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MAJOR ROBERT ARTHUR, C. A. C. . . . . . *Editor and Manager*
FIRST LIEUT. JAMES L. WHELCHEL, C. A. C. . . . . *Assistant Editor*

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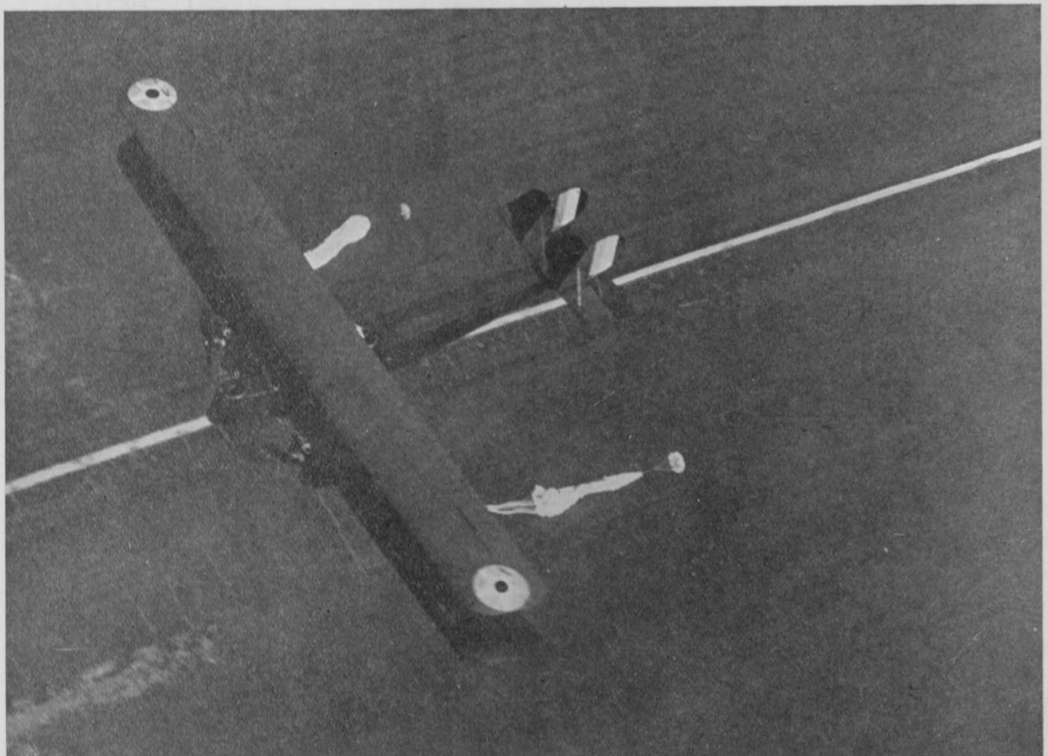

Official Photograph, U. S. Army Air Corps

Two Men "Pull Off" From a Martin Bomber

THE COAST ARTILLERY JOURNAL

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Present Status and Development of the Coast Artillery

A LECTURE

By MAJOR GENERAL ANDREW HERO, JR., *Chief of Coast Artillery*

THE Coast Artillery Corps is a combatant branch and a supply branch as far as concerns controlled submarine mines. It has always been charged with duties and missions pertaining to coast defense. Prior to the World War the Coast Artillery Corps devoted itself almost entirely to the problem of harbor defense (including overseas naval bases) by fixed armament and its accessories. But coast defense is a broader term. It includes dispositions and operations having for their object the repulse of a hostile attack upon any portion of the seacoast of Continental United States, the Panama Canal, or the insular possessions, or upon naval vessels or merchant shipping in or off harbors or in coastwise sea lanes. So our conception of coast defense has broadened from the original idea of the fixed harbor fort with a limited and practically an independent mission, to a defense of the entire coast line, a defense of overseas naval bases, and a defense of important bays and coastwise lines of water communications such as between Boston and New York. The mission of the Coast Artillery has been broadened to cover cooperation with the Navy, with the Air Corps, and with all arms of the land forces in this general mission.

The missions and composition of the Coast Artillery Corps are given in G. O. 22, W. D., 1927, as follows:

> *Coast Artillery.*—The missions of the Coast Artillery are the attack of enemy naval vessels by means of artillery fire and submarine mines and the attack of enemy aircraft by means of fire from the ground.
>
> The Coast Artillery includes all harbor-defense artillery, all railway artillery, all antiaircraft artillery, and all tractor-drawn artillery especially assigned for coast-defense purposes. In addi-

tion it includes such sound-ranging units as are needed in performance of its missions.

As a branch it consists at present of 16 white regiments and 2 Filipino Scout regiments of harbor-defense artillery, 3 regiments of tractor-drawn artillery, 2 of railway artillery, and 6 of antiaircraft artillery; 2 sound-ranging batteries; 7 mine planters, 1 cable ship, and the submarine mine defenses: In all, approximately 1000 officers and 11,800 men.

Harbor defense includes dispositions and operations for the defense of limited portions of the seacoast, ordinarily confined to important harbors or naval bases. Such dispositions include fixed armament, mobile armament, controlled submarine mines, and the troops and accessories for their employment and local defense, the whole constituting a harbor defense command. The armament consists of 3-inch, 6-inch, and 12-inch guns, and 12-inch mortars; 14-inch guns in some of the later defenses, and 16-inch guns in the more important ones. Antiaircraft defense is provided for by 3-inch fixed antiaircraft guns (105-mm. in the case of Panama), although mobile guns would also be used. Observing stations, command posts, lines of communication, fortification power plants, searchlights for the illumination of targets at night, are all provided. In other words, the harbor defense is a carefully prepared, highly organized defensive position capable of instant and efficient action when properly manned. Supplementary to the fixed defenses are the railway artillery and tractor-drawn artillery. The strategic advantages of high-power mobile artillery were always appreciated, but the practical application was not developed until this armament was actually provided as a war measure during the World War. The railway artillery, 7-inch, 8-inch, 12-inch, and 14-inch guns, and 12-inch mortars, is used to reinforce the fixed batteries in harbor defense, to defend harbors not fortified, and to cooperate with other mobile forces in beach defense. The tractor-drawn artillery, 155-mm. G. P. F., is similarly used to reinforce railway artillery in its mission, and to undertake a similar mission in areas where trackage does not permit the use of railway artillery.

Against landing operations the Coast Artillery mission is to cause enemy warships to be at such a distance that they cannot support the landing with their secondary armament (rapid-fire guns), and to increase the distance the landing parties and impedimenta must be brought from transport to shore. This simplifies the beach defense and increases the time for concentration of mobile forces. The Coast Artillery has the added mission of protection, by antiaircraft fire, against enemy attack or bombardment planes during the landing. The actual repulse of a landing in force or the defeat of a force once landed is the function of the field forces.

PRESENT STATUS

Prior to the development of the airplane and air forces the missions of the harbor defenses were stated as follows:

a. To prevent the bombardment of the city and harbor defended;

b. To afford safe refuge for our own shipping both naval and commercial;

c. To hold an enemy blockading fleet at such a range as to enable our own fleet to debouch and take up battle formation without being subjected to effective fire during the process;

d. To defend naval bases both at home and in our overseas possessions so as to free the fleet for its true mission—securing control of such sea areas as might be necessary.

e. To assist other land forces in preventing an enemy from obtaining a base for the invasion of our territory.

The development of the air forces has added to the harbor defense the mission of defending itself, by antiaircraft fire, against air attack, and of cooperating with other antiaircraft units, and with any Air Service units available, in the defense of the city and harbor against such attack.

Of these missions the first (*a*) is no longer capable of being met with certainty. The great range of modern naval artillery enables a fleet to bombard some of our coast cities from a range beyond that of most of our fixed guns and at a range where, while hitting a city is certain, hitting a ship is improbable. Should an enemy be willing to wear out the guns of his main battery and use his major-caliber ammunition in the general bombardment of a city he can (by selecting favorable weather conditions) do it with probably small risk. Except for a chance hit on some valuable utility it may be said that such use of warships by the enemy would be to our advantage, by reason of the deterioration of the enemy guns by erosion. Also the bombardment from the air of a city cannot be provided against with certainty by antiaircraft fire alone. Given sufficient well-trained and well-equipped antiaircraft artillery, the effective bombardment of any special utility such as a navy yard can be prevented, but for the defense against air bombardment of a general locality an air force is necessary.

The remaining missions of the harbor defenses are as practicable of fulfillment today as ever, provided always the Coast Artillery has the necessary antiaircraft units to protect itself against bombardment from the air. With reference to mission *c*, it may be noted that here the initiative lies with the defense which selects the time for the debouchment and should assemble the necessary planes to gain temporary control of the air in that area.

The question of continuing the fixed fortifications arose when our modern fleet was being constructed. Many thought the fleet could defend the coast. Reflection showed that this was unwise. The cost of the floating defense was greater than that of the harbor fort, the fleet could not be tied down to coast defense and still fulfill its own mission, and none could be certain that the ships would not be elsewhere when needed. The same question has arisen as to the Air Corps and can be answered in the same way; in addition, it should be said that we have the guns and forts (some needing additions in armament and installations, but the bulk of the cost already paid).

As to the ability of the fixed battery to continue in operation, the point has been raised that many can be bombarded by warships from ranges beyond that of the installed armament. This is true in places, but at our more important harbors—positions where it is possible the gain might offset the disadvantages of using the warships' main batteries and ammunition for such a purpose—long-range guns (fixed or railway) are either provided or included in approved plans. To the idea of such attack by an enemy's navy has now been added bombardment from aircraft using both high explosive and gas bombs. The target afforded by even the largest battery is still a small one. The percentage of hits from the altitude at which antiaircraft guns would cause the attackers to fly, and the limited number of bombs carried would require a very large attacking force to give reasonable hope of silencing even a few of the batteries. And it may be said that no element of our land forces can be so easily and effectively protected against gas as can the fixed battery. The electrical installation permits the use of fans to dissipate non-persistent gas; gas-proof rooms and clothing can be provided; and tanks of gas neutralizing mixtures (on the principle of the fire extinguisher) can be installed for use against persistent gases. All in all, there seems no reason why our fixed forts today cannot be fought as was Fort Sumter during the Civil War, when that fort was battered for nearly four years by land and naval guns but the garrison still held the Union fleet from Charleston Harbor. It is purely a matter of determination and leadership. And for both forms of attack the harbor fort would, in most cases, have the support of appropriate naval and aircraft units—especially if the position defended were important. Like other arms of the service, the Coast Artillery in modern war does not expect to operate alone.

Development. The project for seacoast defenses, originally prepared by the Endicott Board and revised by the Taft Board, has been constantly under revision by the Board of Review, War Department, and later by the War Department General Staff, so that plans and designs have kept pace with modern conditions and inventions. Installations have seriously lagged behind the projects approved, due to lack of funds, but today our main harbor defenses have been strengthened by a total of eleven 16-inch guns, four 16-inch howitzers and thirty 12-inch long-range guns (30,000 yards) already installed, and work has been started on another battery of 16-inch guns.

Our principal line of development work with respect to harbor-defense artillery is, at present, the means of fire control. Base lines have been extended until they will enable us to track the target accurately to the limiting horizon when visibility conditions permit. The installation of these long-range guns has necessitated new apparatus in stations and plotting rooms; for example, long-range depression position-finders, plotting boards, and mechanical devices for computing firing data. We have under test a mechanical computer that furnishes automatically firing data (elevation and azimuth) to all the guns of a battery. Submarine mines have been improved and increased in size, while mines that are expected to overcome the serious difficulties of high tides and swift currents have recently been successfully tested and have been approved for certain localities.

Antiaircraft Artillery

As indicated, the Coast Artillery is also charged with the development and use of antiaircraft artillery and antiaircraft machine guns. This is a most important part of the mission of the Corps, and one in which we are most actively engaged and interested at the present time. Coast Artillery personnel was charged with the antiaircraft service during the War, and in the allocation of duties after the War antiaircraft artillery was assigned to the Coast Artillery. In a way it seemed logical to do so, as its personnel has always specialized in artillery fire at moving targets. Yet the problems of coast defense and naval gunnery are not so complicated in their nature as those of antiaircraft gunnery, where the 3-dimensional motion and the very high speed of the target, together with the short time available in action, put the problem in a class altogether different from ordinary "flat" gunnery. The triangles to be solved are spherical triangles.

When the Coast Artillery took over the antiaircraft defense, there was not very much known about it or its possibilities. The guns were like other field guns, mounted on high-angle carriages. Their initial velocity was low, the position-finding system was rather cumbersome, and an average of about eight seconds "dead time" had to be allowed for telephoning, for setting scales on the guns, cutting fuze, loading, and firing. A target which flies one hundred miles an hour is moving fifty yards a second. At a range where the time of flight of the old war-time guns was twelve seconds, the target would fly in that time of flight plus the eight seconds of dead time, a distance of one thousand yards; that is, the future position of the target is one thousand yards ahead of the present position. Such a long prediction gives opportunity for errors; and even though no error of prediction were made, the plane in that length of time might, and probably would, change course.

We began concentrating on needed improvements. We have received considerable amounts of money from Congress for the development of this work, which has proceeded by leaps and bounds, and as a result antiaircraft armament and its accessories has made very remarkable improvement since the War.

Today the armament consists of:

3-inch AA gun, fixed mount, length 50 calibers, muzzle velocity 2600 f. s. (used), maximum vertical range 10,400 yards, horizontal 15,400 yards.

3-inch AA gun, mobile mount, with practically the same characteristics.

105-mm. AA gun, fixed mount, for certain specific localities, M. V. 2800 f. s., vertical range 14,000 yards, horizontal 20,000 yards.

37-mm. automatic gun, fixed and mobile mounts.

.50-caliber and .30-caliber machine guns, tripod mounts, and multiple mounts.

The position-finding system has been simplified and data transmission systems devised and applied; and for night firing we have the improved sound locators and 60-inch searchlights.

Until tests have clearly shown what the materiel is capable of, we do not consider that we have anything at all except a hope. The 37-mm. automatic and the 105-mm. gun are in the hope stage, and we confine our planning at present to the 3-inch gun, the .50-caliber machine gun, and the 60-inch searchlight. The framework of the antiaircraft defense is the 3-inch battery, with its fire-control apparatus, consisting of computer, height finder, and a very fine B. C. telescope, all located close together under the eye of the battery commander. We know the capabilities of this battery, and we feel that such a battery is capable of executing its mission quite efficiently. At 5000 yards horizontal range and at an altitude of 4000 yards it is thoroughly reliable. Directly overhead, there is a dead cone which, at 4000 yards altitude, is 330 yards in radius for the fixed gun and about 660 yards for the mobile gun; for this reason the batteries are placed so that one will cover another, or not more than 5000 yards apart.

Without entering into technical details, I will give concisely the results that have been secured by improvements made in guns, mounts, and position-finding and data-transmission systems. Taking the results of fire after the War when using the same war materiel, we had an average "dead time" of eight seconds, an accuracy of 4½% of hits, and a rate of fire of eleven shots per gun per minute. At the present time we have reduced the dead time to 1½ seconds; the accuracy of fire is 9.15% of hits, and the rate of fire is now 22 shots per gun per minute. The present battery has four guns instead of two, as formerly. So that we have doubled the accuracy, doubled the rate of fire per gun, and doubled the number of guns.

The antiaircraft defense of forces in the field is an *area* defense, as distinguished from the defense of particular points or activities. The corps regiment consists of a gun-battalion of three batteries, each of four 3-inch guns; a machine-gun battalion, four batteries of twelve guns each; and a battery of twelve 60-inch searchlights. The lights are organized in three platoons, one of which always operates with a gun battery, normally the same one.

The regiment furnishes the antiaircraft component of a corps and extends its defense up into the rear portions of the divisional areas, to about 4000 yards from the leading elements—up to about the zone of the corps artillery. This gives the guns (but not the machine guns) a reach out to or beyond the front line. These regiments are backed up by the army antiaircraft regiments, which push up into the rear area of the corps and cover railheads, airdromes, and important ammunition dumps.

These batteries have the mobility of cargo trucks. The occupation of a position is about the same as other light batteries; one hour is a good allowance of time from arrival of the trucks near the position until the battery is ready to fire.

