, the G-2 section of General Petain's staff submitted a memorandum on the subject of a German offensive, which summed up the situation as follows:²⁴

- a. In view of the condition of German resources in men, only large operations, promising great results, will be undertaken.
- b. It will require at least until July 15 to prepare such an offensive.

Notwithstanding early ideas as to an offensive, defensive measures were still provided for. The Tenth French Army, as previously noted, did not conclude its preliminary operations for an offensive until July 13. On July 1, Marshal Foch issued Orders No. 4, which, in part, stated:

* * * the enemy has been stopped 30 kilometers from Dunkirk, 60 from Abbeville, 60 from Paris, 25 from Chalons.

An advance of 40 kilometers toward Abbeville will cut the communications with the north part of France, and will separate the French and the British Armies.

An advance toward Paris, even if not so great, without influencing operations decisively, would seriously affect the political action * * *.

Paris and Abbeville are then the places that must above all be covered.

The order then prescribed that, on the sector Chateau-Thierry to Lens, steps be taken to defend every foot of ground, and that, in addition to local reserves in Flanders and Champagne, the main re-

²²Orders la 2605, First Army, June 21, 1918.

Orders la 2622, Army Group, German Crown Prince, June 21.

Orders la 844, Army Group, German Crown Prince, June 25.

Orders la 2740, First Army, June 28.

²³*Guerre de 1914-1918*, p. 47.

Order 1534, Allied GHQ, June 19, 1918.

²⁴*2eme Bureau, Etat Major Francais, etude No. 3122/XXII.*

serves be placed so as to be able most quickly to come into line near Paris or Abbeville. The order ends with the statement:

The allied reserves will enter the battle wherever it takes place. To assist their suitable and coordinated intervention, these reserves should, if possible, be organized into corps or armies.

There are several points worthy of attention in this order. Whereas strenuous resistance was ordered to be made on the line north from Chateau-Thierry, there was no such requirement as to the front east from Chateau-Thierry. In part this was probably due to the G-2 memorandum of June 27 which, from a purely hypothetical study, considered that the next German offensive would be neither toward Abbeville nor toward Paris, the two points which, if reached or approached, seemed to offer the greatest advantages to the Germans as being the most dangerous to the allies. An attack east of Chateau-Thierry was not considered as particularly advantageous to the Germans or dangerous to the allies. It was therefore thought rather improbable, and not specially important if it did occur.

In fact, the Germans thought, on their part, that a decisive battle which would probably result in bringing the war to a close in their favor ought to be made suddenly about the end of July and be directed toward Paris, and they issued preliminary orders for this on June 22. On July 4, General Ludendorff ordered that preparations be made to extend this attack to include Amiens.²⁵ But they also felt, as already discussed, that the Marne salient was in such a dangerous condition that the situation there would have to be improved before they would be justified in concentrating their reserves in Flanders. While the Rheims operation was a special one with a limited objective, it was hoped that the attack on Rheims would draw the allied reserves away from Flanders, thus facilitating a later decisive attack toward Abbeville.²⁶ The observed allied preparations for an attack toward Soissons were not seriously considered as dangerous in view of the presence of the Ninth Army.²⁷

The French memorandum of June 27 and the order of July 16 were incorrect in assuming that the Germans would not undertake operations with limited objectives but would confine themselves to major operations with unlimited objectives toward either Abbeville or Paris. The German expectation that the allied reserves would be

²⁵Letter Ia 8895, German GHQ, June 22, 1918.

Letter Ia 2829, Army Group, German Crown Prince, June 26, 1918.

Ludendorff's *Own Story*, II, 311, states that this attack was to be made north of the Lys, but this is not borne out by the German orders examined—message, German GHQ, 9:45 a. m., July 4, 1918, No. Ia 8994.

²⁶Hindenburg, *Out of My Life*, p. 371.

²⁷See Footnote 15.

sent to Rheims when that city was seriously threatened was also incorrect. These reserves were stationed where transportation lines were such that they could be quickly concentrated near Paris or Abbeville.²⁸

The French order of July 1, as a result of not prescribing a strenuous defense east of Chateau-Thierry, led naturally to the adoption of an elastic defense along the Marne and in Champagne to conserve losses, a serious matter in comparison with the relative unimportance of German gains in terrain in these localities.²⁹

The order of July 1 foresaw the employment of the reserves in large masses, requiring them to be organized into corps for this purpose, and presumably, if their number could be made sufficiently large, into one or more armies. This method of employing reserves differs radically from the common one of reinforcing organizations already in line. It requires that the organizations in line be given a *defensive* mission, while the *offensive* is to be undertaken at the proper moment by a separately organized force brought into action at a selected place and time, not necessarily in the zone attacked.

The preparations of the Germans for their coming attack were not well concealed.³⁰ Commencing June 30, the French obtained various sources of information concerning the proposed German offensive.³¹

In carrying out Marshal Foch's directions, General Petain, the French C-in-C, provided strong reinforcements for the entire front from Chateau-Thierry to the Argonne, and on July 3, ordered the headquarters of the Ninth French Army to Provins, with directions to prepare plans against any hostile penetration of the allied line and to be ready to assume command in the area in which penetration occurred.³² Here again we see a clear division between missions of high commands, two armies in line having defensive zones to defend; one army in rear in reserve, its mission either counter offensive or defense in the open, as circumstances might require.

On July 8, General Petain received a recommendation originating with the Tenth French Army, which was then proceeding with

²⁸French Orders of Battle.

Current maps.

²⁹Report, 3d Division, Aug. 5, 1918.

Letter, Col. Kelton, Chief of Staff, 3d Division, July 20, 1918, to General Fox Conner.

G-3 at GHQ, A. E. F.

Notes by Gen. Dickman, Commanding 3d Division, on Lieut. Hene's article in the *Field Artillery Journal*, April, 1921.

See also Marshal Foch's instructions of July 10, discussed in following paragraphs.

³⁰Ludendorff's *Own Story*, p. 308.

Hindenburg, *Out of My Life*, p. 375.

War Diary, Seventh Army.

Intelligence Reports, Seventh Army.

³¹Summary of Information, GHQ, A. E. F., June 30, 1918, *et seq.*

Guerre de 1914-1918, p. 48.

³²Letter, French GHQ, No. 3915, July 3, 1918.

operations preliminary to its proposed attack. In this letter the army commander expressed his view that a large serious offensive, made between the Aisne and the Ourcq, would result in the fall of the Marne salient. The commander of the Reserve group of armies approved this view, and the commander of the Sixth French Army (holding the line from the Ourcq to the Marne) suggested that his army, even if not reinforced, could usefully prolong to the south any attack by the Tenth Army.³³

On the same day this recommendation was received, General Petain formally approved it. He added that an attack by the Tenth Army would be the best means to meet the proposed German offensive, and he ordered that prompt, secret preparations to carry this out be undertaken.³⁴

On July 8, General Petain sent instructions to the Fifth and Fourth French Armies, holding the line from Dormans to the Argonne, as to the method of defense to be used by them. The Fourth Army occupied, in Champagne, a strongly prepared defensive zone, and it was ordered to resist along its "intermediate" position, withdrawing its troops from the first line so as to save them from hostile destructive fire, especially that from trench mortars.³⁵ This order was in accordance with a previous one on tactics in defense, in which it was prescribed that a zone wide enough to include the area likely to be bombarded by the enemy be secretly abandoned.³⁶ It was also a development of the order of July 1, already discussed, pointing out the relative unimportance of German gains in threatened areas on both sides of Rheims.

The instructions sent to the Fifth Army, whose front, occupied a few weeks only, was not strongly fortified, were to organize in depth and to defend its first position, which was the only one on which considerable work had been done.³⁷ No instructions as to defense appear to have been issued for that portion of the Sixth Army west of Dormans, along the Marne, and which was not involved in the offensive operations contemplated south of the Ourcq. This, the right sector of the Sixth Army, included the 3rd U. S. Division in first line along the Marne and part of the 28th U. S. Division in reserve near St. Eugene. It would seem that this part of the front threatened with attack ought to conform to the plan of defense ordered for east of Dormans, and the method of defense adopted indicates that this was understood.³⁸

³³*Guerre de 1914-1918*, p. 49.

³⁴Letter allied C-in-C, No. 9732, July 8, 1918.

³⁵*Guerre de 1914-1918*, p. 50.

³⁶Instructions, French GHQ, No. 26,510, Jan. 24, 1918.

³⁷*Guerre de 1914-1918*, p. 50.

³⁸FO 7, 8d Division, 6:00 p. m., July 2, and annexes issued later, conform in general with the French plan for an elastic defense.

The information received by Marshal Foch by July 10 enabled him to announce that a German attack was imminent, would occur about July 15, and would be on both sides of Rheims as follows:³⁹

East attack—between La Pompelle and Massiges, directed toward Chalons.

West attack—from Vrigny (on the Vesle) to Jaulgonne (on the Marne), on both banks of the Marne, and directed toward Epernay.

In fact, the original date of the attack by the Germans, intended for July 20 was changed to July 12, but, to complete preparations, it was again changed to July 15.⁴⁰ The information of the allies as to this attack is seen to have been remarkably accurate.

On July 12, additional instructions were sent out by General Petain concerning the defensive, with a view to breaking up the German attack,⁴¹ and four British divisions were thus asked for from the British.⁴²

On July 12, General Petain made his decision as to how his command would act in the forthcoming battle. This decision is explained in two letters sent out on this date. In the first of these letters to the commander of the Center Group of Armies⁴³ he assigned the maintenance of the continuity of the front as the primary mission, then after the enemy had been stopped, to pass to the offensive. If the enemy made a deep penetration this Group of Armies was authorized to use the Ninth Army.

The offensive part of General Petain's plan is explained in part in the same letter to the Center Group of Armies and in a separate letter sent both to the Reserve and the Center Groups of Armies.⁴⁴ These letters announced the mission of the offensive as being the reduction of the Marne salient, with a minimum objective of preventing the use by the Germans of the road and railroad communications about Soissons, and freeing Rheims from danger. To carry out this mission the Sixth and Tenth Armies were to attack along both sides of the Ourcq on the west of the Marne salient, and the Fifth Army on both sides of the Aisne on the east of the salient,—the two attacks to be made as rapidly as possible with a view to

³⁹G-2, Bulletin No. 9050/XXII, Allied GHQ, July 10, 1918.

⁴⁰Ludendorff's *Own Story*, II, 507.

Message la 2648, Army Group, German Crown Prince, July 4, 1918.

Letter German GHQ, No. la 8685, June 14, 1918.

⁴¹Letter No. 1940, July 11, 1918.

⁴²Letter to Marshal Haig, No. 2021, July 12, 1918.

Telegram to Marshal Haig, July 13, 1918.

⁴³Letter No. 14,542, July 12, 1918, to the Center Group of Armies.

⁴⁴Letter No. 14,546, July 12, 1918, to both the Reserve and Center Group of Armies.

uniting on the high ground north of Fere-en-Tardenois. To insure surprise, not exceeding four days would be allowed to prepare for the attack, the preliminary order for which might be issued July 14.

The plan outlined in the preceding paragraph was a bold one. It contemplated a strict, but elastic, defensive along the Marne and in Champagne, with no offensive in these sectors until after the German attack had been broken. But on both flanks of the German attack west of Rheims, where a salient already existed, powerful attacks were organized to strike toward the vicinity of Fere-en-Tardenois. If these attacks could unite promptly there was a chance of enveloping, and capturing or destroying, all Germans south of an east-and-west line through Fere-en-Tardenois. Having this mission in view there was probably no particular objection to the Germans gaining some ground to the south of the Marne, as this would increase the probability of their being cut off. Some time would be needed for the Germans to become seriously involved south of the Marne, and the date, July 18, allowed about three days for the German attack to exhaust itself. The success of the plan depended on the defense along the Marne and in Champagne being elastic and not becoming a disaster. Should the latter event become probable, it would be evident before the flank attacks against the Marne salient were launched, and these could then be changed if advisable.

On July 13, Marshal Foch approved the instructions issued on the preceding day by General Petain, at the same time suggesting that as strong a force as possible be used to strengthen the contemplated offensives of the Sixth and Tenth Armies.⁴⁵

At 3:00 P. M., July 13, General Petain telegraphed to the Reserve Group of Armies:

The attacks of the Sixth and Tenth Armies, referred to in my letter of July 12, must be ready to start on the morning of the 18th.⁴⁶

For the attack the following troops were available on the evening of July 14, in order from north to south:⁴⁷

TENTH FRENCH ARMY

IN LINE

XVIII French Corps

70th French Division

15th French Division

⁴⁵*Guerre de 1914-1918*, pp. 52-3. Marshal Foch directed that as large forces as possible be reserved for the offensive of the Tenth and Sixth Armies.

⁴⁶*Attaques des 6 et 10 Armees precues par mon Instruction du 12 Juillet devront etre pour voir declenchees le 18 au matin.*

Guerre de 1914-1918, p. 53.

⁴⁷Order of Battle, French GHQ, July 14, 1918.

I French Corps

55th French Division

152nd French Division

XX French Corps

11th French Division

Marine Division (French)

XI French Corps

48th French Division

128th French Division

IN RESERVE

19th French Division

38th French Division

153rd French Division

1st U. S. Division

The Tenth Army was to be supported by six additional divisions,—one American, two British and three French, making eighteen divisions in all, and was to have 470 batteries of artillery, 40 air squadrons, and 375 light tanks.⁴⁸ It was to attack without artillery preparations.⁴⁹

On the same date, the Sixth Army had the following troops north of the Marne, available for operations, in order from north to south.⁵⁰

SIXTH FRENCH ARMY

IN LINE NORTH OF THE MARNE

II French Corps

33rd French Division

2nd French Division

VII French Corps

47th French Division

164th French Division

167th French Division

26th U. S. Division

IN RESERVE NORTH OF THE MARNE

168th French Division

4th U. S. Division

⁴⁸Order 227 (1225/8), XX French Corps, July 16, 1918.

⁴⁹*Guerre de 1914-1918*, pp. 53-4.

⁵⁰*Ibid.*, p. 54.

⁵¹Order of Battle, French GHQ, July 14, 1918.

IN LINE FROM THE MARNE, INCLUSIVE, EAST

XXVIII French Corps, General De Mondesir
 39th French Division
 3rd U. S. Division

III French Corps
 125th French Division
 51st French Division

IN RESERVE SOUTH OF THE MARNE

28th U. S. Division
 73rd French Division
 20th French Division

The Sixth Army was to be supported by one additional division (American) north of the Marne. For the attack there was provided for this army 230 batteries of artillery, 28 air squadrons, and 170 light tanks. An artillery preparation of one and one-half hours was to precede the attack.⁵¹

Altogether, for the attack on the west flank of the Marne salient, there was to be available by daylight of July 18:

18 divisions, with
 700 batteries of artillery,
 68 air squadrons,
 545 light tanks.

East of Dormans to Rheims, inclusive, was the Fifth French Army, with a mission at first defensive and latter offensive, subject to the latter duty being assigned to the Ninth French Army, which was moved from Provins to Fere Champenoise, closer to the prospective battlefield. The order of battle from south to north was:⁵²

FIFTH FRENCH ARMY

IN LINE

V French Corps
 8th French Divisions
 40th French Division

II Italian Corps
 8th Italian Division
 3rd Italian Division

⁵¹*Guerre de 1914-1918*, p. 54.

⁵²Order of Battle, French GHQ, July 14, 1918.

First French Colonial Corps

2nd French Colonial Division
 154th French Division
 3rd French Colonial Division

IN RESERVE

77th French Division
 10th French Colonial Division
 120th French Division
 7th French Division
 71st French Division
 10th French Division
 5th French Division

No reinforcements appear to have been intended for the Fifth Army, which, however, had strong reserves. We have already noted that on July 13, Marshal Foch had indicated that the offensives of the Sixth and Tenth Armies were to be as strong as possible, and to comply with this requirement additional reinforcements which could yet be brought up by July 18 were sent to the west of the Marne salient. From a transportation point of view, this was the easier side of the salient to which to direct them. Tactically, it offered fairly open terrain for the attack, contrasted with the difficult country, already commented on, southwest of Rheims. Strategically, the concentration of the available means in one sector promised greater gains than a dispersion over two separated sectors.

On the entire front from the Marne salient, inclusive, to the Argonne the allies had available:⁵³

57 French Divisions
 7 American Divisions
 4 British Divisions
 2 Italian Divisions

70 Divisions in all

Of these, twenty-seven divisions with the Sixth and Tenth Armies had an offensive mission, and forty-three had a defensive mission. Of the latter, fourteen divisions with the Fifth Army might be used offensively later; the remaining thirty-nine divisions in Cham-

⁵³French Order of Battle, July 14, 1918.

pagne had purely defensive missions. Against these forces the Germans had available the following troops:⁵⁴

NINTH ARMY

Fully fit for fighting: 115th, 241st, and 53rd Reserve Divisions.
 Fit for fighting after reorganization requiring two to four weeks: 6th, 14th, 15th, 28th, 34th, 46th Reserve, 105th, 211th, 223rd, 14th Reserve, and 11th Bavarian Divisions.
 Fit only for defense purposes: 42d and 47th Reserve Divisions.
 Total in the entire army: sixteen divisions.

SEVENTH ARMY

Fully fit for fighting: 10th, 22nd, 23rd, 33rd, 36th, 37th, 40th, 50th, 87th, 103rd, 113th, 123rd, 195th, 200th, 201st, 1st Guard, 2d Guard, 10th Reserve, 28th Reserve, 51st Reserve, 12th Bavarian, 6th Bavarian Reserve and 4th Ersatz Divisions.
 Fit for fighting after reorganization requiring two to four weeks: 86th, 5th Guard, 3rd Reserve, 45th Reserve, 78th Reserve, and 10th Bavarian Divisions.
 Fit only for defense purposes: 10th Landwehr Division.
 Total in the entire army: thirty divisions.

FIRST ARMY

Fully fit for fighting: 9th, 199th, 203rd, 239th, 3rd Guard, Guard Ersatz, 8th Bavarian Reserve, 26th Wurtemberg, and 15th Bavarian Divisions.
 Fit for fighting after reorganization requiring two to four weeks: 213th, 238th, 242nd, 19th Reserve, and 80th Reserve Divisions.
 Total in the entire army: fourteen divisions.

This gives a grand total for the three armies of sixty divisions, to which should be added the ten divisions of the Third Army, making seventy divisions in all, which gives a total number of divisions exactly equal to that on the allied side. The relative strength of divisions is known in part only. The Seventh German Army reports an average strength of 573 men per infantry battalion, which would indicate about 10,000 men per division.⁵⁵ The reports of the other

⁵⁴Estimate of Divisions, Army Group, German Crown Prince, July 18, 1918. See also footnotes 19 and 20.

⁵⁵*Op. cit.*

German armies are not at hand. The returns of the American divisions indicate an approximate strength of 24,000 men.⁶⁶ The strength of the French, British, and Italian divisions is not on hand. On the whole, it would appear that the Germans were certainly not superior in numbers to their adversaries, and were probably inferior. This must have been known to the Germans as their intelligence service was good. They seem to have relied on supposed superiority of troops in tactics and morale, induced by their earlier successes in the spring and particularly by their latest great battle at the end of May along the Chemin des Dames. Therefore, with full appreciation of the danger of attacks against the flanks of the Marne salient and with urgent warnings of enemy concentrations opposite the west side of the salient, German GHQ decided to proceed with an offensive intended to remove the danger of the Marne salient by capturing Rheims and straightening out the line from the Marne to Champagne, preliminary to a decisive battle to be fought as soon as practicable after the completion of the Rheims operations. They were so confident that, in addition to the Rheims operation, they undertook simultaneously to attack from Rheims as far east as the Argonne to capture Chalons,—a desirable objective but not at all necessary to the capture of Rheims, which was their main mission.

This undue optimism was the ruin of the Germans. Their strength was insufficient to make any substantial gains about Rheims and was still less so in Champagne; while the Ninth German Army, left to guard the flank of the German attack across the Marne, proved fully unequal to stop the foreseen attack made by the allies on July 18. It is well to note that nowhere in the German orders and papers relating to their attack of July 15 is there evidence of any intention of advancing toward Paris. The attack across the Marne was toward the southeast, not southwest, in which direction Paris lay.

On the other hand, we find that the German attack was known in advance by Allied GHQ and that Marshal Foch decided to meet this by a passive defense on the fronts against which the attack would come. Reserves were provided behind these fronts in case any such disaster as happened a few weeks earlier on the Chemin des Dames should again occur. These reserves were not altogether under front-line commanders but were largely retained for possible use under separate commanders to be used in masses. But the main defense was to be a powerful counterattack, made on the west front of the Marne salient at a date to be selected after the progress of the Ger-

⁶⁶Only partial returns of the American divisions are at hand. The 3d Division reports in their War Diary 24,568 officers and men as of July 14. Partial returns of the 1st, 2d and 28th Divisions indicate that their total strength on the same date was about 24,000.

man attack had become known, and which counterattack was carefully prepared for by a series of minor attacks with limited objectives made in order to seize a favorable line of departure for the infantry and to seize woods to conceal a numerous artillery and tanks. With this plan it was only necessary that the troops on the defensive front should hold while inflicting as great a loss as possible on the attacking Germans in order to exhaust their troops and engage their reserves. Losses of terrain, if not too great, were of secondary importance to that of inflicting severe punishment on the enemy. In fact, on the Marne front there was some advantage in leading the Germans across the Marne and thereby increasing their difficulties in meeting the counterattack.

The outstanding feature of the great battle commencing July 15, 1918, is the fact that the commanders on both sides had good information as to the strength, dispositions, and intentions of the other side. Each selected a plan and proceeded to carry it out, while making what he thought was necessary to counter the moves of the enemy. Between the two commanders Marshal Foch won, having correctly gauged the probable success of the German attack against his elastic defense while conserving his main force for the counterattack.

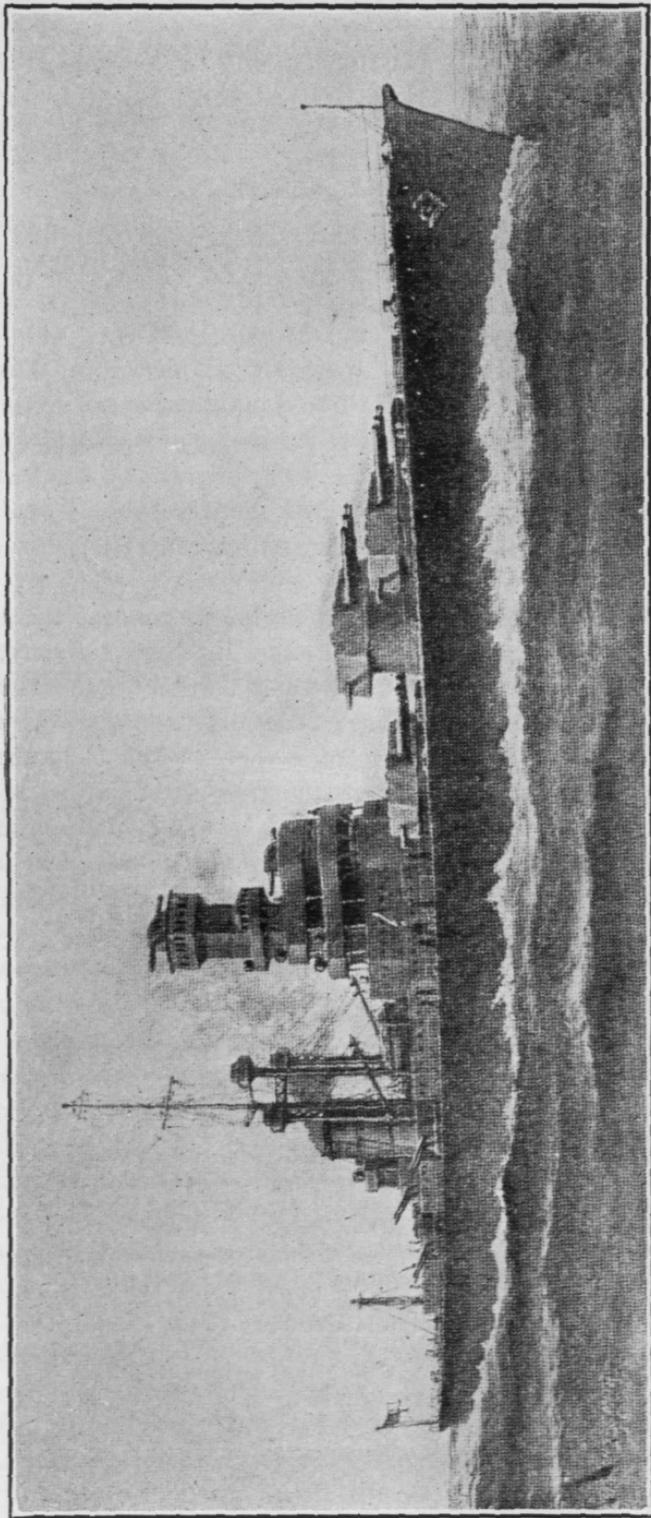
In modern wars between great nations it is probable that, in future, great moves can neither be made nor prepared for without the other side becoming aware of the general nature of what is being done. Good generalship will then rest not only in having a good strategical plan, but in the ability to carry it out against the known general measures taken by the enemy to resist or to counter by a plan of his own in the same or another theater of operations. This will require that any plan of attack shall be adopted only after carefully estimating the enemy reaction as to strength, time, and place. Any error in the estimate may lead to fatal results. The plan must be such that with the means available it will be possible to carry it out. The German plan for their attack on July 15 was not in itself a bad plan, even if it had no great strategical objective. But the available means were insufficient, and the plan was tactically poor. The allied plan to meet the German attack was good both strategically and tactically. Strategically, if successful, it promised to secure valuable terrain with the capture of important German forces in the Marne salient. Tactically, the plan was sound, as the available forces were so disposed as to place a minimum force on the fronts which were not strategically important while preserving a main force on the flank of the German attack where victory promised important results.

The battle, started July 15, 1918, is an excellent illustration of a modern battle and how it is prepared for. The lessons to be drawn are:

- a. Good intelligence service—this is indispensable.
- b. Careful estimate of the enemy action as to time, place, and strength.
- c. A clear decision which will be practicable as to time, place, strength, and enemy action.
- d. Careful preparation to carry out the decision. This does not mean that nothing shall be done until every little detail be worked out. On the contrary, no time should ever be lost to prepare for any plan that it appears may eventually be carried out. Note that the allied counteroffensive of July 18 was foreseen and some preparations started as early as June 7.
- e. Secrecy. While it may be impossible to conceal the general preparations made from an active, intelligent enemy, much may be concealed, such as the exact date preparations will be completed, relative importance of preparations at different places, employment of reserves. We have seen, for instance that while the Germans knew of the allied reserves, they wrongly believed they would be directed to strengthen fronts attacked, whereas in reality they were held on a front not attacked for use in a counter offensive.

Our country is founded upon the theory that it belongs to the people, not the people to the state, and differs from all other countries except England in that respect. Our citizens consequently have more individual freedom and rights than those of any other nation. They have need for a greater sense of civic responsibility. They need the restraining influence that comes from military training, its belief in the law of service and cooperation, its respect for the rights of others, its feeling of comradeship, and its proper pride in self and national accomplishment.

—John W. Weeks, Secretary of War.



H. M. S. NELSON

Courtesy of the Scientific American.

Displacement, 35,000 tons. Length overall, 792 feet. Extreme breadth, 106 feet. Normal draft, 30 feet. Speed, 23 knots. Armament: nine 16-inch guns in three turrets, twelve 6-inch guns in six turrets. Probable armor: turrets, 18-inch; belt, 12-inch.

Last Word on the 5-5-3 Ratio

By J. BERNARD WALKER

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WE have before us a copy of the recent hearing before a Subcommittee of the House Committee on Appropriations—a volume of 1,000 pages—which contains the most complete data on the Navy that we have ever seen in a document of this character. The Secretary of the Navy and the officers at the heads of departments were subjected to a very searching examination, particularly as to the status of our treaty battleship fleet, and the public is now put in possession of the facts.

The hearing constitutes a complete refutation of the propaganda of the past few years, which sought to persuade the American public that our battleship fleet was far below the standing of five in the Treaty allocation of 5-5-3 to the United States, Great Britain and Japan. The most startling disclosure is that of the enormous range of the guns of the 32,600-ton battleships which would lead our fleet in battle. These ranges are from 34,500 yards to 35,700 yards. So far as we know, this is the first time these figures have been made public, and they constitute a knockout blow to those who have claimed that our fleet is outranged and outsped by any other fleet. As a matter of fact, the "boot is on the other leg"; for the extreme range of the latest British battleships is only 24,300 yards, or from 10,000 to 11,000 yards less than that of our leading ships. The enormous significance of this is seen from the following considerations.

It is universally agreed that, as in the great war, so in any war of the future, battleship actions will be fought with the respective fleets drawn up in two parallel lines, or, as it is technically known, "in column." No matter how high may be the speed of individual ships, the speed of the whole column as such will be governed by that of the slowest ship in the fleet. This speed is about the same in the two fleets, the slowest American ship being credited with a speed of 20.5 knots and the slowest British ship with a speed of 21 knots. It is probable that, in the unlikely event of a naval battle between us and the British, the two fleets would settle down to a speed of about 20 knots. The British line includes five 25-knot ships and four battle cruisers credited with speeds of 29 to 31.5 knots.

Whatever might happen during the approach of the two fleets, it is certain that when they fell into line for the great test, these faster vessels would have to hold their speeds down to the fleet fighting speed of 20 knots.

If the weather is clear, and we will suppose it is, and if airplane and general scouting information has been ample and correct, the two fleets will deploy into column before they come within range. Thereafter they will approach each other on more or less converging courses. Now let us see what would happen. The head of the British

CAPITAL SHIPS OF THE UNITED STATES

Name of Ship	Turret Guns		Maximum Angle of Elevation in Degrees	Range in Yards	Speed in Knots	Displacement in Tons
	Diameter of Bore in Inches	Length in Calibers				
West Virginia	16	45	30	34,500	21.2	82,000
Colorado	16	45	30	34,500	21.4	32,600
Maryland	16	45	30	34,500	21.1	32,600
California	14	50	30	35,500	21.7	32,300
Tennessee	14	50	30	35,700	21.4	32,300
Idaho	14	50	15	24,000	21.3	32,000
New Mexico	14	50	15	24,000	21.1	32,000
Mississippi	14	50	15	24,000	21.1	32,000
Arkansas	12	50	15	24,350	21.1	26,000
Wyoming	12	50	15	23,500	21.2	26,000
Arizona	14	45	15	21,000	21.0	31,400
Pennsylvania	14	45	15	21,000	21.1	31,400
Oklahoma	14	45	15	21,000	20.6	27,500
Nevada	14	45	15	21,000	20.5	27,500
New York	14	45	15	21,000	21.5	27,000
Texas	14	45	15	21,000	21.0	27,000
Florida	12	45	15	22,000	22.1	21,825
Utah	12	45	15	21,600	21.0	21,825
Grand Total						525,850

line, containing their latest ships of the *Royal Sovereign* class, would come under the fire of the head of our line at a distance of over 17½ miles, or at a distance where their own 15-inch guns, firing at maximum elevation, would drop their shells 10,000 to 11,000 yards, or 5 to 5½ miles, short of the American line. They would not dare to come in end-on, because in that position they would be raked by our salvos, and in spite of the dispersion of the falling shells, a single eight-gun salvo might drop from three to half-a-dozen shells upon the deck of any ship thus approaching. Hence, the approach would be made on a converging course, and instead of 15 minutes it would take some 25 minutes or more for the British to get within range. During all that time they would be exposed to heavy shell fire of a most devastating character to which they could make no reply. With our system of fire control, and assuming airplane spotting to be possible,

it would be possible to drop between 1,000 and 1,200 shells upon the leading ships of the British line before they could get in close enough to return our fire.

It is surely no exaggeration to say that, under existing circumstances, if our fleet were able to maintain airplane spotting, the head of the British line would be crumpled up and either severely crippled or put entirely out of the fight before getting within hitting range.

CAPITAL SHIPS OF THE BRITISH NAVY

Name of Ship	Turret Guns		Maximum Angle of Elevation in Degrees	Range in Yards	Speed in Knots	Displacement in Tons
	Diameter of Bore in Inches	Length in Calibers				
Royal Sovereign	15	42	20	24,300	21.6	25,750
Royal Oak	15	42	20	24,300	21.5	25,750
Revenge	15	42	20	24,300	21.9	25,750
Resolution	15	42	20	24,300	21.6	25,750
Ramilies	15	42	20	24,300	21.5	25,750
Malaya	15	42	20	24,300	25.0	27,500
Valliant	15	42	20	24,300	25.0	27,500
Barham	15	42	20	24,300	25.0	27,500
Queen Elizabeth	15	42	20	24,300	25.0	27,500
Warspite	15	42	20	24,300	25.0	27,500
Hood	15	42	30	30,300	31.5	41,200
Renown	15	42	20	24,300	31.5	26,500
Repulse	15	42	20	24,300	31.0	26,500
Tiger	18.5	45	20	23,800	29.0	28,500
Benbow	18.5	45	20	23,800	21.5	25,000
Emperor of India	13.5	45	20	23,800	21.5	25,000
Iron Duke	13.5	45	20	23,800	21.6	25,000
Marlborough	13.5	45	20	23,800	21.6	25,000
Thunderer	13.5	45	20	23,800	21.	*22,500
King George	13.5	45	20	23,800	21.4	*23,000
Ajax	13.5	45	20	23,800	21.1	*23,000
Centurion	13.5	45	20	23,800	21.9	*23,000
Grand Total						580,450

* These four to be scrapped when *Nelson* and *Rodney* are completed, when total will be 558,950, against United States 525,850; the extra tonnage allowed to offset greater age of British Fleet.

As the fleets continued to close in, the British with a range of 24,300 yards, and the next five of our ships with from 23,500 to 24,000 yards, would engage each other. At this time our eight older ships with 21,000 to 22,000 yards range would be outranged by the opposing British ships by from 1,800 yards to 2,800 yards. Our own line, of course, would close in until these older ships could reach the enemy; but for several minutes the tail end of the British line would have the advantage of ours. But this temporary advantage of the enemy over our older ships, which would last for four to six minutes, would not compensate for the fact that for 25 minutes at the commencement of the action the best ships of the British line

had been subjected to an overwhelming gun fire to which they could make no reply.

The British line would include four battle cruisers, of which the *Hood* alone, with guns of 30,300 yards range and 12-inch armor, could stand up to the fire of the 14-inch and 12-inch guns of our older ships. The other three, *Renown*, *Repulse* and *Tiger*, with only 9-inch armor, would probably share the fate of the three battle cruisers that were sunk by 11-inch and 12-inch gun fire early in the battle of Jutland.

It is for these reasons we are satisfied that the American public, on looking at these two tables and the sketch* prepared by our artist showing the approach of the two fleets, will agree with us that, far from our fleet being outranged, and outspeeded, we ourselves have the whiphand, and with equal gunnery and equal seamanship could very reasonably count upon a sweeping victory.

And let it be clearly understood that if the proposed elevation of all guns of our fleet to 30 degrees were followed out, not merely our "big five" but our whole fleet of 18 ships would have the enemy under fire for from 15 up to 25 minutes before he could reach us. Such a change would vitiate the nice balance which was determined upon between our officers and those of the British in the selection of the respective battleship fleets, and would place us at an enormous fighting advantage.

It was brought out at the hearing that, with the exception of the *Florida*, the boilers of the ships which had to reduce their speed in the Panama maneuvers had been repaired and that these ships can now make their trial speeds. The *Florida* is in port for similar repairs.

In conclusion, there are two duties which confront the United States—first, to grant, without any reduction, the appropriations asked by the Navy Department for repair work; and secondly to bring our fleet up to Treaty strength in unarmed cruisers, fast scouts, airplane carriers and such vessels as are not limited by Treaty.

* Not reproduced.

The Past and Future of Defense Against Aircraft

By CAPTAIN BENJAMIN F. HARMON, C. A. C.

PRIOR to the World War the pages of this and other publications devoted considerable space to the then debatable question: "Is the dirigible or the airplane of military value?" Aircraft were stripped and laid bare in all their weaknesses or presented in all their strength according as the opinion of the writers varied. That question is no longer debatable. The answer has been written in the pages of history. New questions have arisen in the press of the present day and considerable heat is being generated on both sides of the well known "*vs*"—the airplane *vs.* the battleship,—the airplane *vs.* the seacoast gun,—etc., etc. In every case the correct answer would be found and considerable benefit would result from a total elimination of the "*versus*" and the substitution therefore of the phrase "in cooperation with." Thus, in antiaircraft instruction no "*versus*" is permitted. We say to the Air Service, figuratively: "Your pursuit planes are the best defense against hostile planes by day. We will support you at all times and act alone in your absence." The spirit of cooperation is one of the principles of war.

As a result of these current discussions a considerable number of people are losing all sense of proportion. This is to be regretted equally if the value of the Air Service be under-estimated or over-estimated. Inasmuch as the value of antiaircraft defense varies directly with the value of the Air Service let us examine, briefly, some of the factors which determine that value.

We begin with one incontrovertible fact which all the developments in the art of war have not altered—wars are won when our forces strike the enemy forces with such power that his will to resist and to fight is broken down. The doughboy does the striking. Artillery, Cavalry, and Air Service are ancillary means to the building up, preparing, and delivering of that blow. Infantry troops attempting to operate without artillery and air service support would have the most difficult, if not insurmountable, obstacles to overcome. Success in battle is often made possible by the artillery and air service—but is not accomplished by them directly. Wars cannot be won at long distance by artillery or from the air, but by the actual

physical contact of our infantry with that of the hostile forces. It is pertinent to inquire into the role of the Air Service in this scheme.

First the mission of reconnaissance. From the air we observe the location, size, and direction of march of the hostile units. We are thereby enabled to make our plans and to avoid tactical surprise while assembling and maneuvering our forces according to the plans we have made; for example, to attack the enemy who is in strength, position, and has probable intentions as determined by that reconnaissance. The mission of reconnaissance never ends. Formerly the information so obtained could only be determined usually by actual combat; for example, by a force sent against the enemy not sufficient or intended to defeat him, but of sufficient strength to cause him to deploy his units and thus expose by fighting the number and disposition of his troops.

The enemy on his part has certain means of decreasing the power of our attacking blow. Against these means the Air Service must act so that our power may be maintained greater than his. His artillery must be put out of action and the ammunition therefor destroyed. Attack and bombing planes are assigned this duty. Furthermore, artillery planes act as eyes for our artillery units and enable them to engage and destroy the same targets.

The Air Service must act directly to decrease the fighting power of the enemy forces. Destroying supplies, the means of bringing them up (trains, roads, railroad bridges), or their place of manufacture, assists in accomplishing this object. Attacking the enemy forces directly or bombing his cities in addition to reducing the material power of the enemy to fight reduces his morale or his will, which works to the same end.

The foregoing are offensive missions. We must not lose sight of the enemy's attempts to accomplish the same results with his Air Service. We must prevent him from so doing by the attack of our Air Service against his and by the action of our antiaircraft troops. These latter are defensive missions.

This resumé is brief but sufficient to show the great importance of the roles played by the Air Service. Remember at the same time that the only unit of vital importance is the infantry, which alone is the ultimate factor in winning a battle. We must maintain the proper sense of proportion.

Before passing from this subject it would be well to illustrate the importance of Air Service roles, particularly reconnaissance, by reference to the opening phases of the World War. What changes in the history of the world would have been effected by the use of an efficient air force up to the First Battle of the Marne? No one knows,

of course; but it would seem that the following phases would not have terminated as they did.

(a) The German Sixth and Seventh Armies would not have attempted the penetration of the Charmes Gap between Epinal and Toul, thus permitting the French First Army from the right and the second Army from the left (concealed in the Grand Crown of Nancy) to attack them in flank and throw them back in defeat on August 25, 1914.

(b) The German Fifth and Fourth Armies and the French Third and Fourth Armies would not, probably, have engaged on August 22 in the meeting engagement of the Battle of the Ardennes, or, having accepted engagement, the German forces would not have been surprised in their pursuit by the flank attack of General Manoury on August 25.

(c) Von Moltke would have known before September 3 of the French concentrations near Paris and probably would have altered his scheme of operations.

(d) The true state of affairs on the allied left would have been known better to the Germans who would not have abandoned the von Schlieffen plan of passing to the west of Paris with their First Army in favor of passing to the east, thus walking into Marshal Joffre's trap between Paris and Verdun and precipitating the great Battle of the Marne, an allied victory.

This divergence into the realm of conjecture would appear to indicate that airplanes properly used would have changed the history of the war and of the world, but such is not the correct conclusion even if the hypotheses are correct. The reconnaissance theoretically obtained by those planes would have placed in the hands of the infantry the ability to do or prevent certain things, which might have altered history very materially.

This is rather an indirect proof of the value of defense against aircraft, but if the value of aircraft in the military scheme has been shown, then the value of defense against aircraft has been indicated equally, for the two are inseparably inter-dependent. We are justified in expending for defensive measures, in time, money and materiel, in exact proportion to the losses we might incur by permitting an enemy air service unhampered action.

The means of defense against aircraft are innumerable. Foremost of all these is the pursuit plane that can seek the enemy wherever that enemy may decide to fly. Why go further? Because the pursuit plane like any other machine or weapon has its limitations. It must see the enemy before it can attack; and darkness, fog, clouds,

and rain interfere frequently. It must be present in sufficient numbers and at sufficient altitudes to engage all enemy planes. Manifestly over an extended theater of operations this condition is humanly impossible of fulfillment.

At this point the much disputed "control of the air" should be discussed. "Control of the air" is an ephemeral property which an army has today and loses tomorrow. It can be obtained or lost by the same means that Napoleon obtained control by battle. Napoleon, having 20,000 men, for example, would attack a force of 30,000 men and attack with a preponderance of men by the simple expedient of attacking only 15,000 of the enemy at a time. Thus, two forces, Red and Blue, are opposed on a hundred-mile front. Red has 2000 planes and Blue 1000. Has Red Control of the Air? Blue decides to attack or carry out some operation on a certain 25-mile front and secretly concentrates there 500 of his 1000 planes. He appears with 500 against Red's 100 and has control of the air in the vital sector when totally he is outnumbered two to one. There will be times when the Air Service will need help during, before, and after combat, and times when, for some of the reasons enumerated, our air force cannot attack, in which eventualities the anti-aircraft units will cooperate and assist or bear the entire defensive burden as circumstances warrant. It is not possible to oppose every enemy plane with another plane — recall the ratio of hostile planes seen in France to the number of aerial combats noted,— but it is possible and essential that no hostile plane shall approach an objective, whether materiel or body of troops, without being brought under fire.

Means of protection against aircraft operated from the ground are *defensive* because they cannot seek out the enemy where that enemy's will takes him. Part of them may be considered as having an offensive defense because they seek out and engage any plane within a certain radius and others as strictly defensive because they are inert and have no value unless attacked.

Of the defensive means perhaps that of camouflage is best known. Camouflage works both ways. It may conceal from enemy eyes the existence of materiel or troops, or it may lead the enemy to assume that certain batteries or other units exist at points where actually they do not. Nature has created camouflage for us; that is, in woods and forests we have sufficient overhead cover which cannot be penetrated by the eye. We wish to permit men to go from a certain battery to their dugouts. Walking through grass would create paths soon detected by aerial photographs. However, an old trench extends from near the battery position to the dugout. This old trench already photographed will be utilized as a path for pro-

tection from the air. Even a judicious selection of paths is a defense against aircraft and such considerations come under the head of camouflage.

In storing supplies, particularly ammunition or explosives, the total is subdivided and separated so that the radius of destruction resulting from a single bomb is limited to one subdivision. This is a defense against shellfire and accidental destruction as well as aerial bombing. Sandbag parapets or similar walls serve to stop the lateral travel of bomb fragments and thus protect personnel or materiel from all but a direct hit. In a well-organized French airdrome near Verdun each bed in the aviators barracks was completely surrounded by such an "eclat wall."

Barrage balloons form a very effective night defense for small targets such as railroad bridges or individual buildings in a city. This balloon, of a type similar to the kite observaton balloons, but smaller, is effective in a moral as well as a physical sense. That is, the group of defensive balloons must be raised in such positions that the attacking plane is compelled to fly through them to bomb successfully the area protected. Should the balloons be visible to the attacking aviators the presence below those balloons of invisible cables exerts an extremely deterrent force on the aviator's will to pass. It is impossible to estimate the location of the cables, and one of several decisions must be made.

First: To avoid the spot altogether. This was by no means unusual in the World War.

Second: To encircle in search of an opening. If the target is so large that open spots must be left, then these should be covered by a concentration of fire or night pursuit planes.

Third: To climb above the balloons. If the attacker be at a lower altitude and if he be a heavily loaded bomber, his attempt to delay in the presence of enemy fire, searchlights, and possibly night pursuit planes for a sufficient length of time to enable the climb to be made will result in all probability in his own destruction. The efficacy of the balloon presupposes that it be raised above the attacking altitude. This height can be made so great that night bombing from above it at a small target has a minute probability of hitting and the height can be made greater than the ceiling of most bombers.

Fourth: The balloons may be shot down. By the bomber this is practically impossible even should he be at the proper altitude. Balloon engagement is a fine art limited to the highly maneuverable fighting planes. It is possible that such planes might destroy the

balloon defense before the arrival of the bombers, provided they could see the balloons at night.

Fifth: The attackers can fly through the barrage of wires either intentionally or in ignorance of their existence. Here the physical effect enters. The plane, colliding with the taut wire, is destroyed. There are several records of such destruction occurring in the Calais region. The plane may be fortunate and penetrate the wires successfully. The measure of that probability is the ratio of distance between wires to wing span.

The barrage balloon found another use in creating a barrier across well known paths of approach for night-flying planes. These barriers were used in the hope that they would cause the actual destruction of planes or cause them to be lost in circling.

Smoke, generated by combustion or by chemical processes, is utilized to blot from the aviator's sight certain well-defined landmarks or targets either by day or by night. At this point the question is invariably raised, "Does not the smoke itself attract the aviator?" The answer is discovered in the use of the words "well-defined" immediately preceding. Smoke concealment is attempted only where the object concealed is otherwise plainly discernible. There are two general cases. First, it is desired to blot out some landmark utilized as a guide by a hostile aviator to enable him to reach his target. Whether a smoke screen over that landmark would be visible and thus disclose the landmark indirectly depends on existing conditions of visibility. If necessary a repetition of the smoke screen at other points along the route should throw sufficient doubt in the aviator's mind to assist him in getting lost. Second, it is intended to protect a munitions factory which, by reason of its location on a river at a certain point or for some other condition of visibility can be readily found from the air. By covering the entire region with smoke we admit the presence of the factory—since it is futile to deny it—but we conceal its *exact* location and the bombing must be by guess work. The greater the area covered by the blanket of smoke, the greater is the chance of the factory escaping destruction. The use of smoke has the disadvantage of depending upon wind for its efficacy. In too high a wind the cloud is dispersed rapidly, and in too slow a wind it is difficult to cover a sufficient area. Smoke was used to a large extent by the French for the concealment of bridges, factories, and buildings in the Paris region.