In the Zone of the Interior, or in the Communications Zone, protection is contemplated for only those places and activities which are of real importance to the success of operations. In the forward areas, there is a double band of batteries across the front; the defense is an area defense. In the rear areas, the vital point itself is protected.

For protection of troops on the march, the Chief of Coast Artillery has recommended the inclusion in the division of a small antiaircraft machine-gun battalion. The War Department has deferred decision pending the development by troops of the other arms of methods and formations by which they can protect themselves. The recommendation of the Chief of Coast Artillery was made in the belief that professional antiaircraft artillerymen will be more effective per man employed or yard of road-space than will those whose primary mission is ground combat, and also in the belief that only by the use of fire-control apparatus and special mounts can machine guns be directed successfully against low-flying aircraft. No one outside the Coast Artillery Corps should have to create special units or special weapons expressly for antiaircraft purposes. Therefore, we are proceeding in the belief that there will be authorized a small divisional machine-gun battalion.

The duty of this battalion would be to cover the field and service trains of the division while in movement and to go into position at the end of movement to cover the bivouac or the forward combat zone, whichever is the end of the march. In action, the machine-gun platoons would be located within about 1700 yards of the front line, in staggered formation across the division front, the platoons about 1500 yards apart.

In the corps regiment, the twelve machine-gun platoons are placed so as to checkerboard the area where there are so many large, conspicuous, and important activities, such as tank parks, distributing points of ammunition and rations, and the bivouacs of many heavy trains. The .50-caliber antiaircraft machine gun has an effective horizontal range of 1500 yards and, unless the area to be covered is too great, the platoons are placed not farther apart than that.

The conception of the machine-gun defense in the area of the division or of the corps is that a series of machine-gun nets are formed, onto which the low-flying plane will stumble unavoidably, because it is impossible to tell where they are; and no matter in what direction he may fly, two or more such machine-gun nests will be encountered.

At present we are able to fire about 1600 rounds a minute from the 4-gun platoon, with an average accuracy up to 1500 yards of approximately 1%. We are on the threshold of radical improvement in antiaircraft machine-gun fire.

For protection of motorized and animal-drawn trains on the march, we must provide for opening fire within about ten to fifteen seconds of first warning. The speed of the low-flying plane may be taken as 125 miles per hour for purposes of arranging the defense; at this speed a mile is covered in about 29 seconds. From the best information obtainable at present, the low-flying plane may be expected to reach a column within eighteen to twenty seconds after it is first heard. As our equipment stands at present, we can fire without computed data, from machine guns on tripods in trucks. Such fire is limited in accuracy beyond a range of 500 to 700 yards. We can fire effectively up to that range, controlling the fire by tracers. That is not range enough; so a request has been made on the Ordnance Department to develop a trailer carriage for the 4-gun multiple mount. The truck which tows the trailer can carry the computer, the height finder, the crew, and extra ammunition. One or two men on the trailer can ensure readiness to fire within the ten seconds which has been laid down as the limit of warning we should expect.

Joint Army and Navy Exercises and Battle Practice

One of the principal items in a proper defense of our harbors in a national emergency is the detailed cooperation between the Navy and the Army, including their air forces. During the past few years a limited amount of training in joint cooperation has been held and has demonstrated the desirability of making this training more general. Since the World War and previous to 1927 there had been no opportunity for the Coast Artillery to hold a battle practice as a feature of its annual training. During the past year there was instituted a program embodying minor joint Army and Navy exercises and Coast Artillery battle practices in the following harbor defenses: Long Island Sound, San Francisco, Chesapeake Bay, Philippine Islands, Hawaii, and Panama Canal Zone. Part of this program has been completed and both the joint exercises and the battle practices have been very successful. The latter particularly has enabled much needed training being given to a large number of officers in exercising fire control and fire direction of a number of batteries firing at the same time.

Joint exercises with the Navy have permitted training in how best to obtain close cooperation in matters relative to the proper defense of our important harbors. It had been hoped that during these exercises, problems involving joint cooperation between the Coast Artillery, Air Corps, and the Navy, could be worked out but due to unavoidable situations it has not been practical in all cases for the Air Corps to participate. The Air Corps has in each instance furnished observation planes for observing fire for all of the battle practices. It is hoped that during future exercises, programs of training can be so arranged as to permit of this much-needed joint training.

By concentrating in one harbor defense all Coast Artillery troops in the corps area it has been possible to give, in addition to the training in higher command previously mentioned, an opportunity to man a large number of batteries normally out of service. This is of particular value at this time, as, due to the great reduction in personnel, it is difficult to maintain the material in the harbor defenses in a proper condition for service. In fact, the materiel situation is becoming a critical one. This equipment is emplaced and War Department policies require that it be maintained in a condition of use at the outbreak of war. Only when armament and fire-control installations are manned and operated at daily drill can incipient deterioration be promptly noted and corrected. When fire-control installations are not used, the personnel in charge can hardly locate all difficulties that develop from non-use. The holding of joint exercises and battle practices has enabled the determination of the true conditions in respect to materiel and of bringing it up to service standards. By changing the location of these exercises and battle practices in the United States to different harbor defenses each year, much good can be done towards keeping the fortifications up to required standard.

There is need at this time for problems to be worked out in the field involving the joint action of the Army and Navy in the defense of a sector or subsector of our seacoast. All forces of the Army, including the Air Corps, should be employed and by this I mean Infantry troops with supporting Field Artillery should be placed in position in accordance with the definite war plans for the defense of the sector; the assistance of the Navy and Marine Corps, including Naval air force, should be obtained in making landing along the beach as well as demonstrations against fortifications. At the present time there is a lack of definite regulations as to the details of just how all arms would function in a situation such as this. The coordinating of the Naval District Forces (patrol boats, radio communications, etc.) with the harbor defense forces and the Air Corps in repelling a naval attack and the employment of all forces in resisting a landing on our coast will afford many interesting and as yet unsolved problems.

There has been a lack of complete instruction in the General Service Schools or at the War College in the details of problems of this nature. As a consequence the staffs of our corps areas are, generally speaking, not familiar with initiating and conducting such exercises.

It must be borne in mind when considering this subject, that the basic war policy of this country has been one of defense. It is therefore of particular importance that our front line defense, *i. e.*, that of the water's edge, be properly prepared and coordinated amongst all parties concerned.

Antiaircraft With Troops in the Field

After studying the limitations of the old antiaircraft materiel and watching the development of the new materiel during the past two years I am positively convinced that this artillery (guns, machine guns, and searchlights) can do much more towards the protection of combat troops than now contemplated by training regulations. At the time of the writing of much of the present regulations there was a feeling on the part of a great many that the effectiveness of any antiaircraft weapon was very limited and would probably continue to be. It is now apparent that the technique of the arm has been developed to a point where it can effectively perform missions in connection with a broader tactical use, especially in accompanying troops on the march and furnishing protection for combat elements at all times. The technique of the arm can meet the demands of tactics.

The antiaircraft can furnish security for ground troops at all times, except that when troops are on the march the protection will be concentrated on protecting their field and service trains and to covering defiles, such as bridges. In combat or in camp or bivouac, the protection is adequate; it may be counted on to take a heavy toll of casualties from hostile planes.

Combat troops of all arms should be trained to use their own weapons for protection against aircraft; but they should not need to add to their organizations special units or special weapons for the purpose. Fewer men and less materiel will be required by antiaircraft troops than would be needed to accomplish the same end by the use of troops whose primary mission lies elsewhere.

In this connection, if it is a fact as has been claimed, that combat troops far in rear will be forced by aircraft to march at night or across country in order to gain protection from aircraft, it seems to me that we are in a bad way; I do not believe that such a situation exists. The answer to the threat of the airplane is a vigorous development of the antiaircraft artillery and the maximum tactical use of the weapons developed. The Commandant, The General Service Schools, has recommended the inclusion of a machine-gun unit in the Division; my office has more than once made this recommendation; and I believe that serious consideration should be given this important subject.

I wish we could always remember that our antiaircraft artillery is aimed at *hostile* aircraft, not at our own airplanes; that it is designed to be the helpmate of the Air Corps; and that the more effective it is, the more help it will render our own planes which should be free to take advantage of their mobility, radius of action, and speed in their most effective role—the offensive. The relationship between the antiaircraft artillery and the Air Corps is closely analogous to that of the harbor defenses and the Navy. We are now working in the closest cooperation with the Air Corps, just as with the Navy, and as each year goes by, and understanding of each other's problems improves, our relations become more closely harmonious.

Spotting for Antiaircraft Artillery

By CAPT. LOUIS H. THOMPSON, C. A. C.

THE writer has felt for a long time that some means of rapidly and accurately determining range or altitude deviations for antiaircraft artillery fire is highly desirable, and during the past year has devised a spotting instrument for this purpose which proved very satisfactory in target practice.

In using a flank spotter it has heretofore been necessary for the battery commander to estimate the average slant range from his flank spotter to the target during a group of shots in order to convert the observed deviations in mils into yards. For a battery commander with a great deal of experience this method gives fair results, but for the National Guard officer and others with only limited opportunities for firing it is not satisfactory. In getting data for analysis of practice the system must necessarily be more accurate and is consequently more laborious since the accurate determination of slant range from the observer for each shot involves quite a number of steps, and the position of the target for each shot or at frequent intervals must be plotted.

Adjustment of fire from range deviations will ordinarily be more accurate than from altitude deviations as determined from the telemeter. This is due to the large probable error of the telemeter and also to the fact that part of the altitude deviations so determined may be due to a deviation in vertical deflection. If the altitude correction is determined from a horizontal range deviation, then both the altitude and vertical deflection may be corrected at the same time with negligible error.

A device for reading range deviations directly in yards was constructed with very little trouble from one of the speed computers now in service. The observing grill was replaced with a vertical grid with the vertical wires spaced to the same scale as the altitude scale of the speed computer. There should be one horizontal wire across the grid at the same height that the center of grill normally occupies to establish the line of sight of the observer. If this vertical grid is set so that it is parallel to the plane of fire (by setting azimuths from the battery with the instrument oriented) and the altitude scale is set for the proper altitude of the target above the observer, range deviations in yards can be read when the observer's line of sight through the peep hole on T-bar and center of grid is on target. Changing the azimuth of the grid every 100 mils would be accurate enough, as it is apparent that small changes in azimuth would have no appreciable effect, especially when

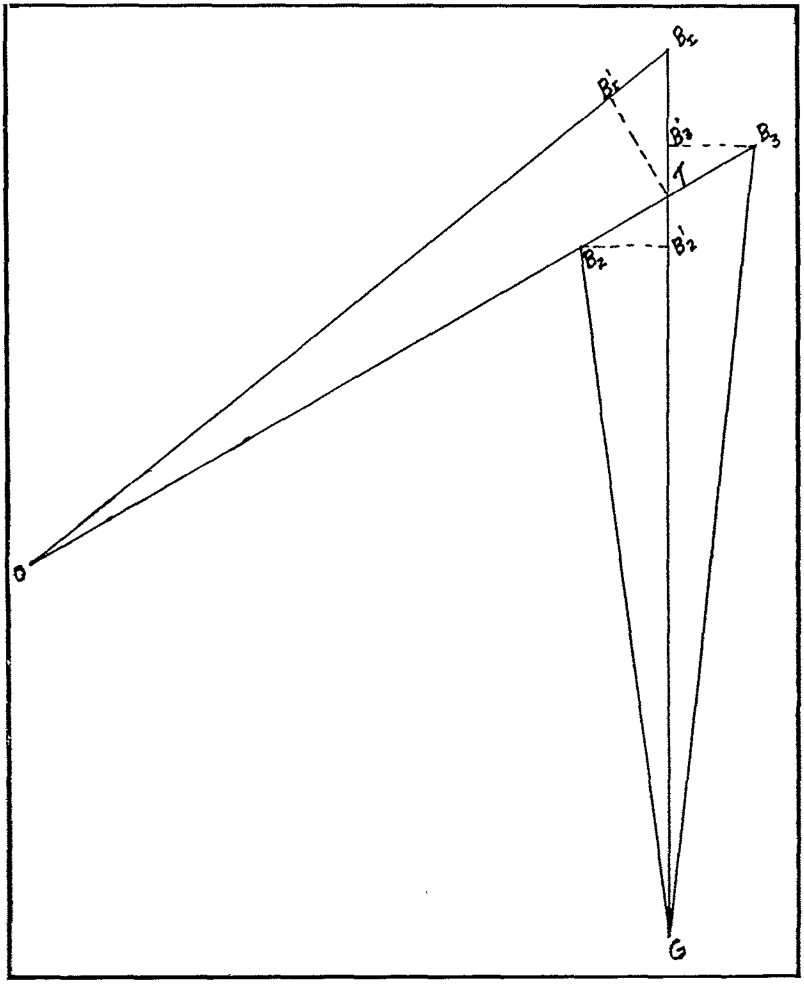

Fig. 1

the G-T-O angle (Gun-Target-Observer) is near ninety degrees. If the spotter is at B″ the assistant spotter may obtain the altitude directly from B″ reader, who overhears it as called off by the B′ reader, or in case the telemeter is used it may be obtained direct from the battery.

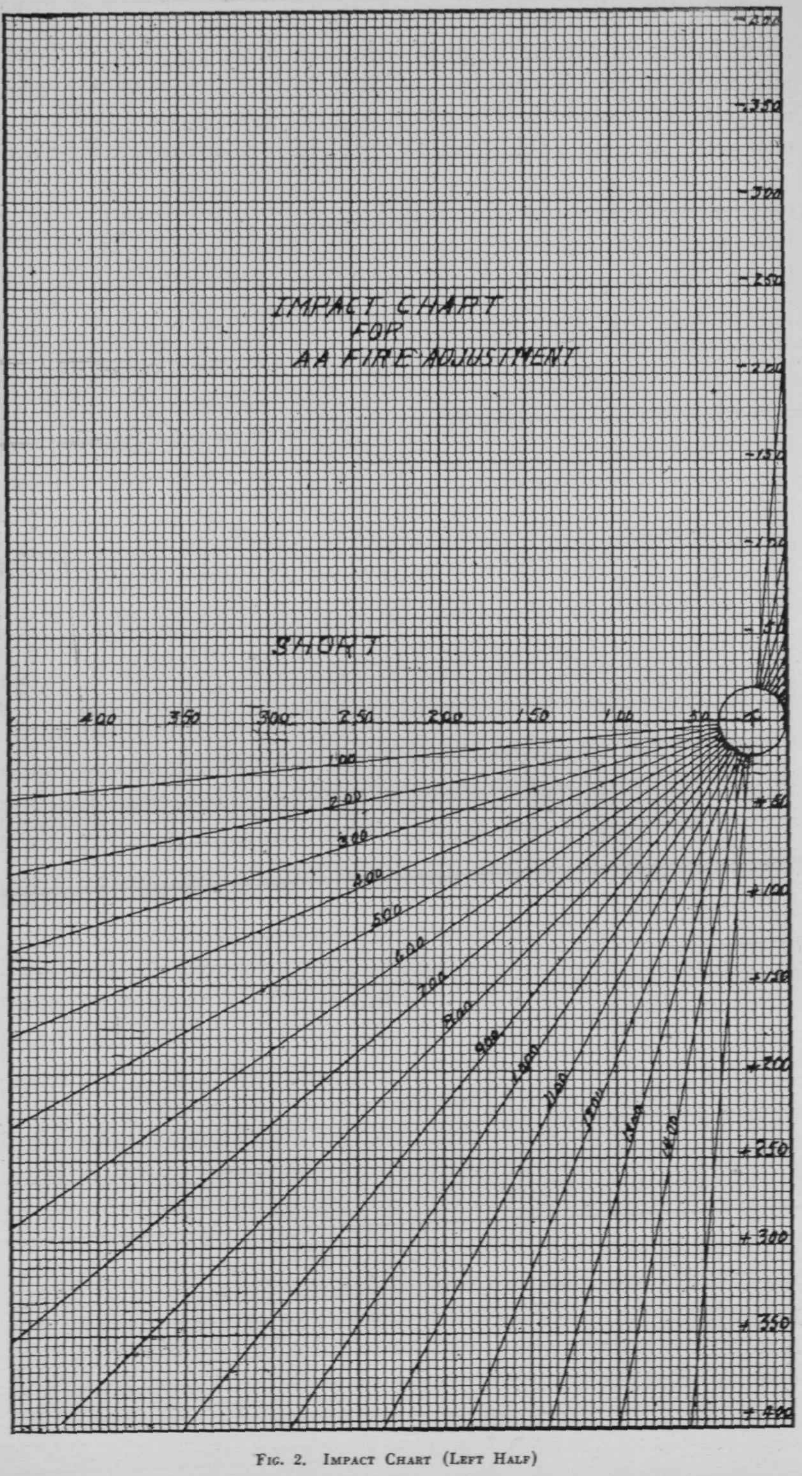

Fig. 2. Impact Chart (Left Half)