The same effect can be obtained by the use of inverted illumination, usually referred to as "luminous camouflage." Here a large zone containing the sensitive spot requiring protection is ruled off in one-kilometer squares. At each corner of these squares is placed

a 20,000 candle-power source of light—electric or magnesium flares—in an inverted 45° reflector. The appearance to the aviator is a sea of light within which his target lies; but its exact location is impossible of determination. If the attack be made within machine-gun range, the plane may be illuminated sufficiently to permit fire—or at least the aviator may imagine himself plainly visible to the ground, in which case he may decide that too great publicity is not to be desired and leave. There is the further possibility that an attacking bomber will be silhouetted against the light to a night pursuit plane above him, thus enabling an attack to be made by that pursuit plane. A project of this nature requires a large, expensive plant and therefore will be unusual.

Lights have also been used in a manner analogous to the utilization of barrage balloons, this type of defense being termed a "luminous barrage." Searchlights are established to create an inclined wall of light through which attacking planes must pass in order to reach a certain target. In passing through this stationary illuminated zone the attacker comes under the concentrated fire of guns and machine guns or perhaps attack planes lingering behind the barrage. This defensive conception arose at a time when searchlights were not producing the desired results. It is thought that development of searchlight materiel will obviate the necessity for any other scheme than the normal, direct searchlight action.

Measures taken for the protection of civilian communities come under the scope of anti-aircraft defense and under the direct jurisdiction of those troops. These protective measures include a thorough surveillance organization to detect far in advance the approach of an attack, the necessary communications system to insure the immediate transmission of intelligence from the surveillance system, and the means and power for enforcement of the obscuration of all lights. It includes the supervision of the organization of bombproof and dugout construction and, finally, the education of the populace in the necessity for their loyalty in carrying out all the details of defensive measures and maintaining that high morale which the people at home must have if their army is to be victorious.

The anti-aircraft means of defense suggested and tried out are legion. The foregoing are those that have had a measure of application and are still considered as factors to be weighed in planning an anti-aircraft defense. The backbone of any defense will always be those weapons that have a striking power—that we have called offensive-defensive weapons; namely, searchlights, guns, and machine guns.

Searchlights are advisedly classed with those defensive means having a striking power. It is true that the power exerted is in a

moral rather than a physical sense, but none the less positive. The difficulties in the path of an aviator making a long-distance night bombardment are innumerable: the actual control of his plane is more difficult; the landmarks are hard to discover and easy to lose; the entire course is difficult to follow—he knows not what is going on about him. Suddenly he is picked up by a group of searchlights and feels himself, in consequence, to be the most prominent object in his enemy's territory. He is a target for guns, machine guns and pursuit planes; his objective cannot be seen; his landmarks disappear; and he is obsessed with an all important problem—to escape from the beam.

The development of the searchlight was greatest with the British, and from them the A. E. F. took its first lessons. The British conception of searchlight tactics differed essentially from the French in that the British developed night pursuit aviation to reinforce the effect of the light itself. In the summer of 1918 they maintained between Cambrai and St. Quentin a special group of fifty-three searchlights and twenty-six pursuit planes established in four lines at intervals of about three kilometers. This organization accounted for twenty German night bombardment planes that summer. Their defense of London was organized in alternate zones of airplane-searchlight and gun-searchlight activity.

The A. E. F. searchlights were operated by the Corps of Engineers. Both in point of operation and research these special troops accomplished all that could be expected. They were hampered, like all anti-aircraft units, by the lack of suitable materiel at that stage of the development of a new science. It should be borne in mind that the searchlight frequently operates under heavy fire. In proportion as the light gets the aviators "wind up" that light is liable to bombing and machine gunning by the plane. This is a bit rough on the light crew, but this is the purpose for which they exist. Every bomb dropped, every foot of altitude given up, every second wasted in attacking the light, operates to protect the area behind that light. It accomplishes its mission by being a target—and in addition tends to draw the attackers within machine gun range.

As the intensity of night bombing increased, the interest in sound apparatus was intensified. The sound locator has two functions to perform; first to direct the searchlight on the present source of the sound, and second to enable the guns to fire at a future point where plane and projectile will meet.

There are two general auricular methods of determining the apparent location of a source of sound: one based on difference in intensity, and one based on difference in phase. In the first method

the observer has, for example, a conical trumpet, the small end of which is connected to his ears by a tubing arrangement. This he revolves until the sound has a maximum intensity in his ears at which time he is pointed at the apparent source of sound. In actual operation the apparatus is oscillated about the apparent maximum (both in elevation and in azimuth) and the mean of the oscillations considered as the determined value. The principal objection to the maximum apparatus is that the sound arrives in varying intensities due, no doubt, to the non-uniform transmission of sound through air pockets and other variations in air density.

To visualize the method of difference in phase, consider a man facing an apparent source of sound. To his unaided ears the sound appears *in front*. Should he turn his head to the left the sound then appears *to the right*, and upon turning his head to the right the sound appears *to the left*. Should he then swing his head slightly so as to receive successively the sensation of sound to the right and to the left, the true direction of the sound in front will be found by bisecting the amplitude of the swings from right to left. Apparatus designed on this principle augment the range and accuracy of the unaided ear and permit of a more exact determination of angular readings, as well as adding the ability to sense a direction in elevation equally well with the azimuthal determination. Perhaps the best known of this type of apparatus is the paraboloid sound reflector—which was used also as a maximum apparatus. The focusing property of a paraboloid needs no description. The two most successful of the paraboloid apparatus were two and three meters in diameter with a 70-cm. and a 1-meter focal length, respectively. At the focal point were placed two sets of small trumpets, one for azimuth and one for elevation, connected by tubes of equal length to the ears of the two operators. In accepting the paraboloid, the French based their acceptance on the following inherent advantages:

1. The sound is intensified and the range increased. In calm weather ranges of fifteen kilometers have been attained.
2. It is not affected by wind.
3. Parasitic and external noises do not interfere. Sounds (gunfire, trucks, etc.) more than 30° from the source of sound do not interfere, and the selectivity in following one of several planes is about two hundred mils.

The magnitude of the oscillation necessary to produce the passage of the sound from right to left was very large. This was partially compensated for by a mechanical index which remained practically at the center of oscillation.

The progress of the experimentation in the development of sound apparatus presents a most interesting study of which the account contained herein is an extremely brief outline. It is impossible to do justice to the entire subject and still consider other phases of anti-aircraft development in an article of this length.

Reference has been made to the apparent source of sound. Sound travels through air at a rate of about 363 yards per second. Thus it would take eleven seconds for sound to reach the ear from a plane four thousand yards distant. During that time the plane will have traveled 550 yards (assuming a speed of 50 yards per second) so that the apparatus would determine an apparent source of sound 550 yards behind the actual or present source. To this lag of sound must be added the effect of wind and temperature on the sound wave, and corrections applied for all these determining conditions to deduce from the apparent position the present position of the source of sound. On this present position the searchlights may open, but additional computations are necessary for artillery fire. Some prediction system was necessary in order that the travel of the target during the time utilized in serving the guns and the time of flight of the projectile might be computed.

Three elements must be determined: the altitude of the target; its predicted azimuth; and its angular height, i.e., the angle formed by the line of sight and the horizontal. From these values the predicted elevation of the gun and the fuse setting may be determined. If a graph be constructed of concentric circles having for radii the cotangents of the various angular heights and with radial lines of true azimuths, then the apparent source of sound as determined by the sound apparatus may be plotted thereon, inasmuch as that apparatus determines an azimuth and angular height. Now it can be shown that a succession of points so plotted will be a reproduction of the horizontal projection of the plane's flight to a scale $1/H$ (H -altitude). If a length of this plot and the time taken in producing that length be measured, then the altitude may be computed. Furthermore, a slide rule may be constructed that will permit the extension of the plot as determined by three separate factors; first, lag of sound and wind and temperature effects on the sound; second, travel of the target during service of the piece; and, finally, travel of target during the time of flight.

The formulæ arrived at for this prediction are empirical. Approximations are made throughout, and the entire system is based on the operation of a non-precision instrument. The prediction cannot be considered except as unsatisfactory and inaccurate—but it was the best method of night fire available. A future point was de-

terminated. Should we fire a rifle, figuratively, at this point, no results would be likely. On the other hand, should we fire a number of shotguns a different story would be told. The predicted point is not exact, but the chances are very high that several 4-, 6-, 8-, or 10-gun batteries firing at that point will include in their dispersed volume of fire the true position of the target. By volume of fire inaccuracies are compensated for. A two-gun battery is of little value for night fire.

What results were accomplished by night firing? In the defense of Dunkirk there existed a specially developed sound organization that accounted for four Gothas in one month (July, 1918). It was about Paris, however, that great results were obtained. Paris is the heart of France and, as such, was not stinted in the materiel made available for its protection. Its antiaircraft guns ran into the hundreds. Smoke screens, alert signals, surveillance lines, listening posts, machine guns, searchlights, bomb proofs, and other defensive means, in materiel and personnel alike, composed an extremely large, efficient, and well-organized plant. The results of this defense are known to a relatively small number of people, but to those who have made a study thereof, it exists as one of the great achievements of the War. Operating under the most difficult conditions against the fleetest of all targets, a measure of defense was given by the A. A. organization far beyond all reasonable hopes and expectations. In 1918, but seven percent of the attacking planes passed the defense and reached Paris. Thirteen night bombers were destroyed. Most significant of all, perhaps, is the fact that in one raid (Aug. 15-16, 1918), eleven thousand kilograms of bombs were destined for Paris, whereas during the entire year, only half that weight was actually dropped on Paris.

The development of night firing methods was due to and parallel with the development of the night bombardment plane which culminated, specifically, in the Gotha. Day firing methods preceded the night-time defense in point of development. At the beginning of the war one saw an occasional Taube and fired at it with an ordinary field gun—if at all. Reconnaissance was, at that time, the all-important air mission, and that such reconnaissance was ineffective is well brought out by General Von Kluck's account of the march of the First Army on Paris in 1914. He suffered continually from a lack of true information regarding his opponents. Repeatedly he was reduced to the merest conjecture as to the location of the entire British Expeditionary Forces. Today, due to the tremendous strides in the science of aviation, such a condition would be impossible. From a small and very ineffective reconnaissance service the Air

Service had developed at the end of the War to a large force performing effectively the missions of pursuit, bombardment, reconnaissance, and attack. As the aerial weapon increased in value greater stress was placed on anti-aircraft defense; as that defense increased in efficacy the planes increased their effective operating altitudes. Thus we have an interesting parallel development of attack and defense during the period of hostilities when theories and conjectures did not enter. The attack of the airplane was a fact and a defense against it worked or it didn't—another fact.

The termination of the war found in each of the allied armies a recognized corps of artillerymen in charge of development and training in the difficult and extremely technical art of delivering accurate fire against an airplane. The French anti-aircraft service claimed one-fourth of the total planes destroyed in 1918—having been developed to this point from a condition of non-existence in 1914. The difficulties to be overcome in accomplishing such results were enormous.

Consider an airplane with a speed of 50 yards per second (about 100 miles per hour). It would require 120 seconds for this target to travel 6000 yards. It takes 20 seconds for the 75-mm. projectile to travel the same distance—the projectile has but six times the speed of the target and that target very slow as airplanes are now considered! Suppose, then, that the target is 6000 yards from the battery—20 seconds away. We can determine exactly where he is now, but his location at the end of 20 seconds is a matter for conjecture. Actually he can be anywhere within a volume about one million times the danger volume of the projectile fired at him. In other words, the mathematical probability of a hit is one in one million. Consider, for a moment, the actual number of planes *destroyed* by A. E. F. gunners (destroyed in contradistinction to *hit*; planes may be hit repeatedly, and were hit, without destruction) in contrast with this probability. Of all the American batteries firing, one plane was destroyed for each 1050 rounds fired. Those batteries that actually brought down planes made a record of one every 604 rounds, and one battery shot down two planes with its first 120 rounds. Why these remarkable results when the mathematical probability is one in one million?—*To be concluded.*

An Outline of Industrial Mobilization

EDITOR'S NOTE: The following paper, prepared in the Office of the Assistant Secretary of War, sets forth briefly some of the salient features of the measures required in time of peace to insure the flow of ammunition and supplies needed by our Army in the event of war. Although this paper has already appeared in mimeographed form, it is here reprinted because of the great importance of the subject, and because of the clear and concise manner in which the problem and its solution is presented.

THE National Defense Act, as amended June 4, 1920, establishes the broad outlines of a military policy for the United States. Under the provisions of this law the Army of the United States, consisting of the Regular Army, the National Guard, and the Organized Reserves, is at present organized, trained, administered, and supplied. Congress, in amending the National Defense Act, made a fundamental change in the business organization of the War Department. The Assistant Secretary of War, under the supervision of the Secretary, is now charged with the control of policies affecting the business administration of the Army.

The duties of the Assistant Secretary of War are defined in section 5*a* of the National Defense Act. As prescribed therein, he has two distinct functions: first, he is responsible for supervising the procurement of all military supplies by the War Department and other duties relating thereto; second, he is required to see that adequate provision is made for the mobilization of materiel and industrial organizations. The statute says he shall be charged with "The assurance of adequate provisions" for industrial mobilization, but this must be taken to mean that he is responsible that adequate plans are made.

Wars are no longer fought by the armed forces alone. Every man, woman and child, every resource, and every dollar in the entire Nation must throw its weight toward victory in time of war. Industry alone can not win a war, but it can lose a war by failing to supply the armies with munitions, vital to their fighting efficiency.

In planning for procurement of supplies in time of war, it is, of course, necessary to know what kind of supplies will be required and how much will be needed. The General Staff indicates to the Secretary of War the military program which is believed adequate for any emergency and determines the types of equipment and tables of allowances. All questions affecting the procurement of supplies—that is, where they can be procured, who will procure them, the rate

of production, and maintenance of an economical program — are determined under policies laid down by the Assistant Secretary of War, the business head of the War Department. The cost of the supply program must be estimated in order that Congress may know the extent of appropriations required and the Treasury Department may have the necessary data upon which to make plans for financing the war.

In this connection the War Department is giving most careful attention to the ways and means whereby profiteering may be controlled in time of war. The principle that men at home shall not make inordinate profits from war, while their fellows are staking their lives and their health for their country, is fundamental as a proposition of common justice. Such a policy was affirmed in a nation-wide referendum by the Chamber of Commerce of the United States during the World War, and has been repeatedly commended as a principle of government. It may, therefore, be regarded as a fixed national policy for the future.

An army requires hundreds of thousands of items of supply, many of which are of a special design not produced commercially in time of peace. Before the War Department could approach industry in order to discuss production, it was first necessary to standardize specifications for supplies wherever practicable. This has been done by adopting, as far as possible, commercial standards, thereby insuring quicker production and reduced costs. At the same time it has reduced the large number of contract forms previously in use to three forms which are about to be adopted for all war contracts. The adoption of such a simple form should obviate many of the mistakes made in the World War by inexperienced buyers for the Government.

Plans for procurement do not stop with the determination of the finished article, but the War Department must go further and plan for the procurement of machines for the making of its materiel, for securing the necessary raw materials which might become critical in time of war, and for insuring an adequate supply of labor, of power, and of transportation facilities.

This phase of procurement planning goes beyond the strictly military features and merges into the broader field, which for want of a better term has been called "Industrial Mobilization." By this term we mean the conversion of the Industrial effort of the Nation from peace production to war production in an orderly manner, so that supplies can be furnished promptly, economic losses minimized, and the return to normal economic conditions at the conclusion of the war facilitated.

In order that these plans may be complete, it is necessary that the war requirements of the Navy, shipping, the railroads, and of the civilian needs be considered. Cooperation with the Navy will be accomplished by the recently created Army and Navy Munitions Board. It will be necessary, in time of war, to create an agency similar to the War Industries Board to coordinate the civilian demands with those of the Army and Navy.

The following indicates the steps which are being taken in working out a plan for the procurement of supplies for the War Department in time of War:

First. Having determined what will be required, it became necessary to figure out how much would be required. This necessarily depends upon the tables of allowances and the mobilization rate, which rate also determines when the supplies will be required.

Second. Having worked out in detail the amount of supplies required, it then became necessary to determine where and how they could be procured. This has been done by the establishment of procurement districts by each branch of the War Department, to each of which has been apportioned a proper share of the total requirements. In order to prevent competition among procuring branches, facilities requested by them have been tentatively allocated for the purpose of procuring the supplies required. The officers in charge of procurement districts are engaged during the present year in making a survey of establishments required to meet the supply program.

There are seven supply branches in the Army. The Quartermaster Corps is responsible for the procurement of all subsistence and forage, all clothing, personal equipment, tentage and general equipage, fuel, oil, paints, vehicles, harness and saddlery, hardware, stoves, tools, furniture, mess equipment, cordage, construction materials, motor vehicles, marine equipment, repair machinery, laundry machinery, and all animals.

The Ordnance Department procures rifles, pistols, machine guns, artillery and ammunition of all kinds, aircraft bombs, fire-control instruments, target materials, grenades, trench-warfare materials, pyrotechnics, special motor vehicles, tanks, and tractors.

The Signal Corps procures communication equipment of all sorts, wire and cable, radio equipment, batteries, photographic and meteorological equipment, and pigeons.

The Corps of Engineers procures surveying equipment, lithographic and map-making materials, searchlights, bridges, railroad rolling stock, railroad shops, lumber for troops in the fields, and water-supply equipment.

The Air Service procures all airplanes and balloons, the engines therefor, special raw materials which are needed for its aircraft, such as spruce and airplane dope. It also buys special trucks needed for its work, lubricants, aerial signaling apparatus, and special aircraft armament.

The Medical Department procures hospital supplies, surgical, dental, and veterinary instruments, drugs, chemicals, reagents and laboratory supplies, and all hospital equipment and furniture.

The Chemical Warfare Service procures war gases and their containers, chemicals, smokes, incendiary materials, gas masks, and other gas defense equipment.

Each branch has a distinct problem. We have those branches of which the Quartermaster Corps is the chief representative, dealing in vast quantities of supplies, mostly commercial in character. On the other hand, we have the case of the Ordnance and Air Service dealing in items which are either not produced commercially in time of peace or in such limited quantities as to have little effect upon wartime procurement. With the first class (those dealing in commercial products) the problem is merely one of stimulating production for which peace-time facilities already exist. The main thing in this connection is to see that specifications follow as closely as possible commercial standards.

The problems facing the Ordnance Department and Air Service are peculiarly critical. In the case of the Ordnance Department, the maintenance of war reserves is vital. While at the present moment we are fairly well off in this connection, ten years or even five years hence we probably will be in much worse shape, especially in the matter of explosives. Weapons of war change rapidly, and it is very difficult to forecast ten years in advance the types that will be required. It is very unlikely that Congress will ever consent to appropriate in time of peace sufficient money to maintain a war reserve which military men would like to have in order to insure a more rapid mobilization. There seems to be, therefore, but one thing to do in connection with the ordnance problem, and that is to secure sufficient appropriations annually to keep the art of manufacture alive. This will involve placing annually "educational" or "experimental" orders with selected facilities, furnishing them with the necessary jigs, dies, gauges, etc., in order to encourage them to experiment in the manufacture of these non-commercial articles.

The Air Service problem is even more critical. It is wholly dependent upon an infant industry which offers considerable hope for the future, but which at the present time is in bad condition due to lack of interest in commercial aviation. Congress is considering

proposals to encourage civilian aviation, and through some legislative stimulus of flying, as well as the encouragement of mail service by airplanes, it is hoped to encourage aircraft production so that it may furnish some foundation for expansion for wartime requirements.

The chiefs of the supply branches have assigned various officers of the Regular Army to the duty of making continuous studies of the problems of procurement and submitting professional papers on the subject assigned. Several hundred officers are now making these studies in addition to their regular duties. Some reserve officers also have agreed to make similar studies.

The general idea is that for each class of supplies, of which there are about ten in each branch, there will be a small group of Regular officers and a group of Reserve officers who are studying the question from various angles; this will give to each procuring service a number of officers who are well qualified to carry out the responsibilities of the service in procurement matters. In this manner Regular officers will learn something of industry; Reserve officers and others engaged in industry will become familiar with the military features involved; and all, working together, will be able to prepare the necessary detailed plans and keep them up to date to meet any changes in probable war needs or industrial progress. As the planning develops, critical features will become known and deliberate decisions can be made, the advice and judgment of men of great experience in industry being obtained on questions of major importance.

The plans for expansion of personnel, in time of war, must go far beyond the personnel available in the Regular Army. By interesting Reserve officers and patriotic civilians in this work, by keeping them informed of the scope of the plans, and, in the case of Reserve officers, calling them to active duty occasionally, a reserve of industrial staff specialists corresponding to the military reserve will be created. In this way the work of furnishing the expanded Army in an emergency with adequate supplies and munitions will proceed smoothly and without confusion as the work will be directed by men familiar with the war-time problem they are confronting, and bring to it their special knowledge and training from civil life.

Where the plans reach beyond the operations of the War Department in time of war and deal with such activities as were handled in the World War by the War Industries Board, the War Trade Board, the Food Administration, the Fuel Administration, the Railroad Administration, and similar bodies, the functions of the department are confined to making plans and keeping them up

to date, based upon a thorough study of what happened here and abroad during the last war. Prominent men who had experience along these lines are called upon for advice. When war comes these plans will be submitted to the President for consideration.

As above noted, the National Defense Act placed upon the Assistant Secretary of War the responsibility for preparing plans for mobilizing material and industrial organizations essential to war-time needs.

Some of the problems which will confront the Government and which must be solved by industrial experts are—

Capital: Finance manufacturers to whom war contracts have been allocated. Prevent profiteering. Stabilize prices in time of war.

Labor: Provide machinery for the settlement of industrial disputes in time of war. Insure a proper distribution of labor. Prevent the assumed necessities of industry becoming a haven for "slackers."

Facilities: Equalize the war load so that industries are neither overloaded nor made inactive. Determine what industries are less essential and provide for them in time of war. Plan conservation in industrial methods.

Raw Materials: Provide for a constant flow of raw materials. Provide for the equitable distribution for the best interests of the Nation. Effect of tariff on strategic raw materials.

Power: Prevent overloading of districts to meet increased demands. Utilize power most economically.

Transportation: Maintain railroads and rolling stock in good condition. Obtain maximum efficiency in the use of rolling stock. Make best use of highways and waterways to supplement railroad transportation.

It is hardly necessary to point out what a tremendous saving a sound plan for industrial mobilization will be in time of war. During the World War the Government departments competed with each other and there was much confusion and lack of coordination. Some industries found themselves swamped with orders they were unable to fill, while other industries were ruined by a sudden cessation of their normal business. In a well-devised industrial mobilization scheme much of this can be avoided. This is a matter of vital importance to the taxpayers. The Army will be equipped for war months sooner than it was during the World War. The war will be shortened by just that much, thereby saving thousands of lives and billions of dollars. It will also mean a minimum dislocation of the normal economic effort and facilitate a return to peace conditions.

EDITORIALS

John W. Weeks

SECRETARY of War John W. Weeks has resigned his office because of ill health. Taking up the portfolio of Secretary of War during the administration of the late President Harding, Mr. Weeks has worked hard to bring the Army to a high state of efficiency. He has been unusually successful in the administration of the affairs of the War Department, and the Army came to look upon him as a personal friend. In his farewell statement made just after he attended his last cabinet meeting, Mr. Weeks stated in part:

My resignation has been tendered to the President. I had hoped to be able to resume my duties, but my physicians advise me that it will be several months before I am able to undertake any strenuous work. Due to the very kind consideration of President Coolidge, I have remained in office in the hope that I could soon return to the Department. I have devoted the past twenty-five years to public service. It is my main interest and naturally I dislike to leave it. I have come to the conclusion, however, that the nation is entitled to a better performance of this important public duty than I am able to give at this time, and therefore I have resigned.

I am especially reluctant to leave the War Department at this time. With a Regular Army of twelve thousand officers and one hundred twenty-five thousand men, a National Guard force of one hundred seventy-five thousand men, a reserve of more than ninety thousand officers, the annual citizens' military training camps of between thirty and forty thousand men and the Reserve Officers' Training Corps, it is not to be expected that there will be unanimous agreement as to the policies of the War Department. There may be room for legitimate criticism, but, on the whole, this great force has worked together as a unit, and during my incumbency I can say that they have worked together most harmoniously. I believe that under the Defense Act of 1920 the Army of the United States has made the greatest advance in its history and has never been more

efficient or more prepared for immediate and effective expansion to meet the requirements of war. * * * I have every confidence that a fair investigation of the Army will demonstrate its efficiency and preparedness. * * *

The President has appointed as my successor Honorable Dwight F. Davis. Mr. Davis has had two and a half years' experience in the War Department, the first two years in the performance of the duties assigned by law to the Assistant Secretary of War and the past six months as Acting Secretary of War. He has administered the affairs of the department with intelligence and ability. I have every confidence in his judgment and common sense. I am grateful to him for his wise counsel and assistance to me and I know he will enjoy the same loyal support that I have received during the past four and a half years. * * * It is with great personal regret that I leave the War Department. I love the Army. The same patriotic spirit and devotion to country that led it to victory in the World War imbues its officers and enlisted personnel in time of peace. I have an unshakable faith in our Army and a deep gratitude to my associates who have been so largely responsible for its administration during my incumbency as Secretary of War. I leave them with the assurance that I will continue my interest in their problems and will always be ready to assist national defense to the extent of my ability.

The Army regrets that Mr. Weeks feels it necessary to retire from office. Its feeling is best expressed in the words of President Coolidge, who in accepting Mr. Week's resignation, stated: "The country is losing a valuable public administrator, and I am losing intimate contact with a friend. You will go down in history as a great Secretary of War."

The Library, Coast Artillery School

On another page the JOURNAL has initiated a new department under the title "Library, Coast Artillery School." In it will be listed from month to month the books received by the library of the Coast Artillery School. The Library wishes to extend every available facility to officers of the Coast Artillery Corps "from Maine to Manila," and takes this method of advertising its most recently accessioned books.

The *raison d'être* of the Library is primarily as an adjunct to the Coast Artillery School, but only slightly second to this is its desire to assist all members of the Corps by supplying, suggesting, and recommending personal literature. As it must of necessity serve

the School first, it is not always possible to lend particular books to officers at a distance from Fort Monroe when such books might be needed for immediate use by directors, instructors, or students at the School and when there is a small number of copies of such books. Fortunately, however, among its 42,000 catalogued books, only a comparatively small percentage are under this restriction. It will be worth the while of any officer to write and request books on the subject in which he is interested or on which he wishes to increase his knowledge; or if he so desires he may give the titles of books which he would prefer, and the Library will make every effort to supply such books or others on the same subject. The books are sent under franked mail, with a return franked label enclosed.

The time limit for the return of borrowed books varies with the number of demands which the Library has for that particular book, with the distance of the station to which it is sent, and with the probability of its being needed for School use. Every request for books is separately handled and separately considered, and in each case an attempt is made to give as long a loan as is thought consistent with the needs of other patrons.

In addition to lending books the Library is very glad to give unbiased criticism on books which an officer contemplates purchasing, or to suggest books on any subject. A very complete set of English and American Bibliographies can be consulted, and the facilities of the Bookshop of the COAST ARTILLERY JOURNAL offer exceptional opportunities for the obtaining of any publication in print, usually at a saving from retail price. Through this same source, subscriptions can be entered to magazines of a professional nature and of a general character.

The arrangement of the Library is such that books of a general nature, such as Encyclopedias, Dictionaries, Atlases, and Directories, which are termed "Reference Books," are segregated in a separate room—the Reference Room—and are not available for issue except in unusual cases by special permission from the Librarian. For this reason, such books could not be sent to borrowers, but where their use is indicated in reading up on any subject, it is believed that officers would be able to consult such books in libraries in their own vicinity. Periodicals, as a general rule, come under the same restriction so far as copies for the last few years are concerned. With older issues which have considerable historical value, the Library is fortunate in possessing fairly complete sets, and a desired volume can usually be spared for a brief period.

While the Library is attempting to be of every possible service to the Corps at large, it is hoped that members of the Corps will,

when the opportunity offers, assist the Library by suggesting for purchase any new or unusual books which they have found to be of value and, when convenient, advise the Librarian as to the titles of any books which they may have in their possession and which they may not desire to keep. Such books would, at times, serve to complete sets or to give the Librarian additional resources on subjects which are not completely covered in the present Library files. This especially pertains to old issues of Drill Regulations, Manuals, and articles of historical interest on Artillery or related subjects. Arrangements can be made whereby such books can be sent to the Library without cost to the donor, but the Librarian should be consulted in each case before shipment is made.

A very complete Map Room is being arranged and through the courtesy of the Map Division of the War College, the Library is in possession of a fairly complete sets of French and British maps covering the European War. These maps will be available for loan, but as it will be practically impossible to replace any of them, the borrower will be requested to exercise extreme care in handling them. So far as the United States and its foreign possessions are concerned, the Library can suggest maps, on several different scales, covering practically any desired section, which can be obtained at very low cost from Government Departments.

To sum it up, when you want information in any of the lines listed above, "Ask the Librarian."

The Case of Colonel Mitchell

[Reprinted from the New York *World*]

It is clear that given his temperament Col. Mitchell ought either to be out of the Army or at the head of it. He is an impossible subordinate. No army anywhere could maintain its self-respect if it permitted its officers to abuse each other in public as Col. Mitchell has abused his superiors. If Col. Mitchell wishes to reform the administration of the Air Service, it was his duty first to make his suggestions through the regular channels and then if they were ignored to resign his commission and conduct his agitation as a civilian. It does not matter how right he may be, as a military man he cannot be permitted to conduct a public propaganda and a Congressional lobby of his own.

Some who have commented upon the affair have assumed that to deny Col. Mitchell the right to issue his statements was a denial of free speech and an infraction of liberty. That is not the case. There is no more fundamental rule of civil liberty than that which

forbids the military to engage in political agitation of any kind. If Col. Mitchell had attacked the pacifists as he has attacked the Army administration, the pacifists who are now defending him in the name of free speech would be trouncing him as a militarist. If Col. Mitchell had attacked the big-navy people or the conscriptionists, Mr. Hearst, who has rushed to his support, would have attacked him for not minding his own business. The only rule, therefore, is to insist that all officers attend to their duties and abstain from publicity, and if they have anything sufficiently important to say that they resign and say it as civilians.

The truth or falsity of Col. Mitchell's charges has nothing whatever to do with his right as an officer to conduct a propaganda. Every man who conducts a propaganda is no doubt as sincerely convinced he is right as is Col. Mitchell. But unless the War Department is to display gross favoritism or abject fear of Col. Mitchell's political strength it cannot allow him liberties which it would not allow any other officer who felt he had something he wanted to say. The truth of the Mitchell charges is a matter for Congress and the President to determine; the immediate business of the War Department is to make a civilian out of Col. Mitchell. Then if the charges of Mr. Mitchell are sustained by a civilian body Mr. Mitchell can, if necessary, be made Secretary of War and allowed to reorganize the whole service.

But from a subordinate officer of the United States Army, were he prophet, sage and genius, infallible and inspired, such conduct as his is destructive and intolerable. It promotes that curse of armies, factionalism and intrigue. It destroys discipline, and discipline in an army, far from being parade-ground stuff, is the very thing which in battle and in crisis makes heroes out of ordinary men and enables cool heads to rule excited hearts. Armies are not democratic assemblages. They are autocratic organizations with a ritual and a point of view distinct from that of civilian democracies. There is no use trying to mix the military and the civilian attitudes. The safety and the effectiveness of each lie in keeping them rigorously distinct. Once you try to mix them you enfeeble the army by encouraging an individualism that it cannot digest, and you produce militarism in its worst form by putting the army into politics.

Discipline is not a fad of the Army's. Discipline is what makes it an army. Uniforms don't make an army. Guns don't make an army. Personal courage does not make an army. Without discipline there is only a mob. Without training which enables great masses of men to be directed by a central command transmitted through a hierarchy of officers there is no army. No wonder soldiers take dis-

cipline so seriously that to a civilian they often seem absurd. They are so thoroughly impressed with the helplessness of undisciplined men in an emergency that they put an emphasis on discipline which civilians find it hard to understand.

It is the public's business to understand it in the case of Col. Mitchell and to realize how conduct like his strikes at the roots of solidarity in an army. When he is once more a civilian like the rest of us he should be listened to with respectful attention and his charges pursued to the end. But while he remains an officer there is no course open but to subject him to the same standards of conduct which every other soldier must obey.

The R. O. T. C.'s Make Good

[Reprinted from the *Chicago Tribune*]

Col. Girard Sturtevant, commanding at Camp Robinson, Sparta, Wis., where artillery reserve officers are being trained, says this country for the first time has a military policy that is both practical and economical.

The fundamental of preparedness, he believes, is the training of reserve officer. This country lacked a corps of reservists when our last war began and the consequence was that our army was officered to a considerable extent by men who were crammed with military knowledge in three months of intensive training. The training had to be incomplete. Men were given commissions, as most of them will admit, long before they were competent to command men in action. The country needed officers above anything else and those who showed aptitude had to take commands before they were ready for them. Many lives were sacrificed needlessly because the officers didn't know their jobs.

We should be in a somewhat stronger position if a war were to be declared in the next few years. There are 80,000 civilian officers who saw action in the war and have since been enrolled as reservists, but it is now seven years since the armistice and in another five or ten many if not most of the civilian officers with combat experience will no longer be eligible for active duty.

The country will then have to rely for its reservists almost entirely upon the younger men who received their military training in the colleges and universities. In most of the land-grant universities, military training is compulsory. It is so at the University of Illinois, where twenty-six regular army men are stationed to instruct the students. Many other universities, such as Yale, have splendid volunteer corps. Men who have had military training in the colleges,

and especially those who have had, in addition, instruction in the technical schools, will become the nation's main reliance.

The college training must be supplemented each year by a few weeks of instruction, such as that at Camp Robinson. The system is not ideal, because it neglects to provide trained men in the ranks, but it is the best we are ever likely to get in this country. As Col. Sturtevant has said, it is practical and economical.

Obviously, the bulk of the training of future reservists must be given on the campus. No effort should be spared, therefore, to impress undergraduates with the importance of that training for the safety of the republic. Similarly, no effort should be spared to impress Congress with the importance of the training of reservists. Great pressure will be put upon Congress this year to slash the military appropriations. Unless the significance of the reserve is constantly emphasized, inadequate provision will be made for it. Nothing could be more disastrous to the nation's defenses.

When Winter Comes

The cold, gray days of winter are upon us. The trees stand forth naked to the sky. The fields are bare, and the corn stalks rustle crisply in the winter breeze which coldly passes by. The deserted road echoes hollowly under the footsteps of the occasional pedestrian hastening to the comfort of his fireside, and the fallen leaves, gold and brown and purple, scamper from underfoot as they, too, seek a shelter of their own. Without, all is dark and gloomy; within, all is cheerful and bright. Winter is here!

The training camps have been broken up and the tentage stored away. The drills of the summer are all past and gone. Programs of training have been filed as completed; new programs begin to appear. Troops are again in their barracks; officers once more are at home. The outdoor season has gone its way, and the indoor season begins. Summer is past! What of winter?

As the flames roar in the fireplace through the long, cold evenings of winter, how shall we pass the time? While the wind drearily moans down the chimney and the snow pads softly against the window panes, what shall we do? Shall we waste time in amusements, in cards or games or play? Or shall we, perchance, catch up on our professional reading—lose ourselves in the adventure and romance of military history or follow in spirit the lives of great soldiers of the past, engross ourselves in the study of tactics and tactical development or improve our knowledge of technic? Summer is gone! What of winter?

The American Soldier

[Reprinted from *Liberty*]

What has the uniform of the American Army meant in the life of the American people? In the first place, after colonial days and its wars, it meant the Revolution and the making of the nation. Then the War of 1812, badly fought because the Army was neglected. The clearing out of the Indians, necessary if this nation should exist * * *.

It meant the settlement of the Mississippi Valley and of the southern Appalations, the acquirement of Florida, of Texas, California, and the coast up to British Columbia.

This was the work of the American Army. Without it the Indians would be all over the place or Europeans would be here. Certainly Mexicans or Japanese would be on the Pacific coast and in its valleys.

The Northern Army kept the Union together after a long war made necessary by the gallantry of the Southern Army.

Which of these results were bad? If not bad, what is there contemptible in the uniform of the American Army?

The Chinese have been overrun by aliens not because they liked peace but because they not only disliked but degraded soldiers. A nation should like peace, but it cannot safely put the soldier under an odium. It may avoid being the Germany of the soldiers who held civilians in contempt and made them get off the sidewalk, but it also must avoid China, which cleared the sidewalks of the soldiers.

When in any considerable number of American States the uniform of the American soldier is in bad form the American nation is out of luck.

It is my firm conviction that the duty of national defense, like the general duty of citizenship, should be broadly extended and borne by all our people.—President Coolidge.

PROFESSIONAL NOTES

Seacoast Artillery Firing

[COAST ARTILLERY BOARD PROJECT NO. 220]

EDITOR'S NOTE: Coast Artillery Board Project No. 220 is one of the most important and most interesting projects ever undertaken by the Board. The JOURNAL regrets that the length of the project is such that it can not be given in full in these pages. However, the project with omissions reduced to a minimum, has been secured from the Coast Artillery Board for publication in three parts, of which this is the second. The action of the Chief of Coast Artillery on all parts of the project published herein will appear with the final installment.

13. *Position Finding.* a. There are three methods of position finding now in use in the Coast Artillery, to wit: (1) horizontal base; (2) vertical base; and (3) the Coincidence Range Finder.

b. Horizontal base lines are in general use throughout the service because long base lines with corresponding great accuracy can be had in almost every locality. Another reason for their general use is that it is not necessary to have such good definition of the target in the instruments for accurate range finding with the horizontal base as with either a depression position finder or the coincidence or stereoscopic range finder, nor is it necessary to see particular parts of the target. The long horizontal base gives the most accurate results in night work for all ranges, and particularly is this so at dusk and dawn. At these times the inherent difficulty of putting all concerned on the same target is increased. The difficulties under which the horizontal base instruments work at night are greatly increased by interference from searchlights. The principal objections to the horizontal base may be said to be:

- (1) Difficulty in getting both base-end instruments on the same target.
- (2) Distance of stations from unit commander.
- (3) Inherent weakness due to communications, number of stations, instruments, etc., the breaking down of or material interference with any one of which puts out a particular base line.
- (4) Limitations on the location of searchlights.
- (5) Difficulty of defending stations.

Of the above objections, the effect of (3), which heretofore has been the most serious, is reduced by taking advantage of the flexibility afforded by the Cloke Plotting and Relocating Board in conjunction with a flexible communications system and providing for multiple base-end stations. The seriousness of the other objections is decreased by providing either vertical base instruments or other self-contained range finders for emergency use. Assuming multiple base-end stations supplemented by emergency position finding equipment, it is believed that the serious crippling of the position finding elements of seacoast artillery

will require an expenditure of ammunition which attacking fleets could rarely afford. Certainly we are in a more secure position in respect to position finding than we have been in the past.

c. The vertical base is applicable only where there are natural high sites. This makes it a special case. With the improvements now being realized in depression position finders, there will be certain situations where such instruments will give satisfactory results under favorable circumstances up to 20,000 yards. Even where there is sufficient height of site, accurate position finding with D. P. F.'s depends upon the ability of an observer to waterline the target and upon there being a clear atmosphere in the daytime or excellent illumination at night. The vertical base system may be said to have on and off days or to be as uncertain as to weather. These defects are compensated to some extent, when compared to the horizontal base, by the less number of stations, observers, instruments, and lines of communication, which make for relative simplicity. In some cases the vertical base may be at or near the battery, so that communication lines will be very short, or so that communication, in emergency, may be by megaphone.

d. Coincidence and stereoscopic range finding offer much the same advantages as vertical base, but are of little value for night work, though for day work the methods are sufficiently accurate for good plotting at comparatively short ranges. They should be regarded solely as emergency methods, of sufficient value to justify their cost.

e. For night work the range finding system is normally dependent on the illumination of the target, except when the enemy's searchlights are directed toward the batteries for a sufficient length of time for range finding with a coincidence range finder. Upon the results obtained in night work and under unfavorable conditions of visibility due to haze and fog should depend the method of range finding which should be adopted as standard. History affords few instances of successful naval attack at night against fortified harbors, but no one has had the hardihood to state a policy of depending on mines alone for our protection at night. On the contrary, it is the determined effort of every one to have range finding conditions such that reliable data for night firing may be obtained as soon as the illumination of the target is sufficient so that it can be seen through a telescope. These being the facts, we almost have to eliminate the coincidence or stereoscopic range finder from consideration for position finding at night. Such instruments require so much illumination that satisfactory range finding at night cannot be consistently done beyond 4000 yards. Similarly for D. P. F.'s or vertical base instruments there will be little or no "bone" at the target to waterline, but the limitations of the vertical base for night work are not so great as those of the coincidence range finder. Comparative results depend largely on conditions under which the instruments are used. In maneuvers it has sometimes been the policy of the Navy to turn searchlights on base-end stations with a view to blinding observers. Under such conditions vertical bases can do little or nothing but coincidence instruments are at their best.

f. In Coast Artillery Board Project No. 5, *Test of 30-foot Bausch and Lomb Range Finders*, the Coast Artillery Board stated as follows:

The Board is unable to come to any definite conclusions at this time as to the relative merits of the 30-foot range finder and the D. P. F. at varying heights of site, observing on a target at varying ranges. While it is believed that it is as easy to train an observer to effect coincidence

as to train him to waterline a target, the amount of training required for an observer on either instrument probably will not be the determining factor in the selection of an instrument. Where the height of site obtainable for a D. P. F. is sufficient to give it an accuracy comparable with that obtained from the 30-foot range finder, considerations of economy will dictate installation of the D. P. F.

The recommendations of the Coast Artillery Board on its Project No. 5 were as follows:

20. In view of the excellence of the results obtained in this and in previous tests it is recommended that the policy be adopted of equipping eventually each battery of Coast Artillery, fixed or mobile, with a suitable range finder for emergency use.

21. It is recommended that a coincidence range finder equal to or superior to the 30-foot instrument tested be assigned to each battery of 12-inch long range guns, 14-inch guns, 16-inch guns, and 16-inch howitzers.

22. It is further recommended that a range finder equal to or superior to the 4-meter instruments tested be assigned to each major-caliber fixed battery other than those enumerated in Par. 21.

23. The assignment of a portable range finder equal to or superior to the 4-meter instruments is recommended as suitable for emergency use by mobile batteries, both tractor drawn and railway. * * *

In Coast Artillery Board Project No. 74, *Fire Control System for 155 G. P. F.'s*, recommendations were made for a self-contained range finder for each battery for emergency use. These recommendations were approved by the Chief of Coast Artillery.

g. From the above discussion it will be seen that the system which is the more desirable from one point of view fails under certain conditions, and this makes it necessary to supplement the adopted standard with another system which is termed emergency. Admitting that the horizontal base system is not perfect, it is, to date, the most satisfactory position finding system developed and merits being the standard. It is the understanding of the Coast Artillery Board that for all batteries, fixed and mobile, the horizontal base system is the adopted standard, and that in connection with this system, where the height of site justifies it, the base-end instruments will be D. P. F.'s, thereby providing a vertical base emergency system. Where a D. P. F. is not provided at a battery it is believed that ultimately either coincident or stereoscopic range finders should be supplied for emergency use for both fixed and mobile seacoast batteries.

h. Seacoast cannon should be placed so as to obtain a maximum field of fire in the seaward area. It is desirable to replace seacoast artillery so that as nearly as possible the entire gun range may be used over the water area to be defended. Conditions will sometimes dictate that batteries be retired somewhat from the shore line in order that they may be given a position in which they may have protection and concealment from seaward attack as well as better siting. The position finding system should be such as to furnish accurate data for firing seacoast cannon to their maximum range, since a particular situation, such as covering the debouchment of a fleet, may demand fire at extreme ranges. For the present, such extreme ranges will not exceed 49,000 yards. If in a particular locality, terrestrial visual position finding cannot be used to give data up to maximum gun ranges, the system must be supplemented by some other position finding method. The daytime effectiveness of terrestrial visual position finding from properly located stations will depend upon atmospheric conditions, that is, con-

ditions of visibility. These conditions will be more favorable in some localities than in others, and will vary from time to time in the same locality. Considering the position finding stations as an origin, terrestrial visual observation is in some localities effective up to distances of 35,000 yards; in other localities the maximum will not exceed 20,000 yards. During foggy and hazy weather the distances will be very much less. At night, with means now available for target illumination, the maximum distances from the station for which under the best conditions we may expect satisfactory results is 12,000 yards. It is therefore evident that with stations located approximately on line with the battery, terrestrial visual position finding would not furnish data for fire at the maximum gun-target ranges of some armament. If, however, the stations are advanced from the battery along the field of fire, just so much as they are advanced will they increase the possible gun-target range which the battery can cover utilizing accurate terrestrial visual position finding data. In localities where the terrain permits, observing stations should be advanced sufficiently to give position finding data throughout the limits of the possible range of a battery. The amount of advancement will depend upon the range of the gun, the distance of effective visibility, and the available positions for stations which will cover the field of fire and at the same time give favorable angles of intersection. In some cases the stations need be advanced but little to provide for the maximum range of the guns, but it should be noted that in such cases any advancement given will increase the gun-target ranges for which position finding data may be furnished under unfavorable weather conditions and at night. In other cases, and perhaps the usual ones, the stations should be advanced as much as 20,000 yards. In general, such advanced stations can be represented on the Cloke Plotting Board and the plotting carried on in the usual way. In some particular situations some of the stations may have to be advanced so that at times the target will be between the battery and the position finding stations. In these cases, the plotting could not be carried on the Cloke Board in the usual way. The Coast Artillery Board is investigating a means for meeting situations similar to the above. At this time, it appears that one solution for situations similar to this would be obtained by the use of two Cloke Plotting and Relocating Boards. A plotting section could be organized at the stations and equipped with one Cloke Board. On this board the target would be plotted with reference to a convenient directing point, and then relocated with respect to the battery on a Cloke Board in the battery plotting room. A situation for which a solution similar to the above would apply probably exists in connection with the Defenses in Long Island Sound. At one entrance of the Panama Canal conditions are such that terrestrial position finding in connection with advanced stations may furnish data for the maximum range of the armament. At the other entrance of the Canal advanced stations are not practicable, so that terrestrial visual position finding is satisfactory only to the extreme limit of visibility from the stations restricted to locations approximately on line with the batteries. In this situation and in other similar ones, the terrestrial visual position finding system should be supplemented by some other system. Specifically, what such system will be remains for future determination, and its development is having the consideration of the Coast Artillery Board. One method which is worthy of consideration and which offers a good basis for development is that of "Position Finding by Airplane," described in the COAST ARTILLERY JOURNAL for January, 1923. Essentially, this method is one of ballistic range firing or using the gun as a range finder in connection with the speed and course of the target, reported to

the battery by aircraft. In this connection, it appears that except in special situations, subaqueous sound ranging may have to be eliminated because of expense, and that the outlook for satisfactory position finding from balloons is not very encouraging.

* * * * *

j. Two observing stations per battery are not sufficient even with facilities for interchange of base lines between various units. Permanent multiple stations should be provided and such provision is understood to be the policy in new installations. It is entirely practicable to construct for each battery a number of emergency observing stations with little expense, except for azimuth instruments and means for communications direct to the battery, so that under no probable conditions need a battery be without a pair of stations for range finding.