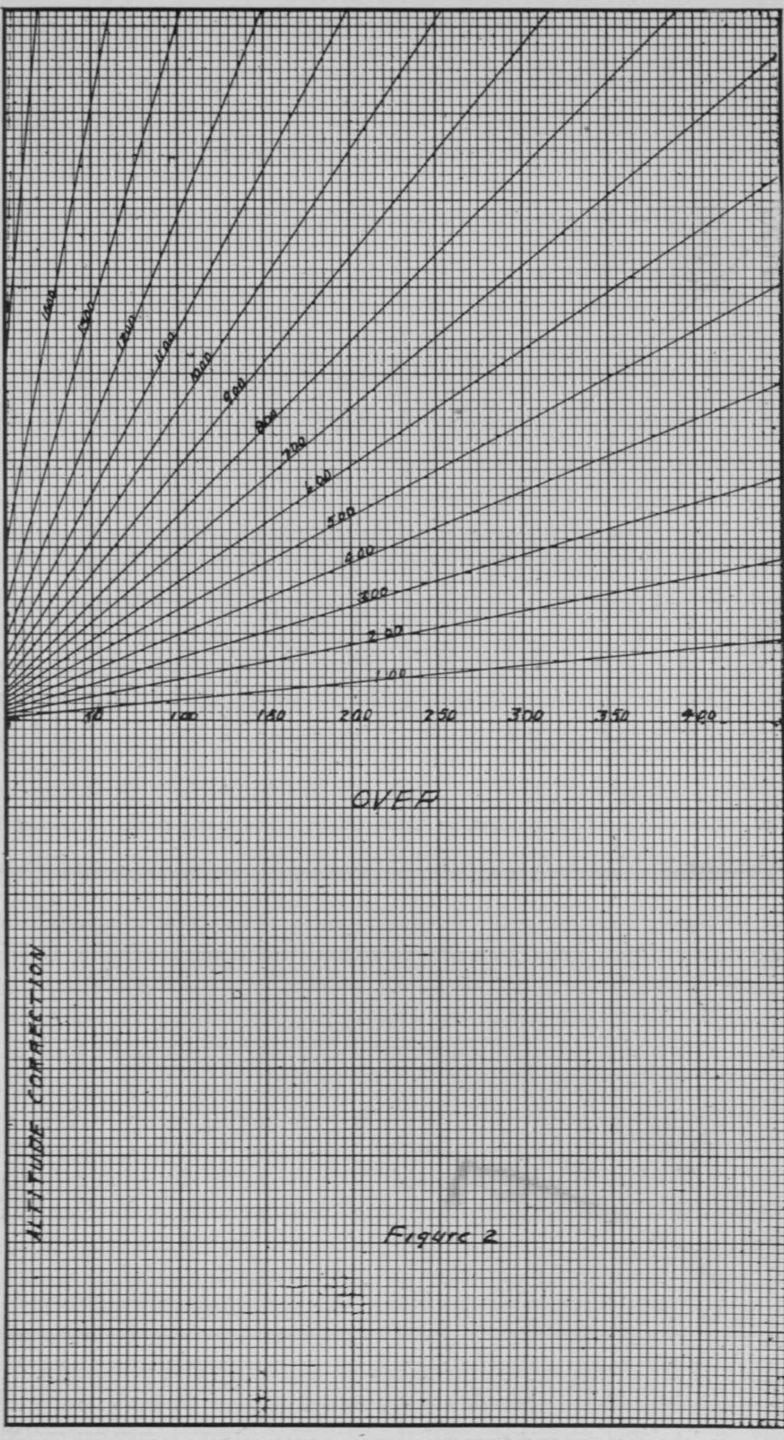

Fig. 2. Impact Chart (Right Half)

Changes of less than 100 yards in altitude are hardly justified. The theory involved will be apparent to any one familiar with the speed computer, as it is evident that the distance from the eye of the observer to the center of the grid is always proportional to the slant range from the observer, and therefore the range deviations can be read directly in yards.

A study of Figure 1 will show the reason for keeping the grid parallel to the plane of fire. Assume a burst to be at B_1. Now if the observer has his grid perpendicular to his line of sight the deviation he will report will be TB'_1, which is obviously incorrect, whereas if the grid is parallel to the plane of fire the deviation reported will be TB_1, which is the correct deviation. The same error will occur when the deviations are being read in mils and converted into yards unless it is corrected for. Now if we assume the burst to be at B_2 the observer will report zero deviation regardless of the position of the grid, but the true deviation is TB'_2. The value of this error is equal to the lateral deviation in yards multiplied by the cotangent of the G-T-O angle. The value of this angle is shown on the instrument as the angle between the vertical plane of the grid and the vertical plane containing the line of sight. In order to measure this angle a small azimuth circle may be fastened to the collar just above the angle of approach dial with the zero on this circle in the same vertical plane as the zero on the azimuth circle of the altitude staff. An azimuth circle graduated in cotangents should be pasted on the angle of approach dial. A pointer pivoted around the collar slides over the azimuth circle fastened to the collar and points to the cotangent scale. If the assistant spotter keeps this pointer set with the reading edge at the proper azimuth on the azimuth circle the recorder may read cotangents of the G-T-O angle directly under the pointer on the cotangent scale. If the gun is on the right of the observer we may call a lateral deviation to the right plus and one to the left minus. The cotangent will be plus for a G-T-O angle less than ninety degrees and minus for an angle greater than ninety degrees. If we now multiply the lateral deviation in yards (with proper sign) by the cotangent of the G-T-O angle (with proper sign) and add this value algebraically to the range deviation reported we will get the correct range deviation. This may be made clear by a study of Figure 1. The spotting recorder will record the value of the cotangent opposite the deviation he is then recording as often as there is an appreciable change in its value. No special effort need be made to synchronize this reading with a particular shot number since the value of the cotangent will be changing gradually and uniformly. It is not contemplated that this correction to range deviation reported shall be made for adjustment purposes, since an adjustment will usually be made on the center of impact of a number of shots and the probability is that the error caused by rights will be neutralized by the lefts so that the deviation of the center of impact as reported will be approximately correct. This refinement is hardly justified even for analysis of practice where the G-T-O angle is anywhere near ninety degrees, unless the construction of the instrument is more accurate than the one made from the speed computer, and would certainly not be

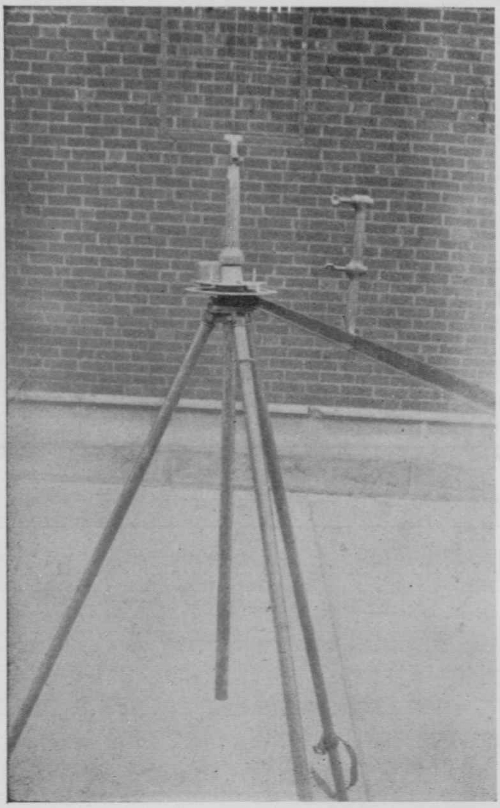

Fig. 3

practicable in any case where the data obtained is to be used for adjustment purposes only.

With three or more of these instruments properly spaced, spotting for all-round fire may be had. The speed of operation is limited only by the time it takes the spotter to call off the deviation. The instant the burst occurs he can see just what the deviation is, and if he is equipped with a headset can give his reading directly to the battery. It was found better in target practice for the spotting recorder to record deviations for a course and send only the center of impact to the battery or to call off the deviations after the course was over.

In order to use range deviations in adjusting fire it is necessary to convert the range deviation into an altitude correction. A convenient chart for doing this is shown in Figure 2. It will be noted that the position of the target is placed not at zero on the horizontal scale but twenty yards to the left. This is done in order to place the center of impact short of the target without resorting to mental arithmetic. For

FIG. 4

an angular height of forty-five degrees this will put the center of impact short by an amount equal to 20/cos 45, which is approximately thirty yards. The operation of the impact chart will be apparent from its construction. The range officer places a pin at the average deviation and the average angular height of the group of shots and reads the altitude correction directly from the chart.

While the instrument described was designed wholly for antiaircraft fire, the same principle may be used for a spotting instrument for any type of artillery fire. This principle is to keep the distance from the eye of the observer to his grid proportional to the range from the observer to the target and to keep the grid parallel to the plane of fire. While no greater accuracy will result than is obtained by methods now in use, the speed of operation will be greatly increased. Deviations could be in the plotting room within two or three seconds after the shot bursts. Many of the personnel errors that result with complicated spotting systems could be eliminated.

The Army Correspondence Courses

By Major S. E. Wolfe, C. A. C.

FOR the purpose of discussion, I have divided this subject into five parts:

a. Purpose.
b. Development.
c. Present scope.
d. Methods.
e. Results and possible application.

a. Purpose.—With the passage of the National Defense Act, as amended in 1920, the War Department was handed a third component of the Army, the Organized Reserves. While the constituents of this component had played a great part during the World War, its peace time functions had not yet been determined. The enormous expense of active training was well known through the experience of the National Guard. It was soon realized that some activity was necessary besides simply obtaining an officer's consent to be enrolled. The logical solution was the creation of the Army Correspondence School.

One of the most frequent questions of the newly commissioned reserve officer is, "Well, what do I do now?" The correspondence courses give an immediate answer to that question. They would serve a useful purpose if they did no more. But they are intended to do more. They serve to provide officers of the civilian army with an opportunity for systematic instruction which will fit them for active duty with the branch of service and in the grade in which they are commissioned. They also prepare them for promotion to the higher grades.

b. Development.—It is believed that prior to the World War, very little attention had been given to instruction by correspondence, by the army, with the result that the War Department found itself confronted with the problem old in application in civil institutions but somewhat of a stranger to the personnel now assigned the task of fulfilling a rather comprehensive purpose. Like many other tasks the army is asked to perform, it had neither the money wherewith to obtain the necessary equipment nor the time to study the problem properly before it had to be put into effect. The natural result was that the first courses prepared were in many cases not entirely suited to the method of instruction and did not satisfactorily fulfill the purpose to be accomplished.

The judgment of the Scotchman that his first sample of corn on the cob was "na sa' bad," after eating cob and all, is very like that of many Reserve officers who had sampled the Army Correspondence Courses. Thousands had enrolled without knowing what they were getting into. The judgment of many of them was that "The courses were pretty good"—with reservations concerning the repetition or continuance of their experience. However, with time and experience the courses were improved. Again the state of unpreparedness necessitated putting the school into operation by various groups of officers from the various branches of the service. Logically, they did not all follow the same scope in their preparation. This defect was remedied by the convening of a Board of Officers at Washington, April 15, 1924, for the purpose of preparing programs of instruction for all Branch Correspondence Courses and for a Command and General Staff Correspondence Course. The report of this board, approved July 10, 1924, contains a detailed description of each course and subcourse, showing the subjects included and their arrangement, and indicates the approximate time to be allotted to each subcourse.

Prior to this time there were two tendencies that had been manifested in the preparation of the courses: first, the tendency to believe that everything from the most minute details of mechanical contrivance to the broadest principles of strategy should be included; second, the tendency to believe that so little could be done by correspondence that instruction given must of necessity be little more than play and pretense. If there is one idea that had never been entertained by the War Department, it is the idea that soldiers and officers can be made by correspondence study alone. The War Department does not intend that the Correspondence Courses shall teach a student officer all that he needs to know when in active service; it does expect the courses to familiarize the student with the theory of his branch and to give him much information that can be given without access to complicated material and without practice in actual handling of men. It expects the courses to make much more rapid and effective the training given at summer camps. They are intended to supplement, not to take the place of outdoor training and of personal instruction given by conferences. Nor are the correspondence courses intended to make unnecessary the M-Day instruction contemplated by mobilization plans. These plans provide for practically all reserve officers a period of thirty days intensive training. The Correspondence Courses are intended to help make this training more rapidly profitable. They are intended to prepare for Federal Service.

c. Present Scope.—The Army educational system provides, for regular army officers, an extensive system of schools, grading upward through West Point, the Special Service Schools of the branches, the Command and Staff School at Fort Leavenworth, until it reaches the heights and spacious outlook of the Army War College. In addition, Regular Army officers are subjected to the enlightening influences of the basic course as an absolute and unescapable requirement at the start of their professional life. Thereafter, other troop-school courses spur them on to greater knowledge. Lectures and conferences are a routine part of their Army service. Most important of all, perhaps, they continually receive the educational benefits of actually doing one job after another incident to the maintenance and training of the three components of the Army. If the National Guard and Reserve could receive the same instruction as the Regular Army, through the same agencies and with the same persistence, the problems of their training would be merged with those of training the Regular Army. But soldiering is not the main business in the life of these two components. Substitutes and expedients must be adopted to prepare them for their military jobs. Hence result the fifteen-day periods of active service in a camp or in a Regular Army organization as a substitute for the year in, year out, service of the military professionals. Also occasional, or even fairly regular, lectures and conferences at Reserve headquarters as a substitute for every day living in the atmosphere of military lecture, conference and troop school. As substitutes for courses which Regular Army officers pursue, short special courses for National Guard and Reserves are given to a very few officers at the general and special service schools. The commissioned officer in time of war must function efficiently regardless of his prewar status. The correspondence courses must therefore fill in the gaps so that all may attain a status of proficiency when called into active service, whether Regular, National Guard, or Reserve. The courses are designed to parallel the Basic Course in troop school, the Company Officers' and Advanced Courses in the Special Service Schools, and the Command and General Staff Course at Fort Leavenworth.

The following are the programs for instruction in the Coast Artillery Courses of the Correspondence School:

Subcourse No.	*Basic Officers' Course Subject*	*Approx. Hours*
1.	Basic Gunnery (except antiaircraft)	50
2.	Basic A. A. Gunnery and Position Finding	40
3.	Weapons and Materiel	50

Subcourse No.	Subject	Approx. Hours
4.	Fire Control and Position Finding for Seacoast Artillery	40
5.	Powders, Projectiles, Primers and Fuzes	20
6.	Organization	18
7.	Military Law	20
8.	Mobilization and Administration	30
9.	Military Hygiene and First Aid	10
10.	Map Reading and Sketching	30
	Battery Officers' Course	
1.	The Battery Command	45
2.	Orientation	35
3.	Applied Gunnery (except Antiaircraft)	50
3*a*.	Applied Antiaircraft Gunnery	40
4.	Gasoline Engines and Motor Transport	38
5.	Field Fortifications for Artillery	25
6.	Artillery Tactics: Seacoast Artillery in Seacoast Defense	45
7.	Artillery Tactics: Antiaircraft Artillery	45
	Advanced Course	
1.	Combat Orders and the Solution of Map Problems	25
2.	The Harbor Defense Command	45
2*a*.	The Antiaircraft Command	45
3.	Tactics and Technique of Seacoast Artillery	45
3*a*.	Tactics and Technique of A. A. Artillery	45
4.	The Associated Arms	30
	Command and General Staff Course	
1.	Tactics and Technique of the Separate Branches	90
2.	Tactical Principles and Decisions	80
3.	Troop Leading, Command, Staff, and Logistics	80
4.	Tactical Principles and Decisions	80
5.	Tactical Principles and Decisions	70
6.	Special Subjects	100

This last course covers the subjects that an officer requires for promotion to, and duty in, the grades of lieutenant colonel and colonel in the combatant arms. Officers of the Reserve and National Guard and civilians who satisfactorily complete the Command and General Staff Course will be listed by the War Department for special consideration in time of national emergency in connection with command and staff assignments or for special additional preparation for such assignment. The course covers 47 map problems and requires approximately 500 hours of study to complete.

d. Methods.—In general, correspondence courses are conducted by Corps Area Correspondence Schools. The War Department has installed a special section in the Adjutant General's Office to handle all correspondence course work. However, the regulations provide that the Corps Area Correspondence Schools shall be a part of the Corps Area Headquarters but Corps Area Commanders may assign the conduct of specific courses to any camp, post, or station under their jurisdiction, which will then constitute branches of the Corps Area Correspondence School. In each special service school there has been organized a "Department of Correspondence Courses" which is charged with the continuing mission of preparing and revising the Branch Correspondence Courses, including the texts, exercises, examinations, and solutions. These courses as well as the one prepared by the Commandant of the Command and General Staff School are finally approved by the office of the Adjutant General. Upon their approval by the War Department they, together with the texts therefor, are reproduced or procured by the office of the Adjutant General and are distributed by that office to the Corps Area or Department Commanders.

The instructors of the Corps Area Correspondence Schools are usually the Regular Army officers on duty with Reserve and National Guard Units, though the Corps Area Commander may detail other regular officers.

While the Correspondence Courses were originally inaugurated to fill a need for the Organized Reserves, there was no objection to including others. The regulations, subject to the limitations noted herein, now provide the following as eligible for enrollment in the Branch Courses:

(1) Personnel of the Officers' and Enlisted Reserve Corps.

(2) Personnel of the National Guard.

(3) Qualified civilians, when facilities therefore are adequate.

(4) Regular Army officers on detached duty of a nature such as to preclude their receiving instruction through other agencies.

(5) Enlisted men in the Regular Army who desire to qualify for commissions in the Officers' Reserve Corps.

The following are eligible for enrollment in the Command and General Staff Correspondence Courses:

(1) All officers who have satisfactorily completed their Branch Advanced Course.

(2) Officers of the Reserve Corps and of the National Guard who are on the General Staff Eligible List.

(3) In the discretion of the Corps Area Commander, officers of the Reserve Corps and of the National Guard above the grade of Major, and civilians who served during the World War as commissioned officers in the grade above that of Major.

(4) Officers of the Regular Army, on recommendation of the Chief of Branch or Corps Area Commander.

Candidates eligible for enrollment, desiring to take one of the courses, make application for enrollment on AGO form No. 145. This application is submitted in duplicate, through military channels. Corps Area Commanders prescribe the approving authority for such applications. They vary from Division headquarters of Reserve Units to designated officials agreed upon by the Corps Area Commander and State officials in the case of National Guard officers. In the event of disapproval by any of these agencies, the application must be forwarded to Corps Area Headquarters for final action.

The approving authority designates the instructor who will conduct the course for the particular student. The approved application is sent to the instructor, who fills out form No. 147, AGO (Lesson Assignment Card) and, in duplicate, form No. 148, AGO (Progress Card), one copy for the use of the instructor and the other for transmission to the School conducting the course.

The original of the application, together with the introduction to the subcourse, Lesson Assignment Sheets Nos. 1 and 2, such texts as are supplied gratuitously, and necessary franked envelopes are sent to the student. Two lessons are supplied so that the student has one lesson on hand at all times while the other is in the hands of the instructor for correction. In some cases I found it necessary to send as many as four lessons at once because I found the student would work two or three lessons apparently in one evening and mail all of them at once. I endeavored to keep them well supplied and except in a very few cases this was not very difficult. There is no limitation on how fast a student may work. A minimum of two hours a week is recommended but enrollment will be continued unless a student fails to complete at least one lesson in a quarter, except the period of summer camps, July to September, or approximately 39 hours of work during the full instructor year. In any case Corps Area Commanders notify the students prior to the cancellation of their enrollment. Having been dropped for not completing the prescribed amount of work does not prevent a student from being enrolled again upon application.

Upon the completion of all the lessons of a subcourse, an examination is given covering the course. Each question is given a relative value based upon a total of 100 per cent. Provision is made to decrease this value on the final examination in case lesson assignment sheets may have been given a certain weight, previously made known to the student, during the course. The total value for the course must total 100 per cent. The examination shows clearly the aids which the student is authorized to use in preparing his paper. He is required to submit a certificate with his paper to the effect that he has received no unauthorized assistance of any kind. The examinations are rated by examiners usually selected from amongst the instructors on duty with the school, but the instructor conducting the course is usually not designated to correct the papers of his own students. Seventy-five per cent is the passing grade for each subcourse. In case of a rating less than 75%, two other examiners are designated to rate the paper. The final rating is the average of the three. In case of failure in a subcourse the student is required to repeat the subcourse or such parts of it as the instructor may deem advisable. He is then granted a re-examination. Upon successfully completing a subcourse the student is furnished a certificate of "Satisfactory Completion of the Subcourse," and automatically enrolled in the next subcourse. Upon completion of all the subcourses in a course, if his rating for all the subcourses is 75% or better he is given a certificate of satisfactory completion for the whole course. In each case of satisfactory completion of a course or subcourse he passes on to the next higher course unless he has been previously exempted from taking that course or subcourse or in case the time remaining in the school year is insufficient to complete the course or subcourse.

The student's work as recorded on form No. 148, AGO (Progress Card), is given due credit by examining boards in granting exemptions from professional examination, in accordance with paragraph 6*g* (2), AR 140-21.

e. Results and Possible Application.—On January 1, 1928, approximately 34,000 Reserve officers were taking Correspondence Courses. Approximately 6000 National Guard officers and enlisted men were taking these courses. On the same date there were approximately 4300 CAC reserve officers, of whom approximately 2200 were taking these courses.

The following plate shows the activity in Correspondence Courses for the years following their revision according to the various branches:

Branch	*Percentage enrolled (Reserve Officers only)*			*Percentage of those enrolled completing subcourses*	
	1924	*1925*	*1926*	*1925*	*1926*
AGD	35.33	38.67	30.73	9.9	18.9
AS	14.00	15.72	14.08	6.4	20.3
Cav.	20.65	23.18	20.47	7.8	20.3
Chap.	14.32	20.73	18.60	6.5	18.0
CWS	35.89	45.60	42.67	11.3	31.2
CAC	21.02	28.23	27.02	4.0	15.9
Engr.	21.14	22.72	20.55	7.5	21.5
FA	14.24	19.57	21.16	5.0	20.4

F. D.	35.51	33.45	27.54	11.2	23.5
Inf.	15.00	17.75	16.87	7.7	18.5
JAG	33.42	31.35	29.00	8.5	28.4
Med.	16.89	13.90	13.15	6.9	19.6
M. I.	49.06	52.89	37.35	4.7	28.7
Ord.	11.63	16.12	14.40	3.5	21.8
QMC	16.72	20.00	19.53	6.1	22.4
SC	24.22	20.76	19.32	7.4	19.7
MP	1.22	4.05	5.65	13.3	0
CGS				7.2	19.0

In addition to the instruction given the National Guard and Reserve Officers, it is believed that the use of Correspondence Course methods, including possibly the use of several specially prepared subcourses, will serve both to standardize the instruction in Officers' Troop Schools and to minimize the amount of time required by the instructors and the students in connection with these schools. In this case the courses would be prepared with a special view to adapting them to the requirements of group instruction.

In this connection the use of a special course in Probability of Fire and Fire Adjustment, as an annual refresher course for all officers, would probably be found advantageous. In view of the probable limited opportunities in the future for field and battery officers to serve with troops, and in view of the various kinds of materiel manned by the Coast Artillery Corps, it is believed that the use of certain of the subcourses of the Battery Officers' and of the Advanced Courses would serve to afford to many field and battery officers an opportunity to broaden their professional knowledge, especially of these types of artillery with which they may not have had a recent opportunity to serve. In the preparation of many of these subcourses special effort has been made to adapt them to the requirements of instruction of officers of the Regular Army.

Conclusion

Even though not universally accepted by the personnel for which it was created, it is believed that the number of officers and enlisted men availing themselves of the benefits to be derived thereform, shows they are fulfilling, as far as practicable and within the money allowance granted by Congress, the need for which the courses were established. The military game is essentially team play demanding perfection in the gregarious arts more than the attainments of the personal type acquired by the golfer or language student. Individual study of an Army Correspondence Course as a means of military instruction bears much the same relation to effective military training as study of Work or Whitehead bears to the playing of a good game of bridge. In time, play and practice alone, without a word from the masters, will make a good bridge player; perfect book knowledge of the best treatises, without practice with others at the bridge table, will merely develop a social pest. But a judicious combination of treatise reading with real play will with marvelous speed make a bridge player out of the most unlightened person. The Army Correspondence courses are in the same way of most value when taken in conjunction with or as preparation for unit and active duty training.

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MAXIM XX

It may be laid down as a principle, that the line of operations should not be abandoned; but it is one of the most skillful maneuvers in war, to know how to change it, when circumstances authorize or render this necessary. An army which changes skillfully its line of operation deceives the enemy, who becomes ignorant where to look for its rear, or upon what weak points it is assailable.—Napoeon's Maxims of War.

The World's Situation in Coal and Iron

By 1ST LIEUT. WILLIAM J. McCARTHY, C. A. C.

THE study of the world's situation on coal and iron is worthy of our utmost attention, as the entire progress of the human race and modern civilization is dependent on these two minerals. If man had not learned the use of coal and how to get pure iron from the ore, we would still be dependent on pack burros and galleys for transportation on land and sea. The invention of the steam engine by James Watt in 1769 has revolutionized human industry and caused civilization to advance in leaps and bounds. We little realize how dependent we are on coal and iron until we stop to consider what the effect would be if the source of supply was suddenly cut off. In such an event, the entire industrial life of the nation would stagnate, millions of people would be thrown out of work, the rich would become poor and the poor more destitute.

COAL

Let us consider the world with respect to the supply of coal. If the store of coal was confined to one nation, perhaps the history of the world would be different. However, the coal deposits are scattered throughout the world and it is due to this fact that we are continually hearing of trade alliances, economic treaties, and so forth.

Coal has been called the sun of the industrial world—it being to the industrial world what the sun is to the natural world—the great source of light and heat with their attendant benefits. Coal is the principal generator of steam. It is also used in the manufacture of iron. Hence it may be said that the three most powerful physical agents of human progress, *i. e.*, coal, iron, and steam have their source and basis in the coal mine.

Dr. Bergius, a German chemist, is said to have achieved the industrial chemists' dream, namely the liquefaction of coal. This is accomplished by subjecting coal to the influence of hydrogen under heat and pressure, saturating the hydrocarbons in the coal, converting them and, it is claimed, a portion of the fixed carbon into liquid coal. At present this process has not proceeded farther than the laboratory stage, but should it prove a commercial possibility, the results on industry can but be conjectured. In such an event the present enormous piles of coal dust common to all coal mines and representing waste would begin to take on a decided commercial value. One mine alone in the Pennsylvania field is said to have a pile of 2,000,000 tons.

The rather broad division of coal into anthracite, bituminous coal, semi-bituminous or lignite, and brown coals has, in recent years, proved insufficient for commercial needs and this division was felt to be so inadequate that the International Geological Congress held in Toronto in 1913 adopted a scheme of classification whereby coal was graded into four main classes and three sub-classes, letters being used instead of names. It also made an estimate of the coal resources of the world in which they took as a minimum thickness of seams to depths of 4000 feet from the surface as one foot and for depths from 4000 feet to 6000 feet as two feet. It is considered that working coal at depths greater than 5000 feet makes the cost of production so high that the coal can not be got to the surface economically. In fact, the British Royal Commission on Coal Supplies in 1905 set the lowest level that coal could be produced advantageously at 4000 feet. So far as I have been able to learn, this level has not been exceeded, but has led to numerous methods of mining by which a greater percentage of coal can be extracted from a given area. The average extraction, however, rarely exceeds 45 per cent although some of the mines—notably the Walker Colliery on the Tyne—was extracting about 54 per cent in 1795.

As a result of this survey it was discovered that the American Continent had in available resources, 5,105,528 in millions of metric tons. Of this enormous figure there is in North America 5,073,431,000,000 tons and in South America 32,097,000,000 tons.

Individually the United States leads all nations, her coal resources being far in excess of the total similar resources of the Entire British Empire. Such being the case, let us consider for a moment her coal regions.

There are four great carboniferous coal fields in the United States. The first and by far the greatest is called the Appalachian or Alleghany region. This vast field extending in a northeast and southwest direction is 875 miles long and varies in width from 30 to 180 miles. It passes through seven states, beginning in western Pennsylvania, embraces the eastern part of Ohio, touches the western corner of Maryland, covers nearly all of West Virginia and the eastern part of Kentucky, crosses the state of Tennessee, and ends in central Alabama. Oddly enough, the greatest anthracite region in the world located in northeastern Pennsylvania is a detached island-like field on the borders of this great coal region.

The second coal field occupies the central part of the state of Michigan. The field, while covering a large area, contains a poor grade of coal running in narrow seams.

The third coal field is a very extensive field covering two-thirds of the state of Illinois, the western part of Indiana and the western part of Kentucky. The best coal in this area comes from Indiana which, while not equal in quality to Pennsylvania coal, is a very good grade and can be produced cheaply.

The fourth coal field is equally as large and comprises the southwestern part of the state of Iowa along the Des Moines River. It spreads southward taking in northern Missouri and the eastern part of Kansas. It touches southeastern Nebraska, passes through Oklahoma, western Arkansas and ends in northwestern Texas.

The Pacific states and Alaska have numerous deposits of sub-bituminous coal and lignite. The principal fields in Alaska are located along the Bering River and the Mantanuska area, the latter being near the government railroad. While coal, both anthracite and sub-bituminous, is plentiful in Alaska, very little has been produced due to the fact that the coal fields of the territory were closed from 1906 to 1913. The production from the date of their re-opening to 1925 was about 670,000 tons.

Based on the International Geological Congress estimates the coal resources of the world by continents are as follows in millions of metric tons.

Continent	*Anthracite, including dry steam coals*	*Bituminous coal*	*Sub-bituminous coals, lignites or brown coals*	*Total*
Europe	54,346	693,162	36,682	784,190
Asia	407,637	760,098	111,851	1,279,586
Africa	11,662	45,123	1,054	57,839
America	22,542	2,271,080	2,811,906	5,105,528
Oceania	659	133,481	36,270	170,410
Total	496,846	3,902,944	2,997,763	7,397,553

Mining experts are of the opinion that it is doubtful if it will be feasible to produce coal on a commercial basis at a greater depth than 5000 feet. Hence, it follows that the coal supply is not so much dependent on the exhaustion of the world's ultimate resources but on how long it will be possible to produce the better grades of coal cheaply. Europe is rapidly exhausting its readily available supply of coal and if this present rate of consumption is contined her fields will be entirely depleted long before Asia or America.

The United States produces about 5,000,000 long tons annually and at this rate of production has a coal supply that will last 2000 years.

Great Britain has resources to last about 600 years or 450 years if the 4000 foot depth level is maintained.

Germany, at her pre-war rate of production, had on hand a supply sufficient for 1000 years. However, the ceding of part of her Silesian coal field to Poland in 1922 and the loss of the Lorraine and the Saar fields to France in 1919 has greatly reduced this reserve and a fair estimate of the length of time it would last would be about from 600 to 750 years.

Belgium has on hand a sufficient supply for about 500 years.

France trails the other countries with a supply which will last about 400 years.

China, by her own rate of production, has a sufficient reserve for 2000 years. However, these resources would be exhausted in 70 years at the present rate of coal production in the United States.

Japan and Russia each have resources estimated to last between 1800 and 1900 years.

The world's ultimate supply, based on the United States rate of production will last for 3400 years. However, it is believed that at our rate of production, coal can only be produced advantageously for 1500 years. Nevertheless, with the increased use of oil as fuel, the indications are that the visible supply of coal will last much longer.