* * * * *

14. *Concentration of Fire and Number of Cannon in a Battery.* a. Each battery being furnished with position finding stations, provision is thereby made for assignment of batteries to different targets or to the same target. Concentration of fire by batteries on one or more targets occasionally will be desirable, particularly at extreme ranges. At moderate ranges, and at ranges within which, in the great majority of our harbors, hostile vessels must approach and remain for a considerable period in order to accomplish any mission seriously damaging to the defense, the Coast Artillery Board believes that a single high-powered gun, efficiently served, frequently will be a suitable assignment to a single enemy target. In certain of our fortifications, a battery consists of a single high-powered gun. Recently the tendency appears to be toward several high-powered guns in a battery. * * *

b. The following is quoted from "Concentration of Fire," pages 14 and 15, *Tactical Employment of Heavy Artillery*.

Fire should not be concentrated on one element of the enemy's forces, however, if such concentration would leave another element free to accomplish an important mission. * * *

In case of a direct naval attack * * *, this may necessitate concentrating fire or dividing it. * * *

It is then a matter of no great difficulty to work out a plan in time of peace for the assignment of targets in the various circumstances that may arise in time of war.

If it can be shown that under any probable conditions of action between naval forces and the defenses of a particular locality, distribution of fire might be desirable, then provision of a fire control installation which contemplates only the concentration of practically all the armament on a single target is unjustifiable. The additional cost of a more flexible system is insignificant compared with the total investment in defensive installation.

* * * * *

g. (1) The reason for railway seacoast artillery is that it possesses strategical and, with obvious limitations, tactical mobility. The number of such guns at the outbreak of war will be limited. The tactical situation in a particular locality may dictate emplacement of high-powered railway guns in such widely separated positions that they will fire as separate units and require separate position finding and fire control systems. Conditions may even dictate assigning these high-powered guns singly to widely separated localities. It appears that the need for a separate fire control and position finding

system with each 14-inch or larger caliber railway cannon is greater than with fixed cannon of similar power. * * *

(2) A single position finding and fire control system cannot be operated so as to furnish moving target firing data for more than two directing points without sacrifice of accuracy, or rapidity of fire, or both. A tractor battery of four seacoast guns can normally be emplaced on any terrain with the separation necessary for protection and still with such grouping as to permit the use of not more than two directing points. The emplacement of a 4-gun railway battery for moving target firing is a much more difficult problem. Limitations of terrain and trackage will normally enforce emplacement in such widely separated positions as to require more than two directing points. It follows that a separate position finding and fire control system is required for each two railway guns in coast defense. It is therefore believed that in no case should railway artillery be organized for coast defense operations with less than one position finding and fire control system for each two guns. Tactical considerations will not demand the organization of railway guns and mortars of less than 14-inch caliber into one-gun batteries. For these reasons it is believed that railway artillery under 14-inch caliber should be organized for coast defense operations into two-gun batteries. If, for calibers under 14-inch, two-gun railway batteries cannot be adopted, then a complete position finding and fire control system for each two guns should be provided, and tables of organization and T. R. 435-225, *Battery of Railway Artillery*, amended accordingly.

(3) In considering the foregoing, the Coast Artillery Board believes that the gain in tactical effectiveness of these high-powered weapons will more than justify the expense of providing the additional materiel and personnel.

15. *Prediction.* a. Since 1912, predictions have generally been made on the plotting board. It is not believed that any mechanical means can be devised which will furnish predictions equal in accuracy to those obtained from the graph of the target's course. Where changes in the course of the target are encountered, poor predictions will follow for a while, but good observation from observing stations, accompanied by prompt report to the plotting room of changes of the target's course, will reduce their number. The accuracy of prediction necessarily depends in a large measure on the plotter. He should be a man of good judgment, have natural aptitude for his work, and above all he must be trained painstakingly. Battery commanders are prone to let plotters drift into the habit of using set-forward appliances in predicting the direction of the target as distinguished from using the appliances in determining the distance the target travels during the predicting interval (the observing interval or a multiple thereof) plus the time of flight. Until a sufficient graph of the target's course is obtained to permit the plotter to use his judgment as to prediction of direction, it is true that prediction of direction on a straight line through plotted points is probably the best procedure unless observers report the target as changing course. When the graph of the course begins to take definite shape and observers are reporting changes of course, the plotter should be trained to make frechand predictions of direction a short distance in advance; then on the predicted direction he should measure off, using the setforward device, the proper distance to be passed over during the predicting interval plus the time of flight. Accurate prediction of direction is largely a matter of training. The necessity for this training was emphasized in

Artillery Bulletin No. 108 (Serial No. 123), dated December 8, 1914. This bulletin has never been rescinded and should not be forgotten. The more simple a predicting device is, the more the plotter's mind will be freed and the more time he will have to concentrate on the prediction of direction and the visualization and plotting of the future probable course of the target. Where errors of sufficient magnitude between the setforward points and the plotted track become evident these errors should be taken into consideration when applying corrections as a result of observation of fire (See Par. 38 *i*).

b. Prediction Devices in Coast Artillery Board Project No. 93. In this study the Board considered the following methods and devices for locating the setforward point:

(1) The Fenton Predictor, *JOURNAL OF THE U. S. ARTILLERY*, Nov.-Dec., 1915.

(2) The Jones Setforward Ruler, *JOURNAL OF THE U. S. ARTILLERY*, Jan.-Feb., 1917.

(3) The Frost Circular Logarithmic Predictor, *JOURNAL OF THE U. S. ARTILLERY*, March-April, 1917.

(4) The Frank Predictor, the Moody-Cummings Predictor, the Willet Coast Artillery Board Predictor, the Frost Predictor, the Proportional Dividers Predictor, all of which were described in the *JOURNAL OF THE U. S. ARTILLERY*, January-April, 1918.

(5) The Proportional Pantograph Predictor, which is in use in the service.

(6) The Setforward Ruler, which is issued to the service.

(7) The Wells Mechanical Predictor.

(8) Free-hand Prediction, as occasionally used in the Coast Artillery.

(9) Time-Range and Time-Azimuth Prediction Board methods for obtaining the position of the setforward point.

c. All of the above methods and devices were concerned with predictions in conjunction with manual plotting boards. After thorough investigation the Coast Artillery Board concluded that:

3. Considering the location of setforward points for a target traveling at high speed (500 to 1200 yards per minute) on courses which are irregular both as to speed and direction, in conjunction with the wide variation (0 to 84 seconds) in time of flight of Coast Artillery projectiles, it is concluded that none of these devices is very satisfactory or possess any material advantages over any one of the others.

4. That free-hand prediction, in which the proportional pantograph or proportional dividers are used as a guide, is the least unsatisfactory, and that prediction on Time-Range and Time-Azimuth Boards will compare favorably with this method.

d. In service, battery commanders generally improvise setforward devices; consequently there are a great many different kinds of devices in service. Most of them require that the travel during the observing interval, the time of flight, and distance to the setforward points be called out, and that an additional man be provided to help the plotter. Such devices as are operated by the plotter alone take so much of his time and put such a burden upon him that he has neither the time nor the freedom of mind to concentrate on predicting in direction.

It is desirable to reduce to a minimum the calling out of data in the plotting room and also to operate with a minimum of men.

e. The pantograph predictor is operated entirely by the plotter, who obtains the time of flight from a tabulation which he can see, or has the time of flight called to him. Unfortunately, some plotters find difficulty in handling the pantograph due to their unfamiliarity with instruments of its kind.

f. A very simple setforward device is described on page 43, part II, *Gun, nery for Heavy Artillery*. It is excellent for high-velocity guns using a single charge and projectile, and gives the setforward point without supplementary means. It requires a scale for each two hundred yards range. The objection is the number of scales required to care for all ranges. However, the scales may be placed where the plotter can readily reach them; or six, or even twelve, such scales may be placed on a short piece of wood of triangular cross-section. A similar result may be obtained by placing several scales on a sheet of paper which can be folded so that any particular scale may be used. Such sheets of scales have been printed and may be obtained from the Coast Artillery Board.

g. Most cannon have more than one powder charge and more than one projectile, so that the times of flight for a particular range vary. In some cases it is desirable to predict thirty seconds ahead; in others a minute ahead; and in the case of extremely long-range firing using aerial position finding, it may be necessary to predict as much as two or three minutes ahead. In view of these conditions, it appears next to impossible to secure a prediction device which will be both simple and universal. The Coast Artillery Board is continuing to investigate the question of prediction devices in the hope of securing a standard device which will be an improvement over those at present in service.

h. Training Regulations 435-221, *Fire Control and Position Finding*, prescribes that a predicted point be determined. This use of a predicted point imposes additional labor upon the plotting details and others concerned with the application of predicted point data. The reason for imposing the additional labor is that the location of the predicted point is necessary to the method of checking now in use. In Coast Artillery Board Project No. 117, *Fire Control Methods for Mortars*, the Coast Artillery Board advanced the opinion that it is desirable to discontinue the determination and use of predicted point data, subject to requiring a suitable check-back system. This procedure would simplify the operations of the fire control system in Case III firing. It should be noted that for a safety precaution at target practice the azimuth of the setforward point could be utilized satisfactorily by safety officers.

j. T. R. 435-221, *Fire Control and Position Finding*, Par. 14 a (3) contemplates predictions based upon travel during two observing intervals. In Case II firing, using normal position finding methods, even fairly well trained troops can predict every thirty seconds and the prediction should be based upon travel during thirty seconds. In Case III firing, using normal position finding methods, fairly well trained troops can predict every thirty seconds using a predicting interval of one minute. In long-range firing, using position finding by aircraft, it may be desirable to predict as much as two or three minutes ahead based upon travel during either a less or similar period. In view of these conditions it is not believed desirable to prescribe either a definite predicting interval or frequency of predictions. The prediction interval should be as small and the frequency of predictions as great as the flow of position finding data and the state of training will permit.

16. *Meteorological Data.* a. Considerable improvement has been made since the World War in measuring wind aloft. From the results of experiments made at Aberdeen Proving Ground the following conclusions are justified:

(1) The method which is now in use for making range and deflection corrections, due to wind, has a theoretically correct foundation.

(2) Errors in the application of the wind correction at the battery are due for the most part to unavoidable approximations in order to meet the conditions required in practice by artillery in service, and are not caused by faulty ballistic theory, except as affected by error in the fundamental retardation law. The approximations include:

(a) The effect of periodic instead of continuous receipt of the meteorological message;

(b) The application of wind velocity values determined at one place to firings made at another place; and

(c) The use of approximate weighting factors.

These errors of approximation are probably no greater than the errors involved in applying a velocity or density correction.

b. For trajectories whose maximum ordinates do not exceed the heights to which balloons may be tracked, the values for ballistic wind are acceptably accurate. With present facilities and under general conditions of visibility, the pilot balloon is lost from view at from 2,500 to 3,000 yards, though under favorable conditions it is observed to considerably greater heights. The values of the direction and velocity of the wind are satisfactorily determined for direct-fire guns. For trajectories whose maximum ordinates exceed those for which accurate wind values can be determined, it is desirable to arrive at an acceptable approximation for the wind values to be used. The present status is indicated by the following statement of the Chief Signal Officer of the Army [O. C. C. A. 665.6/M and OCSO 353.4 (8-25-24)]:

1. Data has been and is being furnished by the Signal Corps at Aberdeen Proving Ground for ordinates from 30,000 to 35,000 feet, but this has largely been done by extrapolation when the balloons did not rise to the desired elevations. * * *

3. This entire matter will be studied with the view of writing instructions which will adequately cover the entire subject of furnishing ballistic wind data for ordinates up to 60,000 feet which must be done by methods of extrapolation and by using averages, or both.

Questions concerning wind aloft are being investigated by the Weather Bureau, the Bureau of Standards, the Ordnance Department, and the Signal Corps. Just what improvement may be expected is problematical, but the outlook, in connection with the meteorological service now available, is sufficiently promising to justify the application of wind corrections, especially for deflection, even in the case of high angle fire.

c. At the present time, ballistic densities are approximated from the density determined at the ground. The value of the approximations is questionable, but the subject is still under investigation and improvement in the accuracy of the approximations is to be expected. It is necessary to make corrections for the effect on the range of a projectile of changes in air density. This is done most accurately by measuring the density at several different altitudes of the trajectory over which the projectile passes, and from these measured values computing a single "weighted" or "ballistic" density. The measurement of the density is best accomplished by an observer in an airplane which makes a flight up to the

greatest altitude which the plane can reach, but not higher than that of the maximum ordinate of all the trajectories over which projectiles are to be fired. The last two figures of the code group in the Artillery meteorological message give the ballistic density for the various maximum ordinates. On account of the lack of airplane facilities in peace time for making density measurements, it is usually impossible to make the measurements aloft at all forts. In order to use a value of the ballistic density more accurate than the surface density, an approximate method of computing ballistic density for all altitudes, based on the surface density, has been devised and is described on pages 47-8 and 86-90 of *Meteorology for Coast Artillery*, by 1st Lieut. J. J. Johnson, C.A.C. The value of this approximate method of computing ballistic density is questionable. When airplane flights are made the ballistic density can usually be determined quite accurately. At present, the meteorological message provides for giving the ballistic wind to the nearest mile per hour, and the ballistic density to the nearest whole percent. It is possible that improvement in the accuracy of making ballistic correction would result from giving the ballistic density to tenths of a percent whenever airplane measurements are made. To show the relative importance of one mile per hour in wind and one percent in air density, the following tabulation is given:

CALIBER	WT. OF PROJ. <i>lbs.</i>	VELOCITY <i>f. s.</i>	RANGE <i>yds.</i>	CHANGE IN RANGE FOR CHANGE OF	
				<i>1 percent in air den- sity, yds.</i>	<i>1 mile pr. hr. in range wind, yds.</i>
155-mm. gun	95	2410	5,000	18	1.8
			17,400	91	22.1
12-inch gun	975	2275	5,000	5	1.5
			30,000	118	18.0
14-inch gun	1400	2400	5,000	4	0.3
			23,000	208	23.5

If the accuracy of airplane measurement of air density warrants the use of tenths of a percent in the ballistic density, it is probable that it would be advisable to have the tenths placed in the meteorological message. The advisability of providing for issuing the ballistic density in tenths of a percent in the meteorological message is being investigated.

d. While methods for determining the ballistic temperature are available, the experimental basis for computing the correction is of such questionable value that it is considered advisable for the present to use the surface temperature.

e. The importance of having accurate meteorological data available to a battery is emphasized by a study of the tabulation given in paragraph 18 *a*, following. Meteorological stations are now established throughout the service, but whether they are as yet very efficient at all stations is a question. There is reason to believe that lack of personnel and the difficulties attendant upon organizing a new service have made for unsatisfactory functioning. It is believed this question merits investigation with a view to securing improvement.

* * * * *

17. *Range Board, Model 1905, and Range Correction Board, Model E, 1923.*
a. Reference is made to Coast Artillery Board Projects Nos. 152 and 170. Due to the increased range of some seacoast armament, the acceptance of the zoning system for long-range guns, and the fact that many gun batteries are assigned more than one projectile, the Range Board, Model 1905, is not suitable in many cases. Investigation was made with a view to securing a satisfactory range board at a minimum of cost. This resulted in the adoption of the Range Correction

Board, Model 1923, for the use of all cannon for which the Range Board, Model 1905, cannot be made suitable. The Range Correction Board, Model 1923, is fully described in T. R. 435-221, *Fire Control and Position Finding*. Range Boards, Model 1905, may be converted into Range Correction Boards, Model 1923, by the addition of an upper and lower roller carrying the correction chart, which is of sufficient length to care for the entire trajectory in all zones of the longest-range cannon.

b. In the past, range boards were designed for use as follows:

(1) To obtain corrected ranges, in which the actual range to each setforward point was corrected on the board.

(2) To obtain a range correction in yards, which was determined periodically and applied to the actual range of the setforward point. Neither of the above methods was considered satisfactory. The first resulted in a hurried operation of the range board with the introduction of inaccuracies and numerous personnel errors. The second was unsound because it resulted in the application of a flat correction whereas the correction changes when the range changes. Investigations made by the Coast Artillery Board in connection with Project No. 114, *Preparation and Adjustment of Fire at Naval Targets*, indicate that for changes in range of a thousand to two thousand yards, the ballistic correction may be assumed without material error to vary directly as the range varies. With the Range Correction Board, Model 1923, and the Range Board, Model 1905, as it is being modified, a ballistic correction is obtained by careful and deliberate operation without reference to the time interval indicators. This minimizes errors in operation.

c. Curves of ballistic effects may be plotted on the range board charts as percentages of the ranges to a scale of $1'' = 2\%$, and a scale for reading the ballistic correction in percent is being provided for all range boards. The same scale is suitable for reading the ballistic correction in yards where curves of ballistic effects are plotted to a scale of 200 yards equal 1 inch. Pending the furnishing of scales of arsenal manufacture, the Coast Artillery Board can furnish suitable paper scales. The ballistic correction, when determined in percentage of the range, is applied to the actual range of setforward points through a Percentage Corrector (see paragraph 19, following) so as to vary directly as the range varies. In this system new ballistic corrections may be applied to the actual range at any time and as frequently as deliberate operation of the range board permith, but no material error will result if new ballistic corrections are applied at intervals corresponding to a range change of as much as two thousand yards.

d. In Coast Artillery Board Project No. 260, *Percentage Range Correction Charts*, recommendations were made as to the construction of range board charts. It is intended that charts constructed in the future have the following specifications:

(1) Corrections to be placed on chart in following order, counting from left to right:

- (a) Velocity,
- (b) Atmosphere,
- (c) Tide,
- (d) Wind,
- (e) Projectile weight,
- (f) Temperature elasticity of air,
- (g) Rotation of earth.

- (2) Reference numbers for atmosphere to vary from 84 to 116.
- (3) Rotation of earth to be given for 35° N. latitude.
- (4) Along right hand edge of chart, range table data for each range to be placed in following order, counting from left to right:

- (a) Perforation of armor,
- (b) Time of flight,
- (c) Probable error,
- (d) Angle of fall.

- (5) If chart is made for non-armor-piercing projectile, column (4) (a) to be omitted.
- (6) Where quantities of (1) (e), (f) and (g) and (4) (a) and (c) are not available because new type firing tables have not yet been constructed, space on the chart to be left for them and values put in at a later time.
- (7) Title to be placed at bottom of chart.
- (8) Minimum range to be 3000 yards.
- (9) If any of corrections (1) (e), (f) and (g) are negligible, they are to be omitted placing a note to that effect at bottom of chart.
- (10) Check points to be given in % up or % down.

e. When guns having range drums graduated in yards for a standard projectile and velocity are furnished projectiles other than standard, a range-range relation is used (see paragraph 19) *but there must be a set of curves for the range board for each projectile or velocity*. If the sets of curves are on different charts, the charts on the range board might have to be shifted during action, which would be undesirable. In some cases, by reducing the vertical scale of the charts, it is possible to place sets of curves for each projectile and velocity to be used by a particular battery; under these conditions the Range Board, Model 1905, equipped with a percentage correction scale and chart, will be satisfactory. This procedure is practicable for 155-mm. G. P. F.'s, fixed 6-inch, 8-inch and 10-inch guns. It will be satisfactory for 12-inch mortars, as a temporary expedient (paragraph 10 b, C. A. B. Project No. 117, *Fire Control Methods for Mortars*). Ultimately mortars and all other armament, except 155-mm. G. P. F.'s and fixed 6-inch, 8-inch, and 10-inch guns, should be equipped with Range Correction Boards, Model E, 1923. It is the belief of the Coast Artillery Board that batteries without the continental limits should be given precedence, and that they should be equipped with Range Boards, Model E, 1923, at the earliest possible date.

18. *Ballistic Range Correction*. a. The ballistic correction is based on variation of conditions affecting the projectile's flight from standard conditions for which firing tables are computed. In computing ballistic range corrections the following are taken into consideration: height of site (including tide); wind; earth's rotation; atmospheric density; atmospheric elasticity; projectile weight; and muzzle velocity. The necessity for ballistic range corrections is universally recognized throughout our service, and to a large extent the necessity has been recognized as a result of experience in firing at short ranges. For long-range firing, ballistic range corrections take on an increased importance. In this connection, the following tabulations are of interest:

CALIBER	WT. OF PROJ.	VELOCITY	ANGLE OF DEPARTURE	RANGE	CHANGE IN RANGE FOR CHANGE OF		
					10 F. S. IN M. V.	1 PERCENT IN C	10-MILE WIND
155-mm.	95	2410	° ' 33	1000	<i>yds.</i> 7	<i>yds.</i> 3	<i>yds.</i> 1
			3 34	5000	30	18	18
			35 11	17000	68	91	221
14-inch	1400	2400	24	1000	8	1	1
			2 39	5000	38	4	5
			20 35	23000	139	85	104
16-inch	2100	2750	21	1000	7	0	0
			1 57	5000	34	4	3
			44 25	44000	278	208	235

b. As compared with pre-war determination of atmospheric conditions, such conditions, in service, are now determined much more accurately. The accuracy of these measurements in service approximates the accuracy of proving ground measurement. The muzzle velocity in service is not measured as it is at the proving ground. Devices for measuring muzzle velocity have not been perfected for use under service conditions, so that the estimate of the muzzle velocity, which must ordinarily be made in service, is based upon very uncertain data. In some coast defenses, muzzle velocities have been measured but the results are of doubtful value. They will remain so until usable facilities are provided for measuring the velocity at each battery. Some officers have questioned the value of firing trial or ranging shots for determining an adjustment of the ballistic correction and then applying the determined adjustment during firing through the medium of the velocity curves on the range correction board. This procedure is advocated by the Coast Artillery Board, and no arguments yet advanced have been sufficient to convince the Coast Artillery Board that for fire at moving naval targets there is any better or more simple procedure. The Coast Artillery Board believes that the best obtainable data for effective fire is obtained by computing a corrected range and azimuth by firing four trial or ranging shots and thereby determining an adjustment to the ballistic correction. For such trial fire a muzzle velocity must be assumed. All other elements affecting the ballistic correction are measured, but are admitted not to be accurately determined.

c. The velocity change due to temperature differing from standard is computed by an approximate formula and gives inaccurate results. The powder charge which will theoretically give a normal velocity is determined under certain standard conditions for the equivalent of a new gun. These standard conditions are never duplicated in service. Two guns will develop muzzle velocities which differ materially, using a powder charge of the same lot. Different storage conditions will cause changes in velocity as is shown by retests of powder. Consequently, we do find in practice that muzzle velocities differ from time to time and from gun to gun. They differ even for the same gun using the same lot of powder on different days. This condition is so well recognized that in Proving Ground firings velocities as determined by measurement on one day are not used on another day, but instead the velocity is remeasured. In the Coast Artillery service, some officers, in considering the error in the ballistic correction as determined by firing trial shots, contend that velocity does not in fact vary sufficiently to account for the errors in the ballistic correction, and hence that the error is not due to velocity, but is due mainly to the effects of some other causes. They attribute the error to retardation, that is, air density, and wind. The Coast Artillery Board does not maintain that the error in the ballistic correction is entirely

due to velocity effects, but it does maintain that velocity is the element which most probably accounts for the major part of any error, and that in practice velocity corrections based on trial shots will place the correction on a curve on the range board which will make the adjustment to the ballistic correction vary with the range in the most reasonable way. Reasonable variations in muzzle velocities are sufficient to account for errors in the ballistic correction, while an unreasonable variation in atmospheric or wind effects must be assumed if the error is attributed to them.

* * * * *

e. Retests of powder frequently show material changes in the velocity to be expected under different conditions of storage, particularly in the tropics. Under service conditions, the muzzle velocity is underdetermined in advance of firing. The actual muzzle velocity will be normal because of changes during storage and powder temperature at time of firing. The correction for powder temperature is based upon inaccurate formulæ, so that the correction may be considerably in error. Tests were made at Picatinny Arsenal with three different lots of powder with velocity of 1950 f. s. to determine coefficients of velocity and pressure increase with increase in temperature. The following velocity coefficients were determined:

P. A. Lot 3425	0.93 f. s. per degree F.
D. P. Lot 3466	0.62 f. s. per degree F.
Standard Lot X1416	0.55 f. s. per degree F.

In the Coast Defenses in Panama, available target practice records indicate a powder temperature of about 82° F. The correction for this temperature from the powder chart is 27 f. s., or 1.2%. The correction may be in error by 50% (C. A. B. Project No. 211). This is important since in arriving at an "assumed" muzzle velocity through a powder temperature correction, a material error is introduced. The error is fairly well corrected for if trial shots are fired and resulting corrections incorporated in the muzzle velocity curves.

f. (1) Coast Artillery Board Project No. 114, *Preparation and Adjustment of Fire*, published in the August, 1923, COAST ARTILLERY JOURNAL, showed how a correction applied through the muzzle velocity or atmosphere curves varied. The atmosphere correction curve diverges from the per cent curve in one direction and the velocity curve in the other direction, but the mean is almost coincident with the straight line representing a percentage correction, that is, a correction which varies directly as the range varies.

(2) Whether due to inaccurately determined atmosphere conditions or muzzle velocity, or both, deviations increase with increasing ranges and decrease with decreasing ranges. A correction based on observed deviations, therefore, should be applied in the form of an adjustment of the ballistic correction, and to that element of the ballistic correction most likely to cause error. Unless the muzzle velocity is measured accurately at the battery firing, it appears that muzzle velocity is the element most likely to cause error in the ballistic correction. If the muzzle velocity is so measured, the error in the ballistic correction should be attributed to retardation. A correction should be applied so that its rate of variation will be such as to obviate the necessity for continuous change in the correction due to changes in range. This

will be accomplished for considerable changes in range if the correction be applied on the percentage corrector (see Par. 19) or on the range correction board, either to the retardation curves or to the velocity curves. Unless the muzzle velocity is measured at the battery firing (and this does not appear possible of realization for some time to come), the correction to the ballistic correction as a result of trial or ranging shots should be applied on the range correction board to the assumed muzzle velocity. Four trial or ranging shots are sufficient usually to give a good adjustment of the ballistic correction. It should be noted that both inaccuracies of operation and accidental errors are likely to be less in registration fire, that is, during deliberate firing of trial or ranging shots, than in rapid fire at a moving target. The adjustment to the ballistic correction determined as a result of such firing will usually need to be corrected from time to time as the firing progresses, but it should only be corrected when the evidence of previous shots is outweighed by the evidence of succeeding shots. In practice these later corrections are most readily applied during firing by making corrections on the percentage corrector, which correction will vary through ranges directly as the range varies, until such time as the total correction may conveniently be taken from the percentage corrector and applied through the muzzle velocity curves on the range correction board. During an extensive series of shots the advisability of taking the total correction due to observation of fire as shown on the percentage corrector and applying it when convenient through the muzzle velocity curves to obtain a new ballistic correction should be kept in mind. The methods here outlined are comparatively simple in application. The importance of this is magnified because, in war, batteries will be officered and manned by personnel whose comparatively short training and experience will make a *simple positive procedure very necessary*.

19. *The Percentage Corrector.* a. This device was recommended for adoption in Coast Artillery Board Projects Nos. 152 and 170. The device and its operation is described in T. R. 435-221, *Fire Control and Position Finding*. Since the percent procedure is to take a ballistic correction from the range correction board, *the primary function of the percentage corrector is to apply the ballistic correction to the actual range to determine corrected range or elevation*. This device does this simply and quickly. This device becomes the elevation board where guns or mortars fire on elevations instead of ranges. As pointed out above, the percentage corrector provides a simple means of applying the ballistic range corrections and corrections based upon observation of fire so that such corrections vary directly as the range varies.

b. The range-range relation feature, which is another incidental element of the percentage corrector, provides for firing a projectile different from that for which a range drum is graduated. The range-range relation is placed on the range scale of the percentage corrector, so that the proper corrected range for the projectile being fired may be read off as readily as if the standard projectile were being used. This method of handling the range-range relation problem, referred to in Par. 17 e, is believed to be more satisfactory than the use of range-range relation tables, which introduce an extra step in obtaining corrected ranges, require more time for operation, and require an extra man for operating them.

c. Some percentage correctors are being manufactured at Frankford Arsenal. At present their use is not prescribed but is authorized. A satisfactory

percentage corrector may be improvised easily from drawings and scales which the Coast Artillery Board furnishes on request. Percentage correctors have been used by a number of Regular and National Guard organizations in drill, sub-caliber and service practice, and reports from such organizations show that the device is satisfactory and desirable.

20. *Range Adjustment Board.* a. This device was considered in Coast Artillery Board Project No. 132. The device and its operation is described in T. R. 435-221. This device affords an excellent means of figuring the range adjustment correction, showing on what shots it is based, and when applied. The device permits an exercise of judgment in the number of previous shots which should be considered in determining a correction to apply to future shots. It is believed the device is a desirable addition to the fire control apparatus of all batteries since it may be used advantageously with any of the methods of adjustment of fire mentioned in Coast Artillery Memorandum No. 4, and is particularly adapted to the method which appears most logical to the Coast Artillery Board, viz., a correction at any period based on the mean of the deviations of such number of previous shots or salvos as, after consideration of elapsed time and changing conditions, seem to indicate the most probable deviations of the next succeeding shots, if uncorrected.

b. One range adjustment board is being manufactured at Frankford Arsenal. A satisfactory one may be improvised locally from drawings and scales which the Coast Artillery Board furnishes on request. Improvised devices have been used by a number of Regular and National Guard organizations in drill, subcaliber and service practices. Reports from such organizations indicate that the device is satisfactory and desirable, but it is evident that its usefulness would be more apparent in prolonged firing such as may be expected in action.

21. *Deflection Board.* There are two deflection boards in service,—one for mortars and one for guns. There appears to be no reason why a deflection board cannot be made satisfactory for both guns and mortars. In Case III firing with both guns and mortars, since travel during time of flight is considered in determining the setforward point, the deflection board must correct for cross-wind effects, drift, and possibly for effect of rotation of the earth. In case II firing, in addition to cross-wind, drift, and probably rotation effects, it is necessary to correct on the deflection board for travel during the time of flight; and in both Case II and Case III firing it is necessary to provide for arbitrary corrections resulting from observation of impacts. It has been determined that curves of combined drift and cross-wind effects can be plotted, so as to be conveniently used on the mortar deflection board. The whole deflection problem is being investigated in C. A. B. Project No. 87, *Deflection Boards, Experimental (All types of Artillery)*. Under this project the Coast Artillery Board is testing Deflection Board, Model E, 1923, which is an experimental board developed at Frankford Arsenal. This deflection board was complicated by providing means for handling deflections in either mils or degrees. This necessity is avoided if sights for all seacoast artillery are graduated for degrees and hundredths, which now seems probable. Assuming this, it is hoped that one type of deflection board can be developed which will be satisfactory for all types of seacoast artillery. A universal deflection board has been developed and is described in the COAST ARTILLERY JOURNAL of May, 1925.—(To be concluded).

The National Rifle Team Match

Against a field of eighty-seven entries, the Coast Artillery Rifle Team took seventh place in the National Rifle Team Match on September 18-19. This, the principal event of the year at Camp Perry, Ohio, is open to teams of ten shooting members, two alternates, a team Captain, and a team coach from the several branches of the Army, Navy, Marine Corps, the National Guard of the several states and territories, R. O. T. C. and C. M. T. C. teams from each Corps Area, and civilian teams from each of the several states and territories. Course fired, for each shooting member: slow fire, 200 yards, A target, 10 shots; rapid fire, 200 yards, A target, 10 shots; rapid fire, 400 yards, B target, 10 shots; slow fire, 600 yards, B target, 10 shots; slow fire, 1000 yards, C target, 20 shots.

RESULTS

No.	Team	Captain	Score
1.	U. S. Marine Corps.....	Major H. L. Smith.....	2318
2.	U. S. Navy.....	Lt. Comdr. W. A. Lee, Jr.....	2787
3.	U. S. Infantry.....	Lt. Col. K. T. Smith.....	2774
4.	U. S. Cavalry.....	Lt. Col. A. H. Davidson.....	2756
5.	U. S. Engineers.....	Capt. J. D. Andrews, Jr.....	2742
6.	Illinois National Guard.....	Major C. H. Davis.....	2709
7.	U. S. Coast Artillery.....	Major C. W. Baird.....	2701
8.	New York National Guard.....	Lt. Col. F. M. Waterbury.....	2693
9.	Washington National Guard.....	Major H. A. Wise.....	2692
10.	Pennsylvania National Guard.....	Col. G. E. Kemp.....	2688
11.	Oregon National Guard.....	Lt. Col. F. M. West.....	2684
12.	California Civilian.....	Ned E. Cutting.....	2680
13.	Kansas Civilian.....	J. P. Clevenger.....	2678
14.	Massachusetts National Guard.....	Lt. Col. C. C. Stanchfield.....	2676
15.	Massachusetts Civilian.....	W. K. Needham.....	2675

COAST ARTILLERY TEAM

Team	Slow Fire			Rapid Fire		Total
	200 yds.	600 yds.	1000 yds.	200 yds.	400 yds.	
Wilson, Charles F., 1st Lt., 6th C. A.....	44	47	88	45	43	267
Barnes, Harry C., Jr., 1st Lt. 4th C. A.....	45	50	91	45	45	276
Brown, James D., Capt., 14th C. A.	41	48	91	47	45	272
Baird, Clair W., Major, C. A. C.....	42	47	94	48	46	277
Loucks, Charles E., Capt., 51st C. A.....	47	48	97	47	45	284
Crolick, John, Cpl., Btry. C, 52nd C. A.....	40	46	93	48	39	266
McCullough, Samuel, 1st Lt., 51st C. A.....	37	48	94	47	46	272
Latimer, David B., 1st Lt., 14th C. A.....	41	47	87	44	42	261
Harkrader, Robert, Sgt., Btry. G, 4th C. A..	38	47	84	48	45	262
Simpson, John W., Cpl., Btry. E, 63rd C. A..	40	45	93	44	42	264
Totals.....	415	473	912	463	438	2701

Team Captain, Baird, Clair W., Major, C. A. C.

Team Coach, Frazer, William D., Major, C. A. C.

Alternates, Mefford, Murrell, Cpl., Hq. Btry., 14th C. A.
 Murphy, Willard D., 1st Lt., 63rd C. A.

Artillery Ordnance Development

EDITOR'S NOTE: *The following notes were compiled in the office of the Chief of Coast Artillery by Captain Aaron Bradshaw, C. A. C. Credit is accorded the monthly Digest of Activities of the Ordnance Department for much of the information contained herein.*

MODIFICATION OF 3-INCH A. A. GUN CARRIAGE, M. 1917.—A project was approved June 18 for the modification of one 3-inch A. A. Gun Carriage, Model 1917, in order to test its functioning when equipped with roller bearings around the cradle trunnions. The bearings will be of the self-aligning type manufactured by the SKF Company.

105-MM. A. A. GUN CARRIAGE.—Under date of June 26, approval was given for the manufacture of one 105-mm. A. A. Gun Carriage. This carriage will be tested at the Aberdeen Proving Ground with the 105-mm. Gun which was approved for manufacture under Project No. 25,174.

ANTI-AIRCRAFT MACHINE GUNS.—An experimental anti-aircraft mount for 37-mm. automatic anti-aircraft machine guns, known as "37-mm. Anti-aircraft Gun Mount, Model 1 E 1," has been completed at Watertown Arsenal and is now at Aberdeen Proving Ground for the purpose of undergoing functioning test.

An experimental anti-aircraft machine-gun mount that will accommodate either the .30-caliber or .50-caliber machine gun, but primarily intended for the .50-caliber gun, and which has been designated "Anti-aircraft Machine Gun Mount, Model 1925 E," has been completed and is now at Aberdeen Proving Ground undergoing test. This is the third pilot model of mount designed for guns of this type, and in its design efforts have been made to overcome the faults in its two predecessors.

Design of a sight to be used on the 37-mm. A. A. Gun Mount, Model 1925 E, was approved for manufacture on June 26. This is an open sight in which deflections, both vertical and horizontal, can be set off just as they are with a telescopic sight. Deflections are to be transmitted to the gun position from a control station.

Sufficient .50-caliber anti-aircraft machine guns have been manufactured to equip completely an anti-aircraft regiment, which regiment will conduct intensive training in order to improve their gunnery, and to obtain more data for improvement on the machine guns, tripods, sights, and other accessories used with anti-aircraft machine guns.

ANTI-AIRCRAFT SIGHTS.—A small number of improved anti-aircraft sights have been designed and manufactured for use with anti-aircraft machine guns. These sights have proved far more effective than previous sights. As a result of test of these improved sights, additional improvements are contemplated from the results and experience obtained during this test. The percentage of hits has been greatly increased with these sights.

.45-CALIBER TRACER AMMUNITION.—Two types of .45-caliber tracer cartridge, one producing a red trace and the other a green trace, have been developed by Frankford Arsenal and were recently tested by the Infantry, Cavalry, Field Artillery, Coast Artillery, and Air Service.

Results of these tests indicated that this ammunition was very effective for night signalling, producing a clear trace for approximately six hundred yards. Experiments conducted during the day, however, indicated that the tracing mixture did not give a sufficient brilliance to be effective for day signalling or for designating targets.

3-INCH A. A. AMMUNITION.—Six thousand rounds of 3-inch A.A. shrapnel, equipped with Type S fuze, have been loaded, assembled and accepted. Orders have been given to Picatinny for an additional ten thousand rounds to be assembled with the Mark III fuze.

Report has not yet been received on the firings to determine the effectiveness of 3-inch A. A. shell against airplanes. Information received from the Proving Ground, however, indicates that the report is now practically complete. Analysis of the fragmentation results with the present Mark I A. A. shell, as compared with the later type (Type E-6), indicates the necessity for repeating the test. It appears that a certain number of effective fragments have probably been lost and have been charged to ineffective fragments too fine to be recovered.

A Protest

A. & M. College, Miss.,
September 14, 1925.

Editor, COAST ARTILLERY JOURNAL,
Fort Monroe, Va.

In your copy of the COAST ARTILLERY JOURNAL for the month of August, 1925, you have an ad of the DuPont Powder Company stating that, "The First American troops to fire French Railway guns in action, were Batteries L and M of the 52nd C. A. C."

I wish to state that DuPont's ad is in error* and am requesting that it be corrected. Copy of letter from the Chief of Coast Artillery setting forth the fact that Battery "H," 53rd C. A. C., was the organization which had the honor of performing the feat claimed by Batteries L and M of the 52nd.

Your attention is further invited to the primer mentioned in General Barrette's letter, which is mounted in the Officers' Club at Fort Monroe, Va.

Sincerely yours,

GEORGE A. NOWLIN, *Staff Sergeant, D. E. M. L.*
Formerly 1st Sgt. Battery "H,"
53rd Artillery, C. A. C.

(Inclosure)

WAR DEPARTMENT
OFFICE OF THE CHIEF OF COAST ARTILLERY
WASHINGTON

March 13, 1918.

Sergeant Joseph Rhuska,
Gun Commander, Battery H, 53rd Artillery, C. A. C.

Dear Sergeant:

General Coe has sent to me the first primer fired in France by the Coast Artillery. He states that the lanyard was pulled by you at 2:10 p. m., Feb. 14. I want to congratulate you on this event, and to say that I am glad to hear such glowing reports of the brigade.

Very truly yours,

J. D. BARRETTE, *Brigadier General, N. A.*
Acting Chief of Coast Artillery.

*EDITOR'S NOTE: E. I. DuPont de Nemours & Company, whose advertisements are always very carefully prepared, are withdrawing the text of this advertisement. They state: " * * * The copy for these advertisements, and the sketches which illustrate them, were submitted to the federal officials at Washington, and approval was given to the text and illustrations."

Coast Artillery Reserve Units

Data furnished by the Office of the Chief of Coast Artillery.

<i>Organization</i>	<i>Address of Unit Executive</i>
Hq. & Hq. Btry., 198th Brigade*	Federal Bldg., Erie, Pa.
Hq. & Hq. Btry., 199th Brigade (A A)	Indianapolis, Ind.
Hq. & Hq. Btry., 200th Brigade (A A)	Federal Bldg., Des Moines, Ia.
Hq. & Hq. Btry., 201st Brigade (A A)	39 Whitehall Street, New York, N. Y.
Hq. & Hq. Btry., 202nd Brigade (A A)	Masonic Temple Bldg., Raleigh, N. C.
Hq. & Hq. Btry., 203rd Brigade (A A)	New Telegraph Bldg., Detroit, Mich.
Hq. & Hq. Btry., 208th Brigade (A A)	39 Whitehall Street, New York, N. Y.
Hq. & Hq. Btry., 209th Brigade (A A)	Army Base, Boston, Mass.
Hq. & Hq. Btry., 210th Brigade (A A)	Unorganized.
Hq. & Hq. Btry., 212th Brigade (A A)	39 Whitehall Street, New York, N. Y.
501st Coast Artillery (A A)	Army Base, Boston, Mass.
502nd Coast Artillery (A A)	39 Whitehall Street, New York, N. Y.
503rd Coast Artillery (A A)	The Lycoming, Williamsport, Pa.
504th Coast Artillery (A A)	Chattanooga, Tenn.
505th Coast Artillery (A A)	Fort Monroe, Va.
506th Coast Artillery (A A)	Federal Bldg., Rock Island, Ill.
507th Coast Artillery (A A)	Ft. Leavenworth, Kans.
508th Coast Artillery (A A)	El Paso, Texas.
509th Coast Artillery (A A)	Seattle, Wash.
510th Coast Artillery (A A)	Chester, Pa.
511th Coast Artillery (A A)	Fort Monroe, Va.
512th Coast Artillery (A A)	Unorganized.
513th Coast Artillery (A A)	39 Whitehall Street, New York, N. Y.
514th Coast Artillery (A A)	State Armory, Schenectady, N. Y.
515th Coast Artillery (A A)	
516th Coast Artillery (A A)	Dauphin Bldg., Harrisburg, Pa.
517th Coast Artillery (A A)	Hq. 9th Corps Area, Presidio of San Francisco, Cal.
518th Coast Artillery (A A)	Hq. 9th Corps Area, Presidio of San Francisco, Cal.
519th Coast Artillery (A A)	Baker-Detwiler Bldg., Los Angeles, Cal.
521st Coast Artillery (A A)	39 Whitehall Street, New York, N. Y.
522nd Coast Artillery (A A)	39 Whitehall Street, New York, N. Y.
523rd Coast Artillery (A A)	Federal Bldg., Erie, Pa.
524th Coast Artillery (A A)	Atlanta, Ga.
525th Coast Artillery (A A)	Indianapolis, Ind.
526th Coast Artillery (A A)	Federal Bldg., Rock Island, Ill.
527th Coast Artillery (A A)	Federal Bldg., St. Joseph, Mo.
528th Coast Artillery (A A)	Minneapolis, Minn.
529th Coast Artillery (A A)	Seattle, Wash.
530th Coast Artillery (A A)	39 Whitehall Street, New York, N. Y.
531st Coast Artillery (A A)	Federal Bldg., LaCrosse, Wis.
532nd Coast Artillery (A A)	Federal Bldg., East St. Louis, Mo.
533rd Coast Artillery (A A)	39 Whitehall Street, New York, N. Y.
534th Coast Artillery (A A)	Masonic Temple Bldg., Raleigh, N. C.
535th Coast Artillery (A A)	
536th Coast Artillery (A A)	New Telegraph Bldg., Detroit, Mich.
537th Coast Artillery (A A)	Minneapolis, Minn.
538th Coast Artillery (A A)	
539th Coast Artillery (A A)	39 Whitehall Street, New York, N. Y.
540th Coast Artillery (A A)	National Guard Armory, Birmingham, Ala.
541st Coast Artillery (A A)	
542nd Coast Artillery (A A)	Portland, Me.
543rd Coast Artillery (A A)	New London, Conn.

*Initials are used as follows after the designation of the unit to indicate armament assignment: A A for antiaircraft; H D for harbor defense; Ry for Railway; and H T for heavy tractor.

544th Coast Artillery (A A)	Hospital Trust Bldg., Providence, R. I.
545th Coast Artillery (A A)	New Orleans, La.
547th Coast Artillery Battalion (A A)	Unorganized.
548th Coast Artillery Battalion (A A)	Atlanta, Ga.
552nd Coast Artillery Battalion (A A)	Unorganized.
601st Coast Artillery (Ry)	Custom House, Boston, Mass.
602nd Coast Artillery (Ry)	39 Whitehall Street, New York, N. Y.
603rd Coast Artillery (Ry)	Chester, Pa.
604th Coast Artillery (Ry)	
1st and 2nd Battalions	Hq. 9th Corps Area, Presidio of San Francisco, Cal.
3rd Battalion	Seattle, Wash.
605th Coast Artillery Battalion (Ry)	Seattle, Wash.
606th Coast Artillery (H T)	Army Base, Boston, Mass.
607th Coast Artillery (H T)	39 Whitehall Street, New York, N. Y.
608th Coast Artillery (H T)	
1st and 2nd Battalions	Hq. 9th Corps Area, Presidio of San Francisco, Cal.
3rd Battalion	Baker-Detwiler Bldg., Los Angeles, Cal.
609th Coast Artillery Battalion (H T)	Fort Monroe, Va.
613th Coast Artillery (H D)	Portland, Me.
614th Coast Artillery (H D)	Portland, Me.
615th Coast Artillery (H D)	Army Base, Boston, Mass.
616th Coast Artillery (H D)	Hospital Trust Bldg., Providence, R. I.
618th Coast Artillery (H D)	New London, Conn.
619th Coast Artillery (H D)	39 Whitehall Street, New York, N. Y.
620th Coast Artillery (H D)	39 Whitehall Street, New York, N. Y.
621st Coast Artillery (H D)	DuPont Bldg., Wilmington, Del.
622nd Coast Artillery (H D)	Unorganized.
623rd Coast Artillery (H D)	Atlanta, Ga.
624th Coast Artillery (H D)	
625th Coast Artillery (H D)	Baker-Detwiler Bldg., Los Angeles, Cal.
626th Coast Artillery (H D)	Baker-Detwiler Bldg., Los Angeles, Cal.
627th Coast Artillery (H D)	
1st and 2nd Battalions	Hq. 9th Corps Area, Presidio of San Francisco, Cal.
3rd Battalion	Baker-Detwiler Bldg., Los Angeles, Cal.
628th Coast Artillery Battalion (H D)	Seattle, Wash.
629th Coast Artillery (H D)	Seattle, Wash.
630th Coast Artillery Battalion (H D)	Seattle, Wash.
653rd Coast Artillery Battalion (A A)	39 Whitehall Street, New York, N. Y.
Hq. Sound Ranging Service	Chester, Pa.
11th Sound Ranging Battery	Chester, Pa.
12th Sound Ranging Battery	Chester, Pa.
13th Sound Ranging Battery	Chester, Pa.
14th Sound Ranging Battery	Masonic Temple Bldg., Raleigh, N. C.
15th Sound Ranging Battery	Masonic Temple Bldg., Raleigh, N. C.
16th Sound Ranging Battery	Unorganized.
17th Sound Ranging Battery	Unorganized.
Heavy Mobile Artillery Battery (Training)	Unorganized.

The Purpose of Equilibrators

By CAPTAIN AARON BRADSHAW, C. A. C.