The coal derivitives or coal tar products are secured from the bituminous coals which comprise about half the world resources of coal. Some of the most important of these derivitives are benzine, toluene, dyes, phenol, paraffin, sulphate of ammonia, tar, pitch and crude oil, and some medicines.

Iron

The situation in regard to iron is one that is of vital importance to all nations in this mechanical age. Modern ordnance would be unknown if iron had not been discovered.

The exact date of the discovery of iron is buried in the dust of centuries. The Bible speaks of Tubal-Cain as an "articifer in iron and brass" at some time about 4000 B. C. Iron was not discovered until long after copper and gold were in general use. This is due to the fact that iron never occurs "native". The Chinese made use of iron several centuries before the Christian era, but the Assyrians are credited with being the first people to use the metal on an extensive scale.

The United States is the world's leading producer of iron ore, producing about 33 per cent of the annual output. The next single large producer is the Lorraine field in France, producing about 25 per cent. The remainder of the output is scattered throughout the world.

Iron deposits are distributed throughout the United States. The largest of these is the Lake Superior district, including the famous Messaba Range, which produces about 85 per cent of the nation's total production. This district comprises the states of Michigan, Minnesota, and Wisconsin and was discovered on September 19, 1844, by William A. Burt, a United States Surveyor, at a point near what is now Negaunee, Michigan. Mr. Burt, who was surveying the copper field, noticed that the needle of his solar compass became unreliable and in looking for the magnetic source of the needle disturbance discovered iron ore just beneath the surface of the earth. Beyond noting in his field book that there was an iron deposit close at hand which would cause variations in the needle, neither Mr. Burt nor any of his party realized that the greatest iron ore field in the world had been discovered.

The latest statistics show the following amounts of iron ore are present in the world:

Iron Ore (Unmined) in Millions of Tons

America	9,855
France	4,369
Great Britain	2,254
Sweden	1,548
Germany	1,374
Russia	1,032
Spain	610
Norway	367
Austria Hungary	284
Luxemburg	270
Asia	260
Africa	225
Australia	136
Greece	100
Total World	23,000

Let us for a moment look on the capacity of the leading nations to produce pig iron. The world is estimated as being able to produce 108,050,000 tons of pig iron, of which about one-half is credited to the United States. This is four times the capacity of Great Britain and three times that of Germany. The following is a capitulation of the capacity of the leading nations to produce pig iron:

Nation	*Capacity (Gross Tons)*
United States	49,000,000
Canada	1,300,000
Mexico	300,000
Total North America	50,600,000
Great Britain	12,000,000
Germany	15,000,000
France	11,000,000
Belgium	3,500,000
Luxemburg	2,800,000
Holland	150,000
Russia	3,500,000
Poland	1,200,000
Rumania	350,000
Austria	600,000
Hungary	400,000
Czechoslovakia	1,300,000
Italy	600,000
Spain	600,000
Sweden	1,000,000
Europe (Total)	54,000,000
Japan	1,200,000
China	950,000
India	800,000
Australia	500,000
Total World	108,050,000 Gross Tons

Just what does this somewhat dry recital of figures mean to us in a military sense. In order to present its meaning more clearly it is necessary to return to the Peace Conference at Versailles and glance over the handiwork of its members.

Responsive to national aspirations, the delegates redrew the map of Europe and presented the world with six new nations and added one thousand miles of frontier to be patrolled and protected. Most of this protection took the form of high tariffs behind which each nation imbued with a sense of commercial patriotism sought to work out its economic salvation in grand isolation from its neighbors. These nations patterned their tariff laws after the United States but soon discovered that to make the isolation idea workable, a nation must have within its own borders or in its dependencies all the essential raw materials of human progress. Unfortunately no nation of Continental Europe possessed these resources. The result was industrial stagnation and strangulation from competition for world markets.

Mr. Hugo Stinnes, the German steel magnate, was one of the first to realize the situation and was largely instrumental in forming the

Continental Steel Cartel composed of Belgium, French, and German iron masters. This combine was formed from grim necessity and not from any promptings of brotherly love. The situation resolved itself into the following factors:

1. The industrial heart of Europe lies in the area occupied by Eastern France, Western Germany, Belgium, and Luxemburg.
2. In this area are located the mines that produce twenty-five per cent of the world's iron ore and about as much coal as the British Isles. Here too are the great blast furnaces and rolling mills.
3. Yet, due to national boundaries, these mills, mines, and furnaces were not producing efficiently. Prior to the war, France depended on Germany for coal and coke, Germany depended on France for iron ore, Belgium and Luxemburg depended on both these nations for part of their raw supplies. France was in a bad way after she acquired the mines of Alsace-Lorraine in that she was more dependent than ever on Germany for coke and coal.

The net result of the situation was an acute depression in the steel industry.

Then came the Cartel which parcelled the world's market to the members according to their capacity to supply the demand. This was so successful in 1926 that Germany ranks second in the production of the world's pig iron. This led to other combines in the European industrial field.

I have tried to show that the United States has been kindly dealt with by Providence in the way of resources of coal and iron and by virture of this fact can dominate the world. I have also shown that the nations of Europe do not intend to leave us in control without a struggle. The question is, will we accept the challenge?

MAXIM LV

A general should never put his army into cantonments when he has the means of collecting supplies of forage and provisions, and of thus providing for the wants of the soldier in the field.
—*Napoleon's* Maxims of War.

EDITORIAL

A British View of Promotion By Selection

THE British Army is confronted by much the same prospect of stagnation in promotion that is attracting so much attention in our own Army. At such a time it is probable that the British system, which allows a certain amount of promotion by selection, possesses some advantages. Where promotion is slow, an officer will be called upon, while passing through any grade, to perform a number of duties of widely differing character, and it will therefore be possible to determine with some fair degree of accuracy the outstanding officers of all-round ability in the grade. With accelerated promotion, however, the difficulty of comparison of capacities of officers increases with the degree of acceleration and it is probable that promotion by selection would not operate altogether satisfactorily at such a time.

That there is some objection to promotion by selection in the British Army is indicated by a letter, recently published in *The Times*, in which the author pleads for a return to the system of promotion by seniority. In this connection, *The Army, Navy and Air Force Gazette* makes editorial comment advocating for the near future an increase in the number of promotions by selection. The following historical development of promotion in the British Army, together with the editorial opinion, is extracted from the *Army, Navy and Air Force Gazette.*

> In the early days of the standing army there was no great complication in the selection of officers. There were no qualifying examinations and the powers of nomination were held in the main by the great nobles, who were given Royal permission to raise regiments for the King's service. The profession of arms had in those days little of permanence. Officers might serve through one war, and then, when peace came be cast out into a world which gave little welcome to unemployed warriors. Merit was recognized as merit always will be recognized, and the great men came to the top. Success is one of the indications of greatness, and it may be argued that there have never been "mute, inglorious Miltons." As the Army advanced into history the system of purchase came into authorized existence, and in days of peace officers with ample private means could, if not deficient in elementary intelligence, make rapid progress to field rank. In war the system was tempered by the right of an officer to succeed the next senior, if that senior

were killed in action. It was an unreasonable system but, like many things which are unreasonable, it worked. The best men still came to the front, even though others remained subalterns until old age. There was a case of a Brevet Lieutenant-Colonel in the 55th Regiment who had acquired merit in the field, and was commanding his regiment in China in face of the enemy. He was superseded by a young Captain from England who had the necessary funds. And there were other similar cases.

The purchase system vanished and was superseded by promotion by seniority, which has remained the general principle until these present times. With a proper age limit for retirement the system has worked well. It has reduced the risk of advancement by favour, and it has given to each officer a reasonable chance of rising in his profession. There were, and are, many loopholes by which the more clever and more efficient may accelerate their progress, and there is, moreover, a definite system by which merit receives special recognition. In the Royal Air Force it is assumed that all promotion is ruled by merit though an examination of the promotion lists would make it appear that seniority and merit are joined in an odd alliance.

In accordance with the newer method of selection, the traditional regimental system has been affected in some degree. In the Cavalry of the Line, according to a writer in *The Times*, 18.5 per cent. of the vacancies in the commands of battalions in the last four years have been filled by the appointment of officers of other units. In the Infantry of the Line the percentage of such appointments is 22. Of those commanding infantry battalions 41 are Staff College graduates and 85 are not. At the present time the prevailing method of promotion is satisfactory, as there is still a large number of officers with war experience and with proved qualifications. As the days pass this number declines rapidly, and if peace is to continue there will be a stay in promotion similar to that which followed the Napoleonic Wars. There is a difficulty in finding a sufficient number of suitable candidates for commissions and the consequent increase in the number of promotions from the ranks is raising the average age of the subaltern class. Thus in the not distant future it will be necessary—if the Army is to retain its efficiency—to increase greatly the number of promotions by selection. With that increase there should also be an increase in the pensions available for the lower commissioned ranks or there should be a careful system of "axing" with appropriate compensation. The belief that progress is slow in the Army is a principal cause of the present lack of candidates for commissions. The Army today is efficient and its officers are well educated. It will maintain that efficiency if there is at all times a proper recognition of merit.

PROFESSIONAL NOTES

Coat of Arms of the Harbor Defenses of Galveston

Shield: Gules, a ship under sail, in chief a mullet, both *argent.*

Crest: On a wreath of the colors a cotton boll proper.

The State of Texas is shown by the lone star, the shipping from the port of Galveston by the ship and by the crest, cotton being the principal product of the port.

Record of Correspondence Courses Completed

The following tabulation of accomplishments in the Army Correspondence Schools, 1927-1928 has been announced:

ACCOMPLISHMENTS OF THE COAST ARTILLERY SECTION,
ARMY CORRESPONDENCE SCHOOL,
ARRANGED BY CORPS AREAS

1	*2*	*3*	*4*	*5*
Corps Areas	*CA Reserve officer strength (June 30, 1928)*	*Subcourses completed*	*Total hours credit*	*3÷2 %*
9th (1)	526	681	13,294	129.5
5th (2)	221	129	2,742	58.2
1st (3)	517	298	5,997	57.6
7th (4)	453	194	4,395	42.8
4th (5)	612	261	4,936	42.6
3rd (6)	660	246	5,975	37.3
2nd (7)	562	194	4,460	34.5
6th (8)	395	110	2,200	27.8
8th (9)	119	27	636	22.7

Tampa A-N Club Host

Tampa (*Special*).—Maj. Gen. Andrew Hero, Jr., Chief of Coast Artillery, U. S. A., and Brig. Gen. G. S. Simonds, Assistant Chief of Staff, War Plans Division of the War Department General Staff arrived from Washington October 21, and were speakers at the Army and Navy Club dinner at the Tampa Terrace Hotel. The dinner was served in the club rooms after a reception in the club library. Maj. P. G. Murphy, president of the club acted as toastmaster.

Gen. Hero delivered a brief address on the organization of the Coast Artillery; its equipment, duties and methods. He described in detail the functions of the railway artillery and the recent development in antiaircraft guns. He told of the advances made in the past three years by antiaircraft batteries with recently developed guns and that they could now fire three times as fast and average twice the percentage of hits. He declared the primary function of the Coast Artillery was to provide complete protection for the shore line of the country so that ships of the Navy and the airplanes of the Army and Navy could be released for attack away from our shores.

Gen. Simonds spoke of the duties of the War Plans Division of the General Staff in preparing for future defense and told of the great reliance placed on the National Guard and Reserve Officers. He was enthusiastic in his reports of the deep patriotism found everywhere among the men interested in national defense. Gen. Simonds recalled the day of 1918 before Amiens when he was Chief of Staff of the Second Corps and Gen. Blanding was in command of one of the brigades of the Corps. He said that they had not seen each other since that time, but that he was especially glad to come to Tampa and have the opportunity to testify before Gen. Blanding's fellow citizens to his fine attributes as a soldier and to the feeling in the Corps that he was always to be depended upon.

Maj. E. W. Niles, assistant to Gen. Hero, emphasized the reliance of the Regular Army on the citizen components.

A message from Congressman Drane was read. Maj. Gen. A. H. Blanding replied to the addresses by the visitors from the War Department. In addition to the guests, there were present Maj. Gen. Blanding, Col. J. W. Morris, Jr., Col. H. W. Hesterly, Capt. O. N. Bie, C. D. Brorein, Vice-President of the Tampa Board of Trade; Maj. J. C. Williams, Maj. T. B. Fersburg, Maj. P. G. Murphy, Capt. J. A. Waterman, Capt. S. M. Regar, Lt. C. R. Norris, Lt. F. R. Grem, Lt. E. M. Fabian and Lt. J. Lyles.—*Army and Navy Journal, October 27, 1928.*

Antiaircraft "Robots"

During the war and again and again since the war we have had proof that for whatever devilish instrument of destruction science can devise science can also invent a counterforce which tends to nullify the effectiveness of the first weapon. It was not long after the appearance of airplanes, tanks and poison gas that antidotes were being developed which in a large measure rendered them no more dangerous than the weapons of war which had preceded them.

One of the forecasts for the next war nevertheless remains a frightful prophecy, picturing fleets of airplanes bombarding defenseless cities with poison gas. How can science counteract the effect of the past year's development in aviation? There is a hint of one way in which this may be done in the report of the invention of a new "robot" gun, which computes and holds its own range through sound waves emanating from an airplane target.

We can imagine the development of such a gun until it afforded an almost perfect defense against airplane attacks. A city might be surrounded by a ring of antiaircraft weapons which would open fire with the approach of enemy planes, not only with their range determined by the sound waves from the attacking fleet but automatically fired by these waves. A protective barrage could be laid down—or perhaps we should say up—which would make it almost impossible for a plane to come near enough its target to drop its bombs with success.

If all this seems fantastic, it does, however, prove the futility of trying to foretell how the next war will be fought. We have and can have no idea of what weapons or what antidotes for these weapons military science may develop. And one thing further it would seem to indicate. As war becomes more and more complicated, necessitating such highly intricate machines for its weapons, it becomes more and more expensive. Its economic toll for victors and vanquished alike becomes that much heavier.

So in a sense the development of these engines of destruction and their defensive antidotes is all to the good. We may eventually come to a realization that no nation in this modern age can afford to go to war.—*New York Evening Post.*

Is War Popular?

There was a magazine article published some time ago entitled "Gentlemen Prefer Wars."

I never read the article, but I like the title.

Curiously enough men have grown eloquent depicting the horror of war, blood, confusion and waste. The play, *What Price Glory*, is in point.

But somehow or other war is always popular. In spite of all its drawbacks people go into it enthusiastically.

One latent reason, perhaps, is an economic one. They know they will be clothed, fed and taken care of when they are in the army. Nothing so frightens the ordinary man as the prospect of losing his job. He doesn't lose his job in the army if he behaves himself. As far as danger and death are concerned they are not very important in the minds of most men compared with economic security.

Another thing you find in war, in spite of all its alleged tyranny, is ideal democracy. Plutocrat and laborer fight side by side, share the same tent, and eat the same chow.

As far as death is concerned most men think less of it than we suppose. It is likely to come to anyone in peace and in war.

The soldier's health is looked after, their living is secure, and there is adventure aplenty.

When peace comes, trouble comes.

There is no unemployment in any country during a war. After the war, in peace, there were two millions unemployed in Great Britain and nearly six million in the United States.

The Comptroller of the Currency said that deflation in the United States of America had cost industry more than the war did. In 1921 trade was at its lowest for twenty years.

What's the trouble?

In war you have four things which peace has been unable to attain.

First, organization, complete and perfect.

Second, a unifying sentiment. Peace has never succeeded in making religion, or organized love, as strong as patriotism, which is, generally, organized hate.

Third, you have discipline. Everybody toes the mark. Everybody co-operates. If a man blats about personal liberty he is promptly shot.

Fourth, the uniform code is Honor. Men don't work for money, but for something better. There is no finer code of honor than among officers of the army. What would happen to us in peace if that held among office-holders?—*Washington Times.*

Mechanism and Defense

Such part of the American people as are interested in the efficiency of the nation's defense will welcome the news that the general staff of the army is convinced from observation and experiment that "tanks and war machines are here to stay." Consequently the staff will recommend the army be supplied in adequate quantity.

We think the conclusion and its corollary are beyond question, and we hope Congress will accept them and act upon them. If there is one result of the late war which stands out, it is the rapid development of motorization and of mechanical devices. The next great war will find the forces on both sides possessed of and employing all the resources of modern mechanism and applied science. Between fairly matched opponents morale will still be the decisive factor, but it will be aided by material of the most elaborate and formidable character. Disadvantages in this phase of armament will mean heavy sacrifices of life and possibly defeat.

It is a foremost responsibility of the agencies of our defense, the War Department and Congress, to insure and provide for alert progress in this new phase of preparedness. At the present moment our army is behind the procession. Although American inventiveness and mechanical genius are of the highest order, although civilian America leads the world in the development and use of mechanical devices for all purposes of peace, we lag in the application of our genius to the problems of military effectiveness. We can catch up. We can, we think, take the lead. It is our duty to our defenders of the future and to the nation to put our army in this respect in the front rank. Undue conservatism in the army and penny wisdom—pound foolishness in Congress should not prevail against this duty.—*Chicago Tribune.*

A Successful Encampment

The 243rd Regiment, C. A. C., perhaps had its greatest camp, during its tour of duty at Camp Wright, from July 15th to 29th. Looking back over the five years during which I have been with the regiment, a general and progressive improvement is noted year by year. The general atmosphere and tone of the camp is better. The fellows themselves seem to take it all more seriously each succeeding year. This progress is quite general, according to a report of the General Committee on Army and Naval Chaplains' visitations of the posts during the period of the National Guard and C. M. T. C. for the past few years.

Whatever judgment we may have as to the method, there is no question but that making the culture of religion a part of the regular training has had gratifying success and there is abundant testimony to the fact that it has given a higher tone to the whole spirit of the camps, varying of course, in the extent to which the commanding officer, and other officers have taken it seriously—the Army wants this religious influence. In most cases the Sunday morning worship is now required, and compulsory church attendance is no longer considered the unnecessary ordeal that it once was. A folder issued in the Third Corps Area explicitly stated that snickers of religion are not wanted.

This noting of general improvement in our camps year by year by no means reflects the work of the chaplains, but is largely due to more wisdom and sympathy on the part of the authorities.

The progressive improvement of the 243rd year by year has certainly been most gratifying to the commanding officer and to the whole personnel, and whatever the extent moral and religious influence have exerted on this improvement is due to the hearty cooperation of its colonel, officers, and men with their chaplain.—*The Bugle.*

Evacuation of the Rhineland

There is now definite prospect of an early evacuation of the Rhineland by the Allied forces. The third meeting of the representatives of the Powers interested—Great Britain, France, Italy, Belgium, Japan and Germany—produced good results. Financial experts are to arrange for a complete settlement of the reparations question, and a Committee of Verification and Conciliation will be set up with the duty of watching over the demilitarised zone. The exact functions of this committee will be decided by negotiation between the interested Governments. The zone with which it will have to deal is the German territory west of the Rhine and to a line 50 kilometers east of the Rhine. It will supervise, but there will be no military element in the supervision. Its duration has not yet been decided. France, Belgium and Italy argue that its duties should continue beyond the year 1935. The Germans, on the other hand, argue that under the Treaty of Versailles all supervision must cease in that year. Some of the Allies, it would appear, expect special settlement of certain financial claims. Belgium, for instance, is said to insist on the repayment of the seven millards of paper marks forced as currency by the Germans during the war. Italy desires a share in the sum paid in place of money paid for the expenses of the Armies of Occupation. These are minor difficulties, and it may be accepted as fact that early evacuation is now certain. France is still somewhat uneasy about her security. Natural though this feeling may be, she must realize that permanent occupation is impossible, and that the risks attendant on evacuation today are less than they would be in a few years.—*The Army, Navy and Air Force Gazette.*

Ally and Enemy Agree

The footless and impolite discussion as to who won the war has been mostly a little Anglo-American family squabble. Of course there wouldn't have been any war left to win in 1918 if the British had not been fighting heroically for three years. And, equally of course, the British and the other allies could not have won the war in the autumn of 1918 if it had not been for the tremendous aid of the Americans. The discussion ought to die and be buried.

French and Americans have not engaged in any similar contest of boasting. Nor have the Germans come forward to state which English-speaking nation contributed most toward the destruction of Hohenzollernism. Germany ought to know. And France, doubtless too courteous to participate in the Anglo-American contest of big claims, ought to know, too.

An interesting volume on the two battles of the Marne has just appeared in Paris. Joffre and the ex-crown prince discuss the first battle, and by implication Joffre placed no very high estimate on the value of the British cooperation at that time. The second battle is dealt with by Foch and Ludendorff. The former pays the highest tribute to Pershing and his men and frankly admits that the American work at St. Mihiel and in the Argonne made victory certain, while Ludendorff unqualifiedly states that the valor, skill and numbers of Americans alone sufficed to decide the war against Germany.

When France and Germany unite in praise, our zealous veterans and chroniclers can well afford to "lay off" the British controversy. Bragging is unseemly, anyway. Even if we did finish the war the British kept it going for us to finish. There's glory enough for everyone.—*Cleveland Plain Dealer.*

Universal Draft

The American Legion, at its convention in San Antonio, adopted Commander Spafford's recommendation that the legion support the movement for a universal draft law.

Regarding such a law opinions are conflicting. Some observers believe that, if it could be enacted, enforcement of it would be so difficult as to make it practically ineffective. Others believe that it would tend to develop war-mindedness among the people and so set up another obstacle in the path of peace movements. Supporters of the plan, of course, see in it a method for correcting the evils of the selective draft which sends some to the battlefield and leaves others at home to make war profits.

Because the proposal is subject to such widespread controversy, it seems unlikely that any Congress in the near future will be prevailed upon to enact a universal draft law.—*Cleveland Plain Dailer.*

Our Highway Program

America's road building program this year involves an expenditure of $11 for every man, woman, and child in the country. It is expected to reach the tremendous total of $1,360,025,776. Widening of old roads is an important feature, particularly the addition of shoulders on paved highways.

According to the American Automobile Association, this means that at the end of 1928 we will have more than 600,000 miles of surfaced highways. The federal aid system, consisting of 185,000 miles of important interstate trunk lines, will be about two-thirds completed.

Our highways are the arteries that give life to the nation. They take more money than almost any other item in the budget, and they pay it back more rapidly in social and industrial progress.

Foreign Periodicals

Revista del Ejercito y de la Marina, May, 1928.

This whole magazine is given up to a description of exhibition of horsemanship by the Mexican army—jumping, training of horses, methods of managing horses, competitions between different organizations, the winners.

Revista Militar, May, 1928—Republica Argentina

OUR MILITARY SCHOOLS AND THE ENGINEERS.

TANKS IN OUR ARMY.

LONG MARCHES, RECONNAISSANCE OF THE ROUTE OF MARCH.

CAVALRY—STILL USEFUL.

THE ARMIES OF THE A. B. C.

NIGHT COMBATS.

COUNT SCHLIEFFEN AND HIS INFLUENCE ON THE ORGANIZATION OF THE GERMAN ARMY FOR THE WAR.

Memorial del Ejercito de Chile, May, 1928

THE BATTLE OF PICHINCHA, by Ordonez.

THE NEW PROJECTILES AND THEIR INFLUENCE ON ARTILLERY.

INFANTRY CANNON. Infantry cannot be successful without cannon which they carry against the enemy trenches. History of accompanying artillery; definition, description, etc.; tactical uses.

HISTORY OF THE TROOPS OF COMMUNICATION IN THE GERMAN ARMY, 1914-18.

USE OF CAVALRY IN THE MOUNTAINS—PAST EXAMPLES AND FUTURE POSSIBILITIES.

ANTIAIRCRAFT DEFENSE—GENERAL PRINCIPLES.

PRECAUTIONS TO BE EMPLOYED BY THOSE IN COMMAND OF EACH CORPS IN CASE OF BATTLE.

IMPORTANCE OF THE TRAIN IN WAR.

INDUSTRIAL MOBILIZATION.

Bulletin Belge des Sciences Militaires, June, 1928.

THE OPERATIONS OF THE BELGIAN ARMY—The Battle of Yser. Journal of October 31, 1914.

THE ROLE OF THE FIELD ARMY AND BELGIAN FORTRESSES IN 1914. By Lieut. Colonel B. E. M. Duvivier and Major B. E. M. Herbie.

A METHOD FOR QUICK ADJUSTMENT BY HIGH BURST RANGING. By Lieut. Colonel Willemaers.

SOUND TRANSMISSION IN THE INTERIOR OF TANKS. By Lieut. De Grave.

THE ORGANIZATION OF THE CZECHOSLOVAKIAN ARMY.

The Army Quarterly, July, 1928.

MILITARY PRIZE ESSAY, 1928. CAPTAIN BERTRAND STEWART'S BEQUEST. By Captain W. J. Slim, M. C., 6th Gurkha Rifles.

COLONIAL DEFENCE. By Major G. N. Macready, D. S. O., O. B. E., M. C., Royal Engineers.

OPERATIONS IN TRANS-CASPIA, 1918-1919. By Colonel J. K. Tod, C. M. G.

THE FRENCH OFFICIAL ACCOUNT 1915.

FROM CHANGIZ KHAN TO LENIN. By Major L. V. S. Blacker, The Guides.

AN UNCENSORED WAR CORRESPONDENT.

THE RUSSIAN DEFENCE AGAINST NAPOLEON IN 1812. Part II. FROM THE NIEMAN TO SMOLENSK, 23rd OF JUNE TO 1st OF AUGUST, 1812. By Alexander Smirnoff.

COMMEMORATIVE WAR MEDALS: THEIR ORIGIN AND HISTORY. By Major T. J. Edwards.

THE ARMY AND THE POPULAR PRESS.

"ARMOURED WARFARE": A PLEA FOR COMMON SENSE. By Victor Wallace Germains.

NOTES ON UMPIRING. By Colonel W. Allason, D. S. O.

SIGNALS AND MECHANIZATION. By F. S. M.

A MOTOR TOUR ALONG THE WESTERN FRONT. By Lieut. Colonel H. de Watteville.

SALVAGE. By "Raganbone."

GERMAN CASUALTIES IN THE GREAT WAR.

Canadian Defence Quarterly, July, 1928.

General Sir Edward Selby Smyth, K. C. M. G.

The First French Advance Into Alsace, 7th-11th August, 1914. By Captain K. C. Burness, M. C., P. P. C. L. I.

Mechanization. By Major L. C. Goodeve, D. S. O., *p. s. c.*, R. C. A.

Recent Mechanical Transport Trials Carried Out in Canada. By Captain N. G. Duckett, attached R. C. A. S. C.

Fleet Aircraft. A Review of the Types of Aircraft Required for Naval Work.

Functions of Destroyers.

The Canadian Militia: From 1816 to the Crimean War. By Colonel C. F. Hamilton.

The Siege of Metz, 1553. By Lieut. Colonel L. J. Austin, C. A. M. C.

Notes on the Military History of Toronto. By Captain J. F. Cummins, C. M. S. C.

A Squadron on Its Own. By Major H. Strachan, V. C., M. C., 19th Alberta Dragoons.

Canadian Medical Units in the Great War. By Major R. M. Gorssline, D. S. O., R. C. A. M. C.

Some More Infantry Ways of Ye Olden Days. By Major D. T. McManus, the Argyll Light Infantry.

A Crusader's Funeral. By W. Boss.

MAXIM XXXIII

It is contrary to the usages of war to allow parks or batteries of artillery to enter a defile, unless you hold the other extremity. In case of retreat, the guns will embarrass your movement, and be lost. They should be left in position under a sufficient escort, until you are master of the opening.—Napoleon's Maxims of War.

COAST ARTILLERY BOARD NOTES

Communications relating to the development or improvement in methods or materiel for the Coast Artillery will be welcome from any member of the Corps or of the Service at large. These communications, with models or drawings of devices proposed, may be sent direct to the Coast Artillery Board, Fort Monroe, Virginia, and will receive careful consideration. W. E. COLE, *Colonel, Coast Artillery Corps, President, Coast Artillery Board.*

New Projects Received and Initiated

Project No. 651, Changes in T. R. 435-211 and A. R. 775-10—After study of proposed changes in these regulations, the Coast Artillery Board was of opinion that AR 775-10 and TR 435-211 permit full individual allowance to each of four men for each active machine gun in the regiment and an expenditure of 8000 rounds for combat exercises (towed target missions) for each active machine gun. The Board expressed the opinion that no necessity for change in AR 775-10 is apparent.

Project No. 652, "Buckman" Paint Gun.—A paint gun devised by Mr. Buckman, Resident Ordnance Machinist at Fort Eustis, is under test by the Board.

Project No. 653, Continuous Fuze Setter T-2 for 3-Inch Antiaircraft Guns.—The operation of the Continuous Fuze Setter T-2 was observed by members of the Board at Aberdeen Proving Ground. As a result of service test at Aberdeen, the Coast Artillery Board recommended that the continuous fuze setter as modified for the firings at Aberdeen in 1928 be issued to all antiaircraft gun batteries in the service and that the number of fuze setters made be limited to the present needs of the firing batteries in order that future manufacture may be adjusted to possible modifications in the fuze.

Project No. 654, Comments on Form for Report of Coast Artillery Battle Practice.—The Board has under study a proposed form to be used in the rendition of reports of battle practice.

Project No. 655, Tracer Thread in Field Wire.—The Coast Artillery Board was requested to submit an opinion as to the advisability of continuance or abandonment of the tracer thread in twisted pair field wire. After consultation with commanding officers of mobile regiments the Board reported as of the opinion that no benefit is derived from the use of a tracer thread in the insulation of one strand of field wire and recommended that the specifications for Signal Corps insulated wire for field use be changed so as not to require the tracer thread.

Project No. 656, Service Test of Stephens Deflection Board.—This is a service test of arsenal-constructed boards. For a description of the Stephens Deflection Board see Project No. 569, published in the April, 1928, COAST ARTILLERY JOURNAL.

Completed Project

Project No. 586, A Standard Fire Control System for Major Caliber Guns for Both Case II and Case III Firings

I. HISTORY OF THE PROJECT.

1. The following is quoted from an office memorandum, OCCA, dated June 10, 1927, file 062.122/Y-41:

> 2. Instructions to be issued to the Coast Artillery Board at once directing that they prepare and have in this office by February 1, 1928, a project, or projects, for approval containing the following subjects:
>
> *a.* Standard fire control system for major caliber guns for both Case II and Case III firing.
>
> *b.* Standard fire control system for rapid fire batteries for short, mid, and extreme ranges.
>
> *c.* Standard system for decreasing the relay time in firing by Case III.
>
> *d.* Standard method of routing all fire control and position finding data among instruments and devices within a battery firing by both Case II and Case III.
>
> * * * * *

2. In compliance with the above a proposed standard fire-control system has been developed and tested as described below.

II. DISCUSSION.

3. The three outstanding conditions affecting accuracy of fire at modern naval targets are:

Long ranges,
High speeds,
Sinuous courses.

It is very desirable that the use of our armament at its maximum range should be a possibility. With some of our guns this range now approaches 50,000 yards. Naval vessels with speeds varying from 20 to 40 miles per hour are the targets to be expected.

4. For this study the problem has been divided into two parts, one concerning fire at targets within visual range of terrestrial observing stations, and the other for those stations requiring equipment not normally provided in present fire-control systems or not sufficiently developed to justify immediate adoption.

5. A recent study of the conditions affecting fire at targets within visual range was made by the Coast Artillery Board in Project No. 220, *Seacoast Artillery Firing* (C. A. JOURNAL, October, November, December, 1925).

6. Development of the fire-control system summarized in paragraph 27 of Project No. 220 has continued with minor changes in methods and apparatus, but with little definite advance toward overcoming the limitations inherent in any system involving both manual plotting and prediction upon the plotting board.

7. The following are the more serious limitations:

a. Plotting board predictions made more frequently than each 30 seconds are normally impracticable.

b. There is at present no satisfactory and universal predicting device for use upon manual plotting boards.

c. Hand prediction upon sinuous courses is difficult and generally inaccurate. High speeds and long ranges (long times of flight) increase the difficulty.

d. Long-range plotting boards adjusted to scales permitting reasonable accuracy are slow and cumbersome. This is particularly true of the Cloke plotting board.