Equilibrators, which are mechanical devices used for maintaining the balance of cannon at all elevations, are necessary on the present field cannons since the tipping parts of these cannon are not trunnioned at their centers of gravity. When cannon are not trunnioned at their center of gravity some device must be utilized which will overcome the muzzle preponderance and maintain proper balance,

Equilibrators satisfy this requirement and, by maintaining proper balance, make it possible for elevation and depression to be accomplished with the minimum work.

In the past, practically all cannon were trunnioned at their centers of gravity. The recoiling parts of the carriages on which these cannon were mounted generally did not strike the ground when the cannon were fired, since they were short, and, due to their limited range, did not require high elevations.

As the elevation and length of cannon were increased to meet the ever-present demands for greater range, the problem arose of providing space to receive the recoiling parts. The first means devised to prevent the recoiling parts from striking the ground, was to dig a hole to receive them, and this was done and is

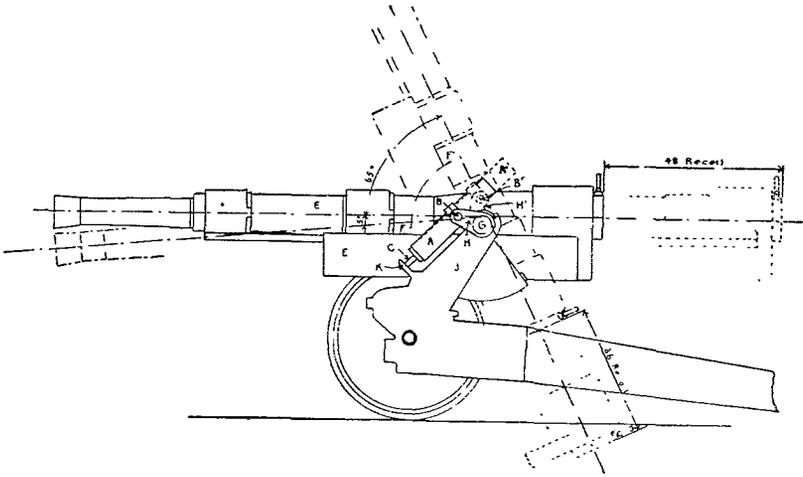


FIG. 1

being done at the present time with old mounts in our service. In the design of the new field mounts considerable study has been given to doing away with this requirement. Three solutions have been seriously considered.

(1) Weighting the breech, which allows for shortening the distance from the breech face to the trunnions without destroying the balance.

(2) Having trunnions at the center of gravity but utilizing a variable recoil system.

(3) Trunnioning the gun in rear of the center of gravity and overcoming the muzzle preponderance by means of equilibrators.

It is maintained that the most practical solution of the problem outlined above is the use of some form of equilibrator and it is believed that in the future all field guns will be equipped with them.

The first equilibrators used consisted mainly of a spring column and a plunger with the spring so adjusted and mounted that it kept the cannon balanced at all elevations. Difficulties were encountered with spring equilibrators due to the fact that the supply of springs was limited due to the severe specifications necessary. This led to the development of a pneumatic equilibrator which is the type now installed on the "155-mm. gun—8-inch howitzer carriage, M. 1920E," and on the "3-inch A. A. gun, M. 1923E."

Figure 1 shows diagrammatically the application of the equilibrator on the "155-mm. gun—8-inch howitzer carriage, M. 1920E." The tipping parts E, with center of gravity at F, are trunnioned at G upon the top carriage J. A pair of arms H, fixed to the trunnion G, receives the equilibrator trunnions at B. The plunger C sockets in the bracket K from the top carriage J. Gravity tends to pull the point F downward about G, which tendency is resisted by the equilibrator through the arm H.

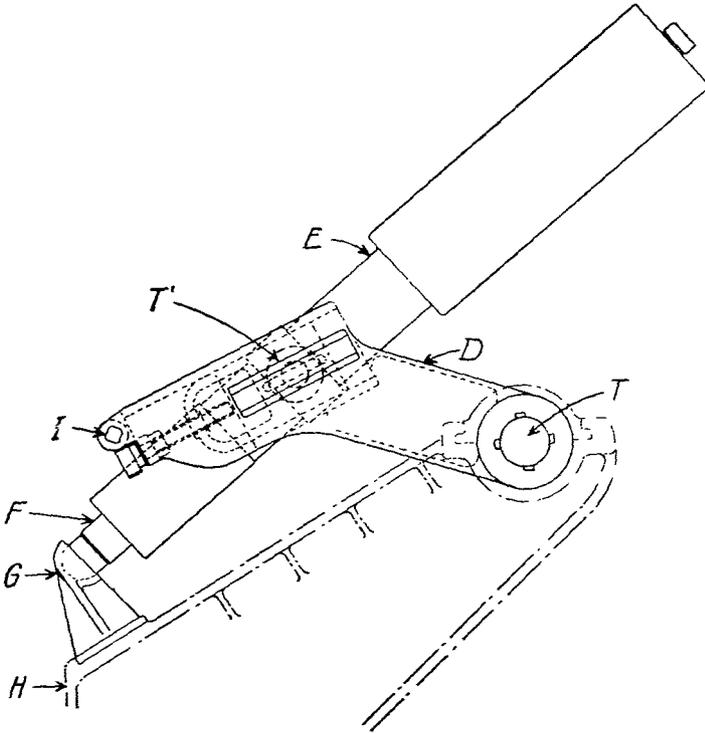


FIG. 2

Figure 2 shows the Pneumatic Equilibrator on the 3-inch A.A. gun mount, Model 1923E. It is of particular interest since it contains absolutely the latest thoughts in equilibrator design. It is designed so that it even takes care of the effects of changes of temperature of the nitrogen used. A brief description of its operation to take care of these effects follows.

The left side view of this equilibrator is shown in Fig. 2. The muzzle of the gun is to the left, and has considerable preponderance. The gun cradle is trunnioned at the point T. Keyed to the cradle trunnion are the arms D which engage a pair of trunnions T' on the cylinder E. A piston rod F, bearing against bracket G, affixed to the side frame H of the carriage, operates within cylinder E. At the upper end of cylinder E is a volume of nitrogen under initial compression. The pressure of the nitrogen exerted between the upper end of cylinder E and the face of the piston, tend to effect a movement of the trunnions T' and the arm D, and consequently the cradle and gun, in a clockwise direction

about the center of the trunnion T. The adjustment of the equilibrator having been made for one condition of temperature, subsequent great change in temperature will necessitate readjustment. This adjustment is accomplished by moving the trunnions T' along the guide ways in the arms D. Such movement simultaneously increases or simultaneously decreases both the lever arm TT' and the nitrogen pressure, depending upon the direction and amount of such movement. If the equilibrator action is too weak the trunnions T' are moved downward in the guide ways. If the equilibrator action is too strong the trunnions T' are moved upward in the guide ways. Movement of trunnions T' is effected by a combination of worms and screws operated by a wrench on the end of worm shaft I shown in Fig. 2.

Changes in 3-inch Antiaircraft Gun Drill

By 2ND LIEUT. J. E. REIERSON, C. A. C.

The following changes in gun drill were made by the writer during the recent test firings at Fort Tilden, New York, and gave very satisfactory results:

Change "Fig. 3—Details, post—3" Gun Trailer Mount," page 4 of T. R. 435-250 as follows:

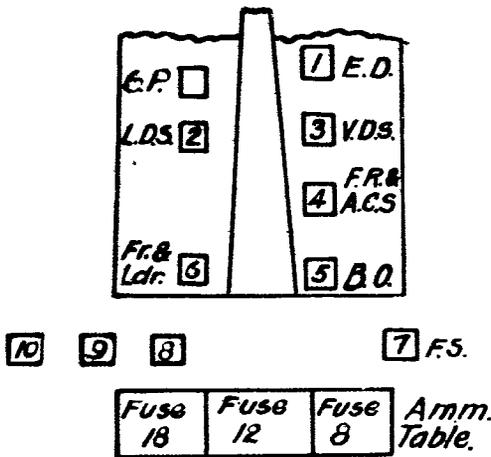


FIG. 3

The gun pointer either *elevates* his sight *to* (or *depresses to*) the burst when firing Trial Shots; for the error in the sight has been determined when the sight is elevated or depressed and the true angular height of the burst can be obtained by correcting the angle of site as read by him. His duties of turning the azimuth pinion knob is dispensed with and instead he traverses the gun (and therefore the sight) as in seacoast guns, because of a recent change made by the Ordnance which locks the pointer, thus causing the gun pointer to traverse the gun to keep his vertical wire on the target. His other duties are as given in T. R. 435-250.

No. 2 (Lateral Deflection Setter) is relieved of traversing the gun. He has the additional duty of traversing back to the azimuth fired on immediately after the projectile leaves the gun, when firing Trial Shots and calibrating, thus eliminating errors in lateral deflection. His other duties are as given in T. R. 435-250.

No. 3 (Vertical Deflection Setter) was relieved of his duty of setting fuze ranges and this duty was given to No. 4.

No. 4 (Fuze Range and Arbitrary Correction Setter) was added, for No. 3 could not set arbitrary corrections (as described in a recent issue) in addition to his other duties. His duties for "Prepare for Action" and "March Order" are the same as given in T. R. 435-250 for No. 4.

No. 6 (Firer and Loader) has all the duties of the Firer and Loader given in T. R. 435-250 for all commands except as noted above.

No. 7 (Fuze Setter) has the same duties as outlined in T.R. 435-250 for No. 8.

No. 8 takes over the duties of the Relayer (No. 7 in T. R. 435-250) for the commands "Prepare for Action" and "March Order" and for all other commands the same duties as Nos. 9 and 10. The Relayer (No. 7 T.R. 435-250) was dispensed with, for it was found that if there were three men in the ammunition detail and each one placed his projectile in the breech the rate of fire could be increased.

Nos. 9 and 10 have the same duties as outlined in T. R. 435-250 except that they take the projectile off the table, cut their own fuze and place their projectile in the breech, approaching the breech from the right rear with their right hand supporting the upper part of the shell and the left the part just above the base so that the hand will not interfere with the loading.

Just before the battery is to commence firing the ammunition will be divided into three piles on the ammunition table and each projectile in its pile will have its fuze cut from "Safe" to a certain fuze. For example the pile nearest the fuze setter will have its fuzes cut to 8, the next pile to 12 and the next to 18. The ammunition detail takes a projectile from the pile which has its fuzes cut just above the fuze coming to the fuze setter. A line was drawn with chalk from the fuze lug (one to be inserted in the fuze slot) down the surface of the projectile so that the proper lug could be inserted more quickly. With the above changes in drill, and methods, a rate of fire of over sixty rounds per battery per minute was obtained.

Table Showing World War Small Arms and Ammunition, Post War Small Arms and Ammunition, and Future Developments

Prepared in the office of the Chief of Ordnance by MAJOR G. P. WILHELM, O. D.

WORLD WAR SMALL ARMS* AND AMMUNITION

Shoulder Rifles.

U. S. Rifle, Caliber .30, Model 1903.

U. S. Rifle, Caliber .30, Model 1917.

Automatic Rifles.

Browning Automatic Rifle, Model 1917. Used in limited numbers by one or two divisions only.

Machine Guns.

Hotchkiss Machine Gun, Model 1914, 8-mm.

Browning Machine Gun, Model 1917.

Tripod, Machine Gun, Model 1917.

Tripod, Machine Gun, Model 1918.

†Tripod, Browning Machine Gun, Antiaircraft, Model 1918.

†Adapter, Antiaircraft, for Machine Gun Tripod, Model 1917-18.

* Small arms are defined as all calibers up to and including automatic 37-mm.

† Question as to whether they were actually used during the war, but were developed during the war.

Antiaircraft Sights.

None were available during the World War.

Small Arms Ammunition.

- Cartridge, Ball, Caliber .30, Model 1906.
- Cartridge, Armor Piercing, Caliber .30, Model 1917.
- Cartridge, Armor Piercing, Caliber .30, Model 1918.
- Cartridge, Tracer, Caliber .30, Model 1917.
- Cartridge, Incendiary, Caliber .30, Model 1918.

POST-WAR SMALL ARMS AND AMMUNITION

Shoulder Rifles.

- U. S. Rifle, Caliber .30, Model 1903.
- U. S. Rifle, Caliber .30, Model 1917.

Automatic Rifles.

- Browning Automatic Rifle, Model 1917.

Machine Guns.

- Browning Machine Gun, Caliber .30, Model 1917.
- Browning Machine Gun, Caliber .50, Model 1921, Watercooled (without tripod mount).
- Tripod, Machine Gun, Model 1917.
- Tripod, Machine Gun, Model 1918.
- Tripod, Browning Machine Gun, Antiaircraft, Model 1918.
- Adapter, Antiaircraft, for Machine Gun Tripod, Model 1917-18.

Antiaircraft Sights.

- Sight, Antiaircraft, Front Area, for the .30-caliber Browning Machine Gun, This sight is being modified for temporary use on the .50-caliber machine gun.

Small Arms Ammunition.

- Cartridge, Ball, Caliber .30—New Service.
- Cartridge, Armor Piercing, Caliber .30, Model 1922.
- Cartridge, Tracer, Caliber .30, Model 1923.
- Cartridge, Tracer, Caliber .30, Model 1924.
- Cartridge, Ball, Caliber .50, Model 1923.
- Cartridge, Armor Piercing, Caliber .50, Model 1923.
- Cartridge, Tracer, Caliber .50, Model 1925.*

FUTURE DEVELOPMENTS

Semi-Automatic Shoulder Rifles.

Three types of semi-automatic shoulder rifles are undergoing development.

Automatic Rifles.

None being developed.

Machine Guns.

None being developed.

An improved tripod for ground use, which can be made immediately available for antiaircraft fire for .30-caliber machine guns, is now being de-

* Special types of incendiary ammunition have been done away with, as it has been found that the tracer bullets have an effective incendiary effect. *

veloped. Three types are being designed, all involving an effective anti-aircraft feature.

An improved anti-aircraft tripod which will take either the .30-caliber or .50-caliber machine gun has been designed and will be adopted.

Antiaircraft Sights.

Two types of improved anti-aircraft front-area sights for both .30-caliber and .50-caliber machine guns are being designed, the better of which probably will be adopted.

Small Arms Ammunition.

Future development is being devoted to improving the effectiveness of tracer ammunition.

Spotting

By CAPTAIN HARRY R. PIERCE, *C. A. C.*

Such excellent results were obtained this year with a Modified Gray Spotting Board that it is thought worth while to make mention of it.

In the first place a regular Gray Board was used, scale 300 yards to the inch for Service Projectile and 100 yards to the inch for the Sub-Caliber Projectile, one scale being graduated on one side of the board and one on the other. Two target blocks were used, one for service and one for sub-caliber with same respective scales.

The modification consisted in using celluloid protractors seven feet long instead of the strings and triangles originally designed. These protractors were made from automobile window celluloid graduated their entire length with lines 0.25 degree apart in reverse of the division in the azimuth instrument or from left to right, 3.00 in the center. The center, or 3.00 line, was inked in red, the other even degree lines black, and the rest green.

Only one man was used to operate the board. This was the greatest advantage because, while it is a great problem, with our customary shortage of personnel, to find three or four extra men capable of performing satisfactorily this important work, it is usually possible to utilize one good man for it.

The one Spotter wore a head set to which were connected, in parallel, three lines,—Plotting Room, B' Spotting Observer, and B'' Observer. During dull moments the Spotter called to the plotting room for ranges and azimuths. Then when the splash came the phone conversation was so synchronized that B' called out his deviation first, quickly followed by B''. The Spotter, who had his B' protractor underneath the B'' protractor, then set the B' deviation of the protractor over the center of the target block and, while holding this protractor with his hand, set the B'' in the same manner. The intersection of the red lines showed him the splash at once which was repeated in yards to the B' Station, also in this case the B. C. Station.

Deviations arrived at the B. C. Station from five to ten seconds after the splash. Of six shots that were fired the greatest error made by the Spotter was fifteen yards and the least error five yards. The 15-yard error occurred on a salvo which was reported as a hit, the center of impact of which however was fifteen yards from the target. The mean error was eight yards.

The advantages of this modification may be summed up in one remark. It takes only one man, and for a job like that, one good man can always be found.

Coast Defense Troops

Seacoast defense is provided for in several different ways by different nations. In Japan, Great Britain and Italy, the army is charged with the operation of the coast defenses, while in France coast defense control is under the naval ministry which, for this purpose, disposes of elements belonging to the war ministry.

In Italy, fixed defense troops are part of the army and are called coast artillery (*artiglieria da costa*) and heavy artillery (*artiglieria pesante*). These two organizations are not considered as a separate branch, but form part of the Italian artillery which is composed of field, heavy field, mountain, coast and heavy, and anti-aircraft artillery. A general officer acts as chief of all artillery. Officers of artillery theoretically are trained for service with any of the above groups; in practice, officers are permitted to specialize for service with that type of artillery which they prefer and for which they are best qualified.

The potential strength of our present military system, Regular, National Guard and Organized Reserves, can only be visualized by those who work with it today and who in 1917 witnessed the dilemma of the War Department. Great cantonments will no longer be necessary, even camps may be avoided. The basic organization is constituted HERE, — THERE, in every hamlet in the country, and the officials, as general managers and foremen, are in place. By a single directive the process can be set in motion of assembling and training locally the patriotic citizen for the defense of his country. If we maintain this system, no longer in a national crisis should our young men depart for unknown battlefields under partially trained officers. The leaders of this force today are veterans of the World War who, with splendid spirit, have continued voluntarily to devote themselves to this service. Their successors are being provided from the youth of the country, through the summer training camps, and through the Reserve Officers Training Units established in many of our schools and colleges.
—General Pershing, at Pittsburgh, April 26, 1924.

MILITARY NOTES

furnished by

THE MILITARY INTELLIGENCE DIVISION, G. S.

Russia

DETAILS OF FEDOROFF MACHINE GUN.—A recent number of a German military publication gives the following details of the light machine gun recently adopted for the Red Army.

This gun, called the Fedoroff after its inventor, weighs only five kilograms and has a caliber of 6.5 mm. It has a movable barrel and a breech consisting of two bolts, one on each side. The magazine holds 25 rounds. The ammunition is of Japanese manufacture which is reported to have been found more suitable than that of Russian make for the gun.

The initial velocity is 680 meters and the rapidity of fire is 25 rounds per minute, individual fire, and from 75 to 100 rounds, rapid fire. There is no provision for cooling the gun.

Poland

ARMY MANEUVERS.—The first Polish Army maneuvers carried out since she gained her independence ended August 20, 1925. The general idea was "a defensive force guarding the frontier."

The first part of the maneuvers took place in Volhyna, near the town of Brody. Fifteen thousand troops were engaged. This was mainly a Cavalry maneuver. It represented a type of open warfare, which was required by geographical conditions of the eastern borders.

The second part of the maneuvers took place in Pomerania, near Thorn. This consisted chiefly of Infantry and Artillery operations under modern conditions.

Both maneuvers were attended by General Gouraud, representing the French, and General Ironside, representing the British.

The Polish troops have shown during the recent maneuvers remarkable fitness, and in the first part of the maneuvers, which lasted three days, and while tropical heat was prevailing, only 32 men out of 15,000 reported sick. The foreign guests, including General Ironside, paid high compliments on the training of the soldiers and the initiative shown. Representatives of the armies of Great Britain, France, Italy, Japan, United States, Spain, Sweden, Finland, Esthonia, Latvia, Roumania, Czechoslovakia, Serbia, and Turkey were present at the maneuvers.

Spain

PERMANENT ARMY IN AFRICA.—The new organization of the Spanish permanent army in Morocco is as follows:

SPANISH TROOPS				
	Officers	Cont. Empl.	Enlisted	Animals
Infantry.....	1,201	74	41,975	6,982
Cavalry.....	159	12	3,523	3,858
Artillery.....	351	178	10,521	4,381
Engineers.....	196	22	7,929	1,423
Q. M. Troops.....	73	44	3,301	1,931
Medical Dept.....	132	18	2,252	655
Veterinary.....	73			
Chaplains.....	33			
G. S. (Topographical, etc.).....			49	
Sea (Stevedores) Cos.....			488	
Aviation.....	56		415	
Total.....	2,274	348	70,453	19,230

Foreign Legion (*El Tercio*), amounting to 252 officers and 8,048 enlisted, are included in Infantry, above. 383 officers and 63 clerks, in addition to the forces indicated above, are also attached to the administration of the protectorate.

NATIVE TROOPS

Officers	Enlisted		Animals
	Inf.	Cav.	
450	10,876	2,180	3,871

There also exist five Groups of *Mehallas* or native troops commanded by Spanish officers, maintained by the Jalifa or Moorish Government. Their strength is variable.

Several *Harcas* or native fighting troops, friendly to Spain, commanded by prominent Moors or Spanish officers, and under the supervision of Spanish officers are actually cooperating in the security of the territory.

The above is the *permanent* Army of Africa. It is now and has generally been reinforced by "expeditionary" units sent from the Peninsula.

Italy

ARTILLERY ORGANIZATION.—The Italian Artillery, as at present organized, comprises field artillery (*artiglieria da campagna*), heavy field artillery (*artiglieria pesante campale*), and horse artillery (*artiglieria a cavallo*).

The field or divisional artillery consists of twenty-seven regiments nominally allotted to twenty-seven of the thirty existing divisions. The three divisions which have no field artillery regiments of their own are stationed along the mountainous northern frontier.

The light regiment consists of twelve batteries (four of which are cadre batteries in peace), organized into four groups or battalions and a depot. Batteries are all equipped with four guns and are horse-drawn, but the different groups have different caliber weapons. The first two groups are armed with the 75-mm.

(2) It is requested that this report be commented upon by the Coast Artillery Board, particular reference being made to mechanical devices described on page 11 of the report.

2. The following is quoted from page 11 of the target practice report above referred to:

(3) Two special mechanical devices were utilized during the practice. A predicting targ and a special form of setforward ruler.

(a) The predicting targ was designed to replace the usual standard targ and to eliminate some of the steps in predicting the setforward point. The device, the dimensions of which were made for the 110° plotting board (long range), consists really of two targs, capable of being displaced one from the other by a scale distance equal to the linear travel of the target during the predicting interval (30 seconds) plus the time of flight. The

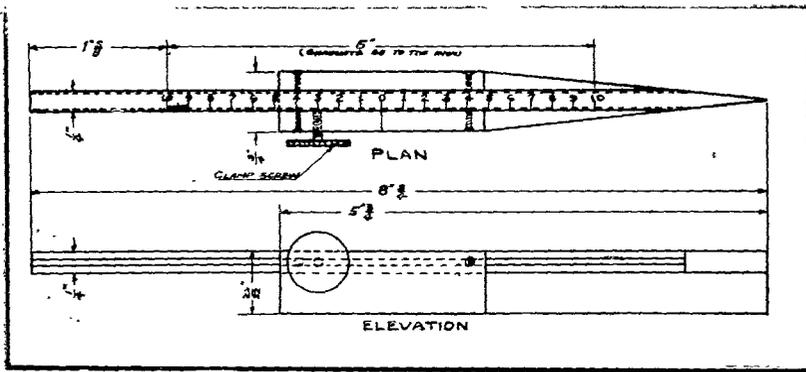


FIG. 1

lower portion is of a height equal to the combined thickness of the two station arms plus a slight clearance while the upper portion is graduated to the scale of the plotting board and can be set up to 800 yards in front of or in rear of the lower portion. In operating the targ the assistant plotter, with the aid of a special form of setforward ruler, keeps the two portions set with respect to each other so that the targ apices are always separated by the linear travel of the target during the predicting interval plus the time of flight. When the arm-setters have called "set," the plotter brings the lower apex against the intersection of the station arms, aligns the targ with the course of the target and then brings the gun-arm up against the upper apex and immediately calls off the setforward range in the same time it would have taken to determine the last plotted range. After the setforward azimuth has been noted by the azimuth corrector the plotter causes the station arms to be cleared, and with a pencil marks the plotted point, and if there has been any change in travel he so notifies the assistant plotter. An alternate method is to mark the plotted point with the standard targ before the arms are cleared.