8. Under the system prevailing since 1912 the accuracy of prediction has depended largely upon the judgment and skill of the plotter, who, presumably, predicts the future direction of travel of the target upon the basis of the graph of its course determined by joining the plotted points of its positions at successive observations. He then employs some form of hand predictor to measure the distance that the target will travel to the setforward point during the predicting interval plus the time of flight of the projectile.

9. It is at once obvious that infrequency of observation, range to the target, and speed, acceleration, and variation in course of the target are the factors against which the plotter must pit his judgment.

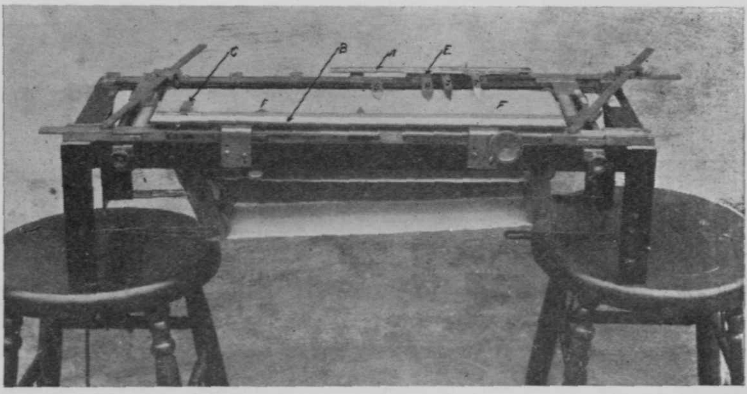

FIG. 1 RANGE PREDICTOR

10. With the 30-second observing interval accepted at present, combined with a correspondingly long predicting interval and with great variation in the time of flight (0—134.5 sec.), it may be safely stated that no plotter can now locate with sufficient accuracy the setforward points for a high-speed naval target upon a sinuous course.

11. From a service standpoint the conditions initially stated, namely, high speed, long range, and sinuous courses, cannot longer be ignored but must be met by the necessary changes and modification in fire-control methods and apparatus.

12. With the above in mind the Coast Artillery Board began an analysis of existing fire-control systems to determine the effect of the factors stated and to find what changes in equipment and modifications in methods could be made to meet the situation.

13. Coast Artillery Board Project No. 327, *Special Conditions Affecting Fire Control With Naval Targets Moving at High Speed,* discusses the effect of the approximate assumptions and methods used in position finding and fire control upon the accuracy of firing data when applied to targets moving at high speed.

14. In that study it is shown that the methods now employed with slow-moving targets require modification to assure the desired accuracy in the case of high-speed targets. These requirements are:

a. That a time of flight corresponding as closely as possible to the range of the new setforward point be used in computing travel to that setforward point.

b. That range-board ruler be set at or near range of the setforward point for which range corrections are to be computed.

c. That range used as argument with deflection board be range of actual (latest) setforward point.

d. That sight deflection for travel of target in azimuth, whether measured by gun pointer or computed on deflection board, be based on time of flight corresponding to range of actual (latest) setforward point.

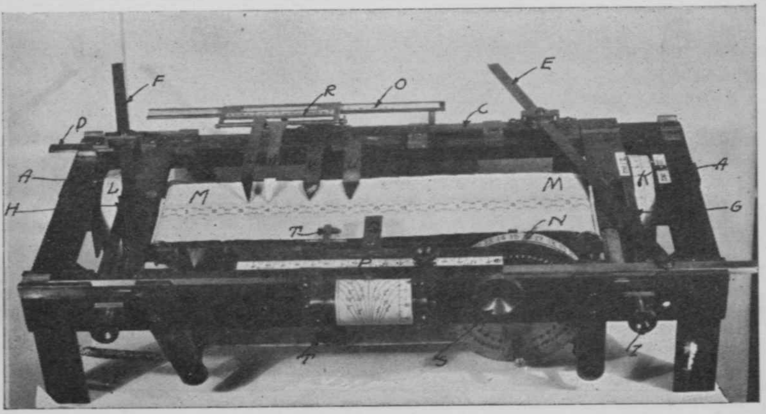

FIG. 2

15. A practical solution of the foregoing requirements has been realized by employing a mechanical extrapolator to compute the range, or time of flight, corresponding to the next setforward point for use upon all devices requiring these data, as well be hereinafter described.

16. The time of flight or range for the next setforward point being available, it at once becomes feasible to pre-operate range and direction correction devices and to apply the results in advance upon the plotting-board scales in a manner similar to that employed with the early Whistler-Hearn plotting board, thereby permitting corrected firing data to be transmitted directly from the plotting board to the guns.

17. It appears that this method attains the maximum speed consistent with accuracy to be expected from manual prediction upon the plotting board, but does not permit reduction in observing and predicting intervals so desirable in work with high-speed targets and sinuous courses. (See *Coast Artillery Shooting*, by Major R. B. Colton, C. A. C., COAST ARTILLERY JOURNAL, Vol. 62, No. 5, May, 1925).

18. It is evident that, with the same degree of accuracy in position finding, the shorter the observing interval the more quickly will a variation in the speed

or course of the target be indicated and verified by a succeeding observation. (See *Fire Control Study*, by Captain W. P. Wilson, C. A. C., transmitted with O. C. C. A. File 665.01, April 20, 1920).

19. In Coast Artillery Broad Project No. 220, *Seacoast Artillery Firing*, paragraph 15, it is concluded that "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."

20. To reduce the observing and predicting intervals below 30 seconds, it is necessary to eliminate manual prediction upon the plotting board and to predict upon other instruments carrying the time-range and time-azimuth relations; the plotting board to furnish only the true range and azimuth of the target.

21. The Coast Artillery Board has constructed and tested mechanical range and azimuth predictors (Figs. 1 and 2) and mechanical interpolator-extrapolators (Fig. 3), which, used in connection with a manual plotting board, modified range correction board Model E-1923, and Stephens Deflection Board, permit the determination and transmission of corrected firing data to two or more widely separated guns or directing points upon a 10 to 15-second basis (Fig. 4).

22. The equipment specified above has been tested using a 15-second observing interval and predicting each 15 seconds with variable predicting intervals of 15 seconds or more.

23. The Modified Range Correction Board (Fig. 15) and Stephens Deflection Board (Figs. 12, 13, and 14) are pre-operated upon extrapolated data (range or time of flight corresponding to the expected setforward point) and the corrections obtained are set in advance upon the predictors, which, operating in turn upon the basis of the expected range, furnish corrected readings directly to the guns.

24. Readings are corrected to compensate for the errors inherent in this and in all other systems in which predictions are based upon rate of change in range and rate of change in azimuth. (See Figs. 13 and 16).

25. At ranges beyond 10,000 yards the inherent error in direction rapidly becomes negligible and the range error practically fixed in amount. The sign of the azimuth error changes when the angle measured clockwise from the gun-target line to the course of the target passes 90°. The range error is always negative in sign (short of the target).

26. Detailed description and operation of the new fire-control equipment and proposed modifications in existing devices appears in Appendix A.

27. Range and azimuth predictors (Figs. 1 and 2) were constructed at Fort Eustis and Fort Monroe. The mechanical extrapolator-interpolator (Fig. 3) had been previously developed in connection with Coast Artillery Board Project No. 326, *Cowen Deflection Board*.

28. The Stephens Deflection Board (Fig. 12), Coast Artillery Board Project No. 569, published in COAST ARTILLERY JOURNAL, Vol. 68, No. 4, April, 1928) has been modified by the addition of a device to determine and apply the correction for the inherent error in azimuth prediction. A scale has been added for reading the azimuth correction for a second gun or pit.

29. The modified Range Correction Board, Model E, 1923 (Fig. 15), Coast Artillery Board Project No. 425 (C. A. JOURNAL, Vol. 64, No. 3, March, 1926) has been changed to carry the total range correction—ballistic and adjustment—in per cent, a slide rule being provided to convert per cent to yards or vice versa.

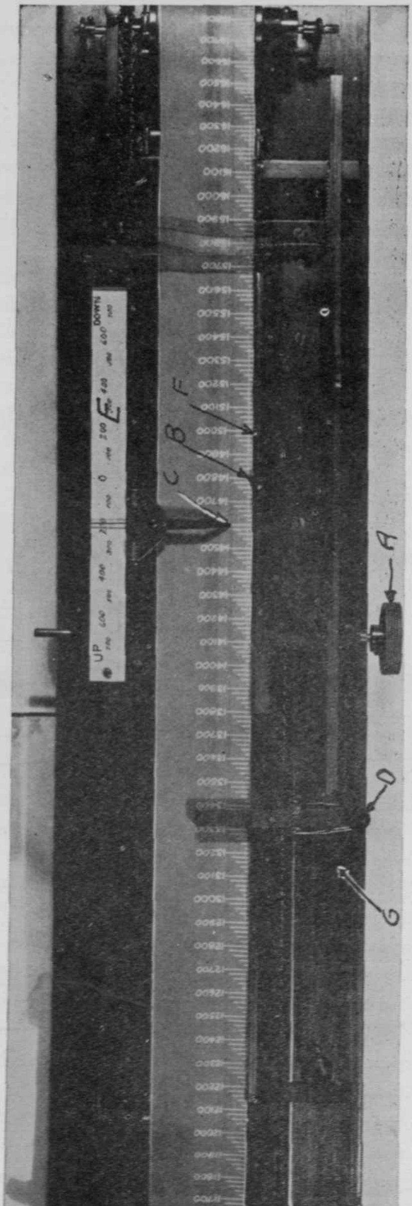

Fig. 3 Range Extrapolator

30. The relative positions of instruments in the plotting room are shown in Figures 4, 5, 6, and 7.

31. It will be seen that the flow of data is direct from the plotting Board (1) through the predictors (5 and 6) to the gun, as indicated by the heavy lines (Fig. 17).

32. As previously stated, the predictors (5 and 6), range-correction board (8), and Stephens Deflection Board (9—10) operate upon the basis of extrapolated data corresponding to the range or time of flight for the expected setforward point. This range is furnished by the range extrapolator (7).

33. Total range and direction corrections are computed by the range correction board (8) and Stephens Deflection Board (9—10) and are then set off upon the corresponding predictors. These are thereby enabled to furnish both corrected range and azimuth of the true setforward point. (See Figs. 1 and 9).

34. At the same operation the predictors (5 and 6) indicate the uncorrected range and azimuth for the setforward point for use by the spotting section when fire is adjusted upon the setforward point. The range and azimuth of the "predicted point" are also determined.

35. Adjustment corrections are applied without delay upon the predictors (5 and 6). They are also applied at the same time upon the Range-Correction Board (8), and the Stephens Deflection Board (9—10), which carry the total corrections (ballistic and adjustment) and furnish a check against the totals carried by the predictors.

36. By the method outlined above, corrections are determined more accurately and are applied without interrupting or delaying the transmission of firing data to the guns.

37. By the addition of an *azimuth* extrapolator (15) identical in principal and construction with the *range* extrapolator (7), the system can furnish complete firing data to the guns for any multiple of 5 or 7.5 seconds, extrapolated ranges being read from the range extrapolator (7) already a part of the system.

38. The predictors (5 and 6), extrapolators (7 and 15), range and direction correction devices (8 and 9—10) are arranged in a close group (Fig. 7). This enables the operator of one instrument to set data computed by his machine upon others, thereby reducing the calling out of data to a minimum.

39. For example, the operator of the range extrapolator (7) determines the uncorrected and the corrected range for the expected setforward point. He moves the range-correction board chart (8) to this uncorrected range and then sets the corrected range (time of flight) upon the range (5) and azimuth (6) predictors in turn.

40. Operator "B" of the Stephens Deflection Board (10) having noted the total azimuth correction and the azimuth difference for a second gun or directing point, sets these values upon the azimuth predictor (6). Operator "A" (9) writes the range wind component upon a blackboard where it may be seen by the range-correction board operator (8).

41. The range-correction board operator determines the total range correction and sets the same upon the range predictor (5).

42. It will be noted that all the operations listed above are accomplished without the necessity for speech.

Fig. 4

43. Since the accuracy of prediction increases with the frequency of prediction, it is considered essential that the 10 to 15-second observing interval be employed with all classes of seacoast armament (fixed and mobile) and that predictions be made each 10 to 15 seconds.

44. The time factor (f)—that is, the dead time (t) plus the time of flight (T) divided by the observing interval $\left(\frac{t/T}{15}\right)$ may be adjusted exactly to suit local conditions (class and condition of armament and state of training of personnel). It is obvious that this time factor should be kept at the smallest value practicable at all times in order to secure the maximum accuracy made possible by this system.

45. With mortars the advantages of this method are particularly apparent, since they may be fired each 30 seconds with the time for relays reduced to 15 seconds or less.

46. Corrected firing data may be furnished to the guns after two observations, permitting fire to be opened within 30 seconds after the first observation in the case of guns. The same applies when targets are changed.

47. Changes from one type of armament to another introduce no basic changes in the fire-control equipment, rate, or method of operation.

48. At each operation of the predictors (5 and 6) upon observed data, the next readings (the "predicted point") to be expected from the plotting board are indicated. As soon as the firing data are transmitted, the machines (5 and 6) are immediately reset to these expected readings; hence no delay is occasioned by the loss of observations.

49. This may be done repeatedly, thereby generating data upon the basis of the last observed rates of travel in range and azimuth. (See Appendix B).

50. With this system the following very desirable changes have been accomplished:

a. The system is universal in that it is applicable to any type of position finding service and to all existing types of fixed and mobile seacoast armament for both Case II and Case III firing.

b. Range sections trained with one class of armament can change readily to another class.

c. All operations being entirely mechanical, errors are reduced to a minimum and the training of personnel is simplified.

d. Prediction is no longer a matter of judgment and skill upon the part of the plotter, whose duties are reduced to locating the position of the target at each 10 or 15-second observation.

e. The predicting interval can be adjusted to the exact minimum value permitted by materiel and state of training of personnel.

f. In the event that the position-finding service becomes temporarily inactive, the predictors can continue to furnish corrected firing data based upon the last observed rate of travel in range and azimuth. (See Appendix B.)

g. Corrected data based upon observations are determined each 10 or 15 seconds.

h. By extrapolation data can be furnished for any multiple of 5 or 7.5 seconds.

i. More accurate firing data are assured through the use of the range or time of flight corresponding to the expected setforward point.

k. No delay is introduced by the application of corrections.

l. The time necessary to furnish data for opening fire or changing targets is reduced.

m. Relay time is reduced, especially for mortars.

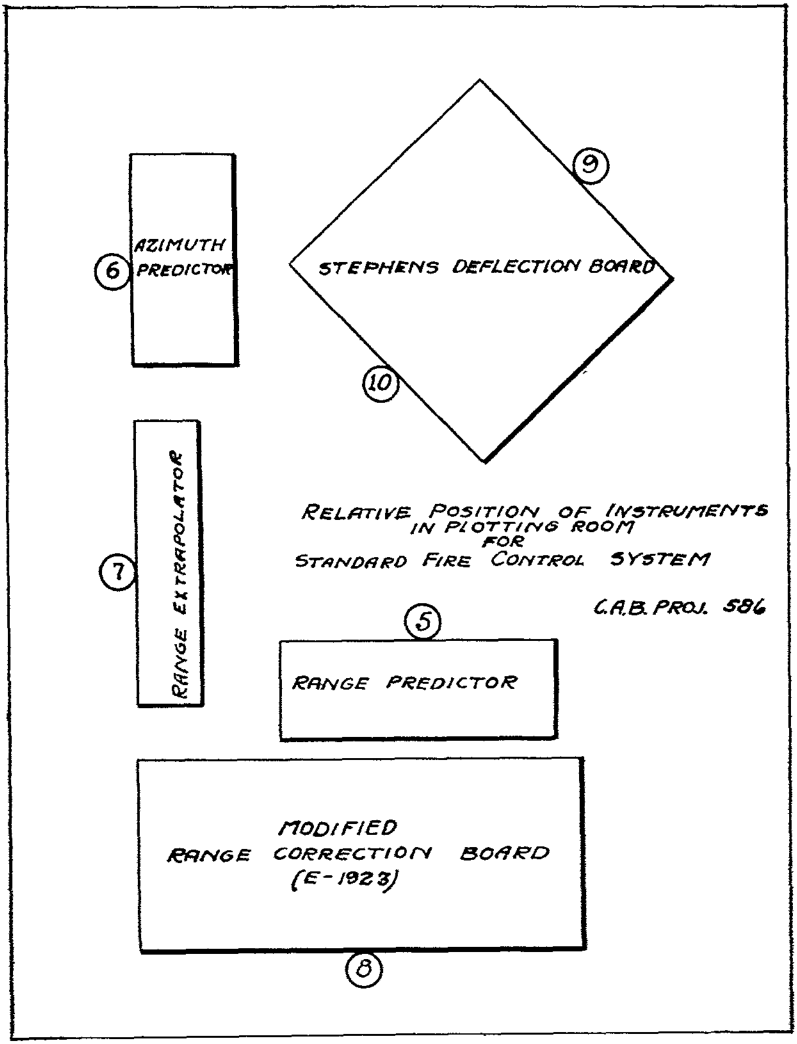

FIG. 5

n. The routing of data through the plotting room is simplified and in logical sequence (Fig. 17).

o. The calling out of data in the plotting room is reduced to a minimum.

p. Corrected firing data for two or more guns or directing points may be furnished.

q. Corrections are applied for errors inherent in the method of prediction employed.

r. Uncorrected range and azimuth are furnished for spotting upon the setforward point.

s. The azimuth of the "predicted point" is available for use when desired.