(b) The special setforward ruler referred to above is constructed of white opaque celluloid and consists of two concentric discs of different radius. The upper and smaller disc's periphery is graduated in logarithmic values of the travel in yards during the predicting interval, whereas the lower and larger disc is graduated in logarithmic values of setforward travel. The time of flight scale is not graduated in seconds but in corresponding ranges for the 12" B. L. R., Model 1895. In operating the rule, its index is set opposite the travel in 30 seconds and the setforward travel is read opposite the range.

3. The following is quoted from letter from Captain Albert M. Jackson, 7th Coast Artillery, to the Coast Artillery Board, dated August 15, 1925:

It will be noted that the predictor is good only in cases where the target is traveling at an angle greater than 6° from either of the arms.

4. The "Predicting Targ" was sent by Captain Jackson to the Coast Artillery Board for examination. A drawing of it is appended hereto and marked "Exhibit A" (See Fig. 1).

5. The Coast Artillery Board made a study of the target practice report of Battery Kingman with particular reference to the "Predicting Targ" and setforward ruler and examined the "Predicting Targ."

II—DISCUSSION.

6. *a.* (1) The "Predicting Targ" does cut down the time required to find range and azimuth of the setforward point; but it accomplishes this at the expense of accuracy. This is so because the travel used in setting the "Predicting Targ" is not the travel during the last observing interval but is the travel during the next to last observing interval. The resulting error will be negligible when target is moving at a slow rate of speed and changing its course but slightly; but this error cannot be neglected when the target is moving rapidly and on a continuously changing course.

(2) Predicted track of target cannot be made properly without taking into consideration the last plotted point. With the "Predicting Targ" the last plotted point cannot be used effectively when course of target changes appreciably.

(3) The "Predicting Targ" cannot be used when target is traveling at an angle of less than 6° from either of the arms.

(4) The "Predicting Targ" is not universal in that it is not adaptable for use with the Cloke Plotting Board.

b. The setforward slide rule is correct in principle, accurate, and easily constructed. It does not seem to possess any particular advantage over other methods at present in use for solving the same problem.

III—CONCLUSIONS.

6. The Coast Artillery Board believes that neither the predicting targ nor the setforward slide rule considered meets the requirements of a standard fire control instrument for Coast Artillery use; but that these devices will be satisfactory in special instances.

7. The Coast Artillery Board recommends that the "Predicting Targ" and setforward slide rule be not adopted for Coast Artillery use; but that their use be permitted where desired.

COAST ARTILLERY SCHOOL LIBRARY

BOOKS CATALOGUED

Unless marked thus "*" these books may be obtained by any Coast Artillery Officer; Warrant Officer, A. M. P. S.; or Non-Commissioned Officer (Grades 1-3), C. A. C., upon request to the Librarian, C. A. S. Library:

- American Society of Civil Engineers. *Transactions, Vol. 88.* 1925.
- Adjutant General's Office. *United States Army Training Manual, Nos. 1, 2, and 4.* 1922-25.
- Adkins, F. J. *Historical Backgrounds of the Great War.* 1919. 292 p.
- Air Service Tactical School. *Combat Orders, Course 1924-25.* 69 p.
- Air Service Tactical School. *Meteorology, Course 1924-25.* 77 p.
- **All the World's Air-Ships.* 1925.
- **Almanach de Gotha.* 1925.
- Army Service Schools. *Troop Leading; An Infantry Division in Attack.* 1921. 236 p.
- American Ethnology, Bureau of. *Annual Report.* 1918.
- Ardant du Picq, C. J. J. J. *Battle Studies.* 1921. 273 p.
- Armaments Year-Book; General and Statistical Information.* 1924.
- *Ayer, Firm, Newspaper Advertising Agents. *American Newspaper Annual and Directory.* 1925.
- Bernhardi, F. A. J. *The War of the Future in the Light of the Lessons of the World War.* 1921. 310 p.
- Coast and Geodetic Survey. *Astronomic Determinations by United States Coast and Geodetic Survey.* 1925. 337 p.
- Coast and Geodetic Survey. *Current Tables, Atlantic Coast, North America for the Year 1926.*
- Coast and Geodetic Survey. *Current Tables, Pacific Coast, North America, 1926.*
- Coast and Geodetic Survey. *Tide Tables, 1926.*
- Coast and Geodetic Survey. *Tide Tables for the Atlantic Coast of the United States including Canada and the West Indies.* 1926.
- Coast and Geodetic Survey. *Tide Tables Pacific Coast, North America, Eastern Asia and Island Groups.* 1926.
- Coast Artillery Journal.* 1925. Vol. 62.
- Coast Artillery School. *General Conferences, 1924-25.*
- Colquhoun, A. R. *China in Transformation.* Rev. and enl. 1912. 302 p.
- Connor, H. G. *John Archibald Campbell.* 1920. 310 p.
- Dotterer, R. M. *Beginners' Logic.* 1924. 342 p.

- Dyke, A. L. *Automobile and Gasoline Engine Encyclopedia*. 13th ed. 1924. 1226 p.
- **E. M. F. Electrical Year Book*. 1925.
- Emerson, H. P. *Modern English*. 1924. 2 v.
- Empire at War, The*. 1921. 4 v.
- Fillis, J. *Breaking and Riding, With Military Commentaries*. 356 p.
- Forester, C. S. *Napoleon and His Court*. 1924. 247 p.
- Giles, H. A. *China and the Manchus*. 1912. 148 p.
- Grueuing, E. H. *These United States*. 2 v.
- Gunners' Instruction (Railway Artillery)*. 1925. 160 p.
- Hering, D. W. *Foibles and Fallacies of Science*. 1924. 294 p.
- Irving, L. H. *Officers of the British Forces in Canada During the War of 1812-15*. 1908. 309 p.
- Jevons, W. S. *Logic*. 128 p.
- Kohler, E. L. *Principles of Auditing*. 1924. 231 p.
- Latigo, E. *Anuario Militar Escuela de Application, Campamante de Colombia*. 1924.
- Luckiesh, M. *Lighting Fixtures and Lighting Effects*. 1st ed. 1925. 330 p.
- Mathews, J. M. *American State Government*. 1924. 660 p.
- Miles, S. *Notes on the Dardanelles Campaign of 1915*. 1925. 80 p.
- Miller, T. *Summary of Supply Principles*. 1921. 274 p.
- Nautical Almanac Office. *The American Ephemeris and Nautical Almanac*. 1927.
- Nautical Almanac Office. *The American Nautical Almanac*. 1927.
- **New International Year Book*. 1924.
- New York (State) Comptroller's Office. *New York in the Revolution as Colony and State*. 2d ed. 1898. 534 p.
- **New York Times Index*. April-June, 1925.
- Osborne, N. S. *A Flow Calorimeter for Specific Heats of Gases*. 1925. 22 p.
- Pearson, F. J. *Modern Military Map Reading and Sketching*. 1st ed. 1924. 280 p.
- Pierrefeu, J. *Plutarchi a Menti*. 1923. 350 p.
- Pierson, C. W. *Our Changing Constitution*. 1922. 181 p.
- Purday, H. F. P. *Diesel Engine Design*. 2d ed. 1919. 332 p.
- Rasp, The*. Cavalry School, Fort Riley, Kansas, 1924.
- **Readers' Guide to Periodical Literature*. 1922-24.
- Remy, C. M. *The Universal Consciousness of the Bahai Religion*. 1925. 64 p.
- Ruhlen, G. *The Third Coast Artillery*. 1925. 19 p.
- Sears, J. H. *The Career of Leonard Wood*. 1919. 272 p.
- Signal Office. *Elements of Cryptanalysis*. 1924. 157 p.
- Smith, W. G. *Practical Descriptive Geometry*. 3d ed. Rev. and enl. 1925. 281 p.
- Southey, R. *The Life of Nelson*. 1902. 351 p.
- Spaight, J. M. *Air Power and War Rights*. 1924. 493 p.
- Thacher, J. *The American Revolution, From the Commencement to the Disbanding of the American Army*. 1861. 486 p.
- Treasury Dept. *Digest of Appropriations for the Support of the Government of the United States*. 1926.
- **United States Catalog; Books in Print 1921-24*. Entries under Author, Subject, and Title, in one alphabet, with particulars of binding.
- **World Almanac and Encyclopedia*. 1925.

BOOK REVIEWS

The Eclipse of American Sea Power. By Captain Dudley W. Knox, U. S. N., retired. The American Army and Navy Journal, Inc. 1922. 5¼" x 7¾". 140 pp.

During the Washington Conference the American delegates refused to give out any news. This matter was left entirely to the British publicity agent. The delegates adopted this policy to prevent the creation of any suspicion that they were using their press to turn public opinion against any nations with whom difficulties might arise. One unfortunate result of that honorable policy was that the American press, and therefore the American public, was dependent upon foreign sources for an interpretation of issues involved. Specifically, no authoritative American version of the proceedings was available. The author of this book offers a professional interpretation of the conference proceedings.

The points advanced are, briefly: (1) that at the beginning of the Conference, due to our active building program and our relatively superior financial ability to pursue such a program, we were in a position to develop a naval power equal to or superior to that of any other nation; (2) that, although the Conference agreement as to capital ships placed us on par with Great Britain, our actual strength, with capital and other naval vessels, naval bases, and naval reserves considered, is not even a close second to that of Britain; (3) that the restriction against further fortification of American Naval bases in Far Eastern waters has reduced our battle strength there far below that of Japan; and (4) that partial limitation of naval armament, in itself, is no guarantee against further naval competition.

The author concludes that sacrifices made by America are far out of proportion to those made by any other power and emphasizes the necessity for keeping our navy up to conference strength, particularly as to personnel. The author's arguments are not radical or new. His views are in line with accepted American Naval doctrine.—C. S. H.

A Chapter of Misfortunes. By Major General W. D. Bird, C. B., C. M. G., D. S. O. Forster, Groom & Co., London. 5¾" x 8¼". 288 pp. 8s.6d.

This book deals with the campaigns in Mesopotamia during the fall and winter of 1915-1916,—when British statesmen first resolved, from military and political motives, to capture Bagdad. The narrative is principally devoted to events leading up to the battle of Ctesiphon and its failure, to Townsend's withdrawal to Kut-el-Amara, its occupation and defense, the battle of Dujailah, and events leading to the final surrender of Kut-el-Amara in April, 1916. It is written principally from diaries kept by individuals participating in the campaigns.

The story is one of a complete failure. Almost suddenly the British invading force was halted from a campaign of brilliant minor successes and thrown

back into a series of misfortunes. Not unlike scores of other military campaigns, it was one where movement was an essential to success; but due to the nature of the country transportation depended tremendously upon the weather and seasons. And there the British campaign failed.

There is an example of lack of proper coordination among the commanders and an outstanding instance of incorrect interpretation of military intelligence on the part of the British. The Turks, directed by a German staff, turned to advantage weather, time, tide, and terrain. The British operations about Kut-el-Amara and to the south were held up, hindered, and finally squashed by an enemy who turned to his aid the flood waters of the Tigris.—C. S. H.

Vauban, Builder of Fortresses. By Daniel Halévy. Translated by Major C. J. C. Street, O. B. E., M. C. The Dial Press. 1925. 6" x 8½". 256 pp. \$2.75.

Few military engineers leave works of such lasting value that they are employed in the defense of their country after a lapse of two centuries. Vauban, Marshal of France, prepared in 1680 the sluices to inundate the lowlands of Newport and Dixmude utilized by the engineers of 1914 to stem the gray horde.

Vauban is the greatest modern master of the art of fortification. M. Halévy, in describing the untiring efforts of this exceptional man to establish the defense of France and render her safe from invasion, deals altogether with his personality and his rise from poverty to the exalted position of Marshal of France. For the technical details of his works one must search elsewhere.

The fluency of M. Halévy's style loses nothing in Major Street's translation. The biography commends itself to the reading of those followers of the profession of arms who, today, should study the lives of our famous predecessors of yesterday.—B. F. H.

Famous American Statesmen. By Sarah K. Bolton. Thomas Y. Crowell Co. 1925. 5½" x 8". 378 pp. \$2.00.

Mrs. Bolton has given a most interesting outline of United States history from the Revolution through the World War. For her framework she has taken fourteen of the nation's most valuable possessions—her great men. These she has presented as human beings with all of the joys, sorrows, successes, and failures common to humanity. In sketching their lives she has related history during the most vital times through which our country has passed. She carries each one from his birth to his death in such an interesting manner that the reader will not willingly lay the book aside until a section has been completed.

The men she has chosen are George Washington, Benjamin Franklin, Thomas Jefferson, John Adams, Alexander Hamilton, John Marshall, James Madison, Andrew Jackson, Daniel Webster, Henry Clay, Abraham Lincoln, John Hay, Theodore Roosevelt, and Woodrow Wilson.

These human sidelights of United States history will be interesting and instructive to both the casual reader and the student of history.—H. B. H.

Two Ordeals of Democracy. By John Buchan. Houghton, Mifflin Co. 1925. 6" x 8¾". 56 pp. \$2.00.

Colonel Buchan, an Englishman, delivered this lecture at Milton Academy on the Alumni War Memorial Foundation on October 16, 1924.

His theme is the necessity for individual decision in traveling the path of duty and courage and devotion. This he has treated by a brief review of the decisions required before and during our Civil War. He highly commends the wise decisions of President Lincoln. "You will all be called upon some day to face situations in public or private life where you will have to choose between two ways * * * and you will have to choose alone."

The work is easily recognized as that of a well-informed student of military history and, although brief, is interesting. Throughout his discussion of the Civil War he makes constant comparisons with the World War and other conflicts.—H. B. H.

Ten Years After. By Philip Gibbs. George H. Doran Co., New York. 1925. 6"x 9". 246 pp. \$2.50.

We have here a survey of world conditions for the past ten years. Armed with a wide knowledge and equipped with an extraordinary insight into human affairs, the author wades through this turbid period of world history, weighing conflicting opinions and facts, and emerges to present in lucid form some of the baffling problems which the more advanced nations must face if they wish to consummate the period of world reconstruction. Incidentally he draws attention to some of the outstanding diplomatic and political blunders made during the period of his survey. The Treaty of Versailles is awarded sharp criticism. Few matters of importance escape his attention.

The book includes four parts,—The World War, The Uncertain Peace, The Present Perils, The Hope Ahead. The following partial list of subheadings may serve to indicate the scope of the book: The Sense of Peace, The Call to Courage, The Spirit of the Victims, Fading Memories, The British Illusion, The Occupation of the Ruhr, The Revival of Hope.

The pages devoted to The Spirit of the Victims stamp Philip Gibbs as an able student of psychology. The lesson driven home is one that the army officer would do well to learn early in his service,—the spirit of the battalion when the leader has blundered.

The pages are filled with food for thought. The style is appealing. "Ten Years After" can hardly fail to attract wide attention.—C. S. H.

History of the Philippines. By David P. Barrows, Ph. D., LL. D. World Book Co. 1924. 5" x 7½". 406 pp. Illustrated. \$1.60.

Doctor Barrows, now Professor of Political Science in the University of California, has held the following offices in the Philippines: City Superintendent of Schools in Manila, Chief of the Bureau of Non-Christian Tribes of the Philippines, and Director of Education for the Philippines.

His work was written for Filipino students seeking information, not only of their own race and island home, but of the place of that race in the history of the Far East and of Europe. It was first produced in 1901-1903. The present edition was revised and published in 1924.

Fourteen chapters cover the history of the Islands and their people under the following headings: The Peoples of the Philippines; Europe and the Far East about 1400 A. D.; The Great Geographical Discoveries; Filipino People before the Arrival of the Spaniards; The Spanish Soldier and the Spanish Missionary; Period of Conquest and Settlement, 1565-1600; The Philippines Three Hundred Years Ago; The Dutch and Moro Wars, 1600-1663; A Century of Obscurity and

Decline, 1663-1762; The Philippines During the Period of European Revolution, 1762-1837; Progress and Revolution, 1837-1897; America and the Philippines; A Decade of American Government, 1903-1913; Toward Independence, 1914-1924.

The history of the Islands proper is paralleled by enough of the European history of the time to show how the latter influenced local conditions. The author has been just throughout the text but has not failed to place blame where it is due. The last chapter, dealing with the independence issue, is particularly interesting. A study of this concise history will help materially in the understanding of the problems of the Philippines.—H. B. H.

The Isles of Fear. By Katherine Mayo. Harcourt, Bruce and Company, New York. 1925. 6"x 9". 372 pp. Ill. \$3.50.

Here is "The Truth About the Philippines," as seen by the author from a first-hand study.

It is pointed out that there is really no Filipino race. There are forty-three tribes, speaking eighty-seven distinct dialects which inhabit about two-thirds of 3141 islands. The population is:

- a. The mountain people of the Island of Luzon, composed of several distinct people.
- b. The Mohammedans (Moros) of the Southern Islands.
- c. The Christian Filipino.

The first two resent being considered Filipinos.

The Filipinos are of two classes "the *cacique* or moneyed class, which bosses, and from which all politicians come; and the *tao*, or peasant class, which is bossed, and which has, in practice, no voice whatever in governmental or political affairs. The *cacique* class numbers perhaps six per cent of the total, and rests, not upon inherited position, but wholly upon the grip of money and of political influence, however recently acquired."

But all the blame is not on the *cacique*. It is doubtful if our form of government is best suited for a people not fully civilized. We were making progress when Mr. Harrison, Governor General from 1913 to 1921, allowed the executive power, which was his as Governor General, to be usurped by the legislative branch. The ruling class of Filipinos were thus for eight years in power. What they did with this power fills the largest part of the book.

One of the toys the ruling class enjoyed was the Philippine National Bank. To quote the author:

Thus an institution whose assets has actually made it one of the biggest banks in the world showed, after five years operation by home talent, first, the loss of the entire capital stock, or \$17,650,000, of which the Government owned \$16,000,000; second, the loss of over half its total deposits; third, the tying up in frozen loans of all its assets over and above its losses; and, fourth, hopeless insolvency.

In a word, having hugged their toy and kissed it and rocked it to sleep, the children had indeed banged it with a club, ripped it open and finally pulled the stuffing out.

Their only embarrassment, indeed, had lain in the question of finding sufficient pretexts for laying hands upon the vaults.

But, fertile ever in curious expedients, they had hit upon the plan of sending forth emissaries into highways and byways to drum up more borrowers.

Said one of these who had penetrated to the manager of a business concern in a distant province:

"I represent the National Bank, and we wonder if you wouldn't like to borrow some money from us."

"I don't need anything," replied the manager, as one might speak to a wandering lightning-rod man or book agent.

"But listen—we could let you have 500,000 pesos just as well as not," urged the applicant.

Twenty million dollars were thus loaned by the bank to private individuals wherewith to do business on taxpayers' money in competition with men working on normal business lines and financing themselves.

And it is an interesting fact that \$20,000,000 is, according to the figures of the American Chamber of Commerce, just about half the amount annually taken from the pockets of the people of the United States and presented as a free gift to the people of the Philippine Islands in the form of remission of customs dues on Philippine goods entering American markets.

The failure of the Filipino appears to lie in his character. To him liberty, self control, and honor are words with entirely different meaning from that given by an Anglo-Saxon—and we judge him by our own standards.

The charm of the book lies in the writer's way of letting her subjects tell the story. Frankly the book is as interesting as if it had a plot. Vivid pictures have been drawn,—told in the words of those who dwell in "The Isles of Fear."

The book is recommended to those who have been to the Philippines, to those who expect to visit the Philippines, and to the citizen who would know more about 10,000,000 people adopted, temporarily at least, by our country.—W. W. I.

How to Read History. By W. Watkin Davies, with a Special Section on American History by Prof. Edwin W. Pahlow. Geo. H. Doran Co., New York. 1924. 4¾" x 7". 259 pp. \$1.25.

A study of such a book as this of Mr. Davies, stimulates one to read history, if merely to test his suggestions and the merit of his selections. It thus admirably accomplishes its purpose. The book may be likened to a handy review of historical literature: it certainly avoids being a mere catalogue of selected works. From a copious introduction giving an insight into the methods to be followed in study, Mr. Davies outlines general courses of reading or, rather, discusses groups of books on Ancient History, Classical Antiquity, The Middle Ages, The Renaissance and the Reformation, Reformation to Revolution, The French Revolution and Napoleon, and the Nineteenth Century, followed by a similar outline covering American History, written by Professor Edwin W. Pahlow. The recommended works have been carefully selected and from them one can form a well-balanced opinion of the affairs of the period studied.—C. D. Y. O.

Analytic Geometry and Calculus. By Crenshaw and Killebrew. P. Blakiston's Son & Co. 1925. 6½" x 9½". 222 pp. \$2.75.

"Analytic Geometry and Calculus" by Crenshaw and Killebrew, professors at Alabama Polytechnic Institute, is written as a text for engineering students at that school, where the work in mathematics is given in two years, presumably the first two years of the course.

The book is elementary, but is clear and well supplied with examples, and should afford the average student a sufficient foundation in analytical geometry and differential and integral calculus to pursue his study of engineering subjects.

Chapter I would be best left out. It is called a review of algebra and trigonometry, but is exceedingly scanty, taking up only five pages of the book. The

student who has had algebra and trigonometry could and would refer to the text he studied; for the student who has not had these subjects, the chapter is altogether insufficient. There is no value in it as a reference.

The succeeding chapters take up briefly and in an elementary manner, but concisely and in a way probably best suited for the average college student: points and distances; the straight line; the circle; the equations of the conics in the simplest standard form; polar coordinates; transformation of coordinates; and conics with axes parallel to the coordinate axes (the last including a brief discussion of the general equation of the conic with axes parallel to the coordinate axes). No discussion of the general equation of the second degree is given, the only reference to the xy term being in a brief paragraph on rotation of rectangular axes. Polar coordinates are only touched on and the authors have purposely left out discussion of tangents and normals until after the methods of differential calculus are taken up.

The text on differential calculus commences in the usual way, the opening chapter on differentiation consisting of thirty-one pages. This is followed by a short chapter on the application of the derivative to mechanics. Following this, tangents and normals are taken up, then a brief chapter on some properties of the conics. This should be more complete or the chapter should be left out. The final chapters in differential calculus are on maxima and minima and on differentials.

There is nothing new in the presentation of integral calculus, the chapters in order being on formal integration, the definite integral, and applications of the integral calculus, mostly to problems of physics and mechanics.

The subjects of the final chapter on series are often taken up in algebra or in differential calculus. Tests for convergency are lightly touched on and the method of expansion by Maclaurin's Series is given. Computation of logarithms by the logarithmic series and the calculation of p_i by Maclaurin's Series are taken up briefly.

A complete set of answers is given and the book should be useful within its province. The print is clear, the figures good, and the volume, in 222 pages including tables and an index, is of convenient form and size—R. V. C.

Guide to London and the British Isles. By Alwyn Pryde. 1924. Forster Groom & Co., Ltd., London. 365 pp. Ill. Maps. 2s.

To one wholly unfamiliar with foreign travel this little paper-covered volume would be the perfect travelling companion; to one who has travelled it is a reminder of many things he enjoyed and many more things he had not known about but never would leave out of a second trip abroad.

Besides, being a complete guide as to one's itinerary, it contains delicate suggestions as to the attitude one should assume when visiting a country not one's own. With its quotations from British authors, its historical allusions, and its informative advertisements it might do away with the need of any other literature while crossing the ocean. Surely one could not require more of a mere guide book.—L. M. C.