III. TESTS:

51. Following a laboratory test by the Coast Artillery Board, the equipment was turned over to Battery "B," 12th Coast Artillery. After about one week's drill the system was subjected to a service test at Battery DeRussy (12-inch D. C.) in connection with Project No. 566/B, *Test of Gas Proofing of plotting Room at Battery DeRussy.*

52. The following is quoted from the Battery Commander's Narrative Report of this practice:

NEW FIRE-CONTROL DEVICES

1. A new system of fire control which is now being studied by the Coast Artillery Board was used in this test after about a week's drill.

2. In this system the range of the plotted point is taken from the plotting board and applied on a range predicting device. This device applies arbitrary and ballistic corrections and turns out the corrected range to the setforward point. The range is then sent directly to the guns. A similar device handles azimuth in the same way. Another device which might be known as a time-of-flight predictor or as an extrapolator is used with the two devices above mentioned. This device determines the time of flight that corresponds to the corrected and uncorrected range of the future setforward point. The operator sets the corrected time of flight on the range and azimuth devices and also sets the range chart of the range correction board at the uncorrected range of the future setforward point. Using the time of flight corresponding to the future range of the setforward point rather than the last plotted point of the course increases accuracy. The Stephens Universal Deflection Board and the modified Pratt Range Board were used in determining the corrections to be applied on the predicting devices.

3. The system worked very successfully. Some of its advantages are considered to be:

a. It enables data taken at one instant to be used for firing fifteen seconds later.

b. The small interval of fifteen seconds greatly increases the accuracy when tracking a high-speed target following either a straight or sinuous course.

c. Reduces the talking in the plotting room materially.

d. The base-end stations may miss several readings without interrupting or delaying the flow of data to the guns. In this connection it is interesting to note that although the base-end stations lost several readings after the fifth shot (which was a hit) the devices continued to send data to the guns and another hit was made on the sixth shot.

e. Reduces the duties of the plotter to a minimum in that it eliminates prediction of the setforward point from the plotting board.

f. The use of the time of flight corresponding to the corrected range of the setforward point increases accuracy, particularly in high-speed targets.

4. Although these devices have been in use but a comparatively few days, their use has been highly satisfactory and it is hoped to test them further in subsequent practices.

53. The system has since been used at Battery *Pennington* (16-inch Howitzers), by the same organization for their record practice of May 14, 1928, and

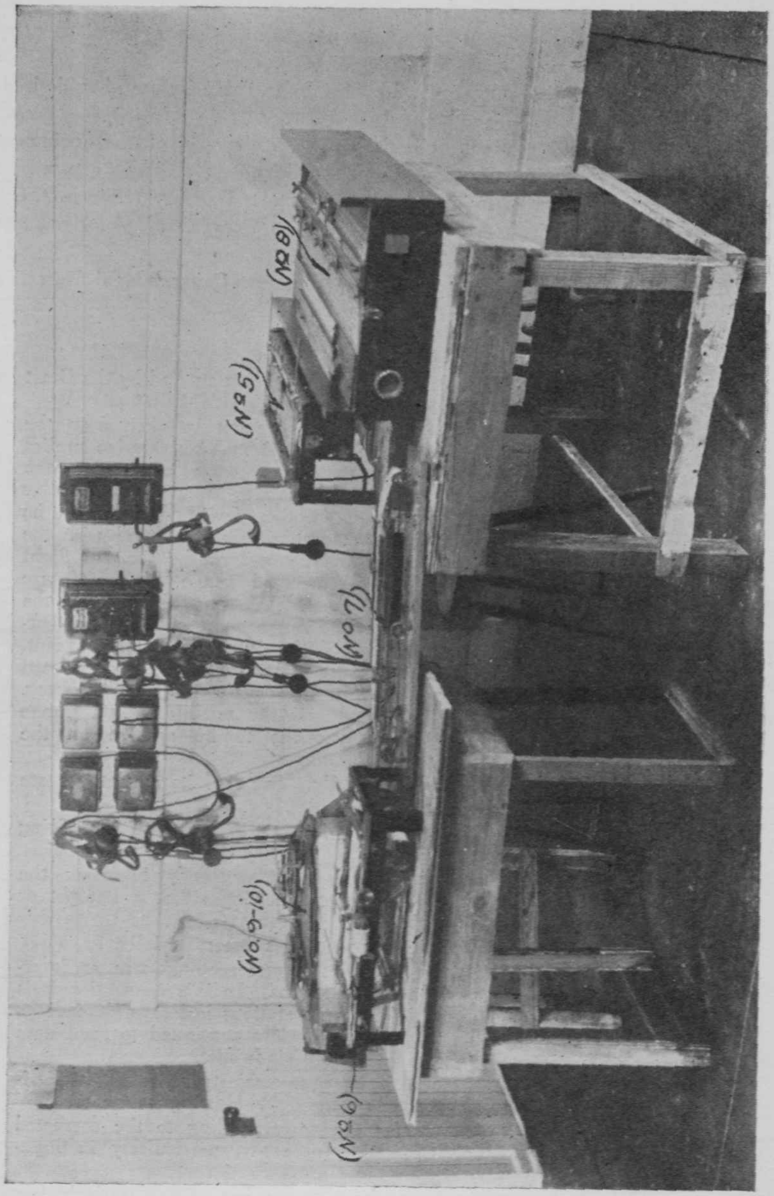

Fig. 6

Fig. 7

for the battle practice of May 23, 1928. In both instances the apparatus functioned satisfactorily. (See Appendix B.)

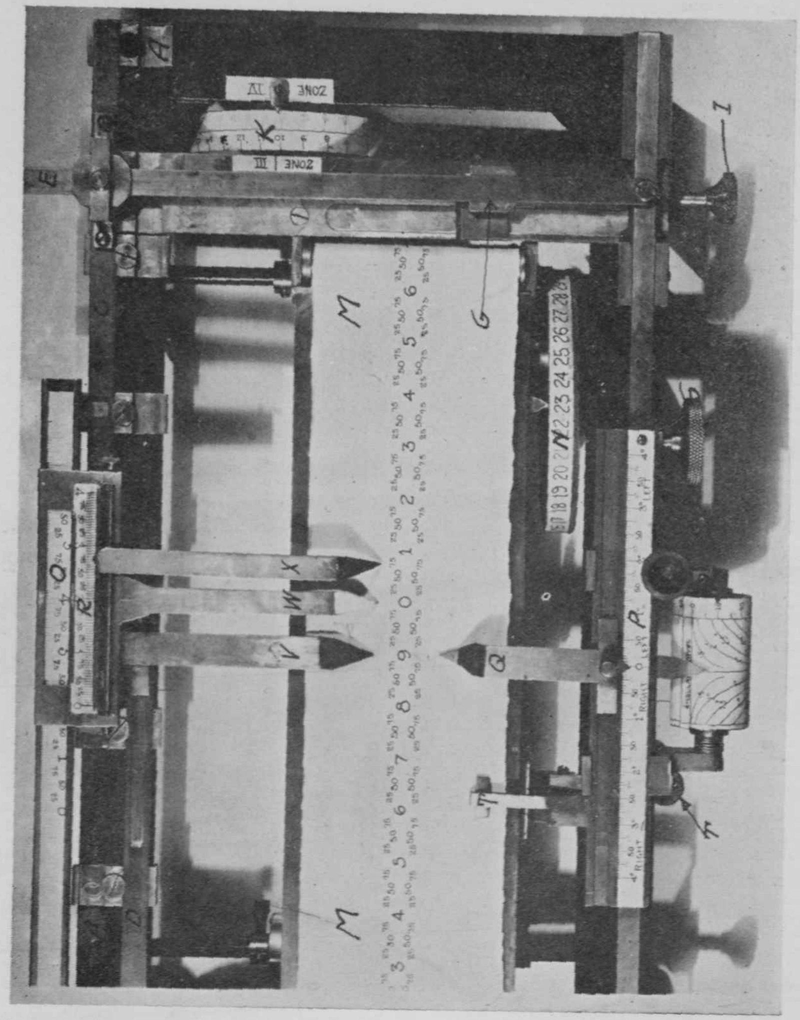

Fig. 8 Azimuth Predictor

54. The following additional tests are contemplated:

a. Fort Eustis or Fort Monroe. With self-contained range finders replacing plotting board.

b. Fort Monroe. Mortar firings.

IV. Conclusions:

55. The Coast Artillery Board is of the opinion:

a. That the fire-control system described above will be satisfactory for use with Coast Artillery Mortars and Guns, fixed and mobile, of all calibers.

b. That the range and azimuth predictors and extrapolators have been sufficiently developed and tested to justify the construction of pilot models.

V. RECOMMENDATIONS:

56. The Coast Artillery Board recommends:

a. That pilot models of the fire-control equipment listed below be constructed by the Ordnance Department for further tests in connection with service firings:

1 Range predictor
1 Azimuth predictor
2 Extrapolators.

b. That in order to facilitate the manufacture of the above equipment, the existing models be sent to Frankford Arsenal for such time as they may be of value there.

c. That a member of the Coast Artillery Board be ordered to Frankford Arsenal for temporary duty for a short period to assist in the interpretation of the design of these instruments.

VI. ACTION BY THE CHIEF OF COAST ARTILLERY:

062.125/BP-41 1st Ind.

War Department, O. C. C. A., July 14, 1928.—To Chief of Ordnance.

1. The above report of the Coast Artillery Board is approved.

2. It is requested that pilot models of the following fire control equipment be constructed, as soon as funds can be made available, for further tests:

1 Range predictor
1 Azimuth predictor
2 Extrapolators.

APPENDIX A

DETAILED DESCRIPTION AND OPERATION OF FIRE-CONTROL APPARATUS
COAST ARTILLERY BOARD PROJECT NO. 586.
PREDICTORS

Range (5) and azimuth (6) predictors are shown in Figures 1 and 2. These machines are identical in principle and similar in operation. Relative dimensions and differences in scales and fittings are clearly shown in the illustrations.

Frames are constructed of 1½-inch angle iron with fittings of brass and steel. Approximate overall dimensions are:

	Width, Inches	*Length, Inches*	*Height, Inches*
Range Predictor	10	30	8
Azimuth Predictor	11	24	5

The machines through setting up similar triangles, predict by multiplying the rates of travel in azimuth and range during the 10 or 15-second observing interval by a time factor (*f*) obtained by dividing the sum of the dead time (6) and time of flight of the projectile (*T*) by the length of the observing interval (10 or 15 seconds) (See paragraph 44, this project). $\frac{t+T}{15} = f.$

The azimuth predictor (6) (Figs. 2, 8, and 9) illustrates the mechanical features and the method of operation.

Three parallel slides, *B*, *C*, and *D*, are carried in guides upon the frame *A*, their relative longitudinal motions being controlled by multiplying arms, *E* and *F*, which slide through and turn about movable pivots, *G* and *H*. These pivots are

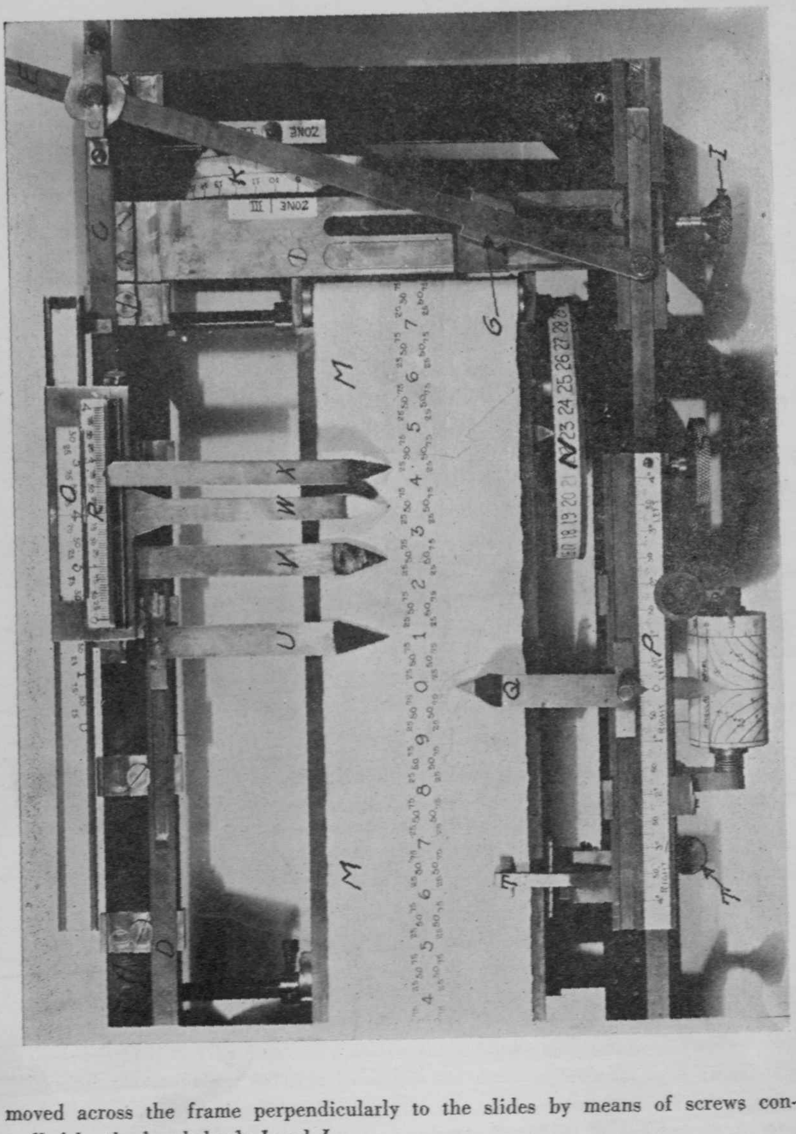

FIG. 9 AZIMUTH PREDICTOR

moved across the frame perpendicularly to the slides by means of screws controlled by the handwheels *I* and *J*.

Graduated drums, *K* and *L*, are connected to the movable pivots through compensating mechanisms designed to spread the scales evenly over their reading surfaces.

Drum L is given a permanent setting for a factor $f = \frac{15+15}{15} = 2$, corresponding to the "predicted point" time.

Drum K is graduated in range or elevation corresponding to f factors determined by the class of armament and local conditions.

The scale of the azimuth tape M is $1'' = 1°$, with the whole degree numbers repeated each ten degrees. The numbering device N indicates the hundreds and tens of degrees.

Scale O carries the total azimuth correction obtained from the Stephens Deflection Board scale G. When necessary, a part of the total correction may be transferred to scale p by shifting the movable set pointer Q.

The displacement correction for a second gun (or directing point), obtained from scale A for the Stephens Deflection Board (9-10) (Fig. 12), is set upon scale R by turning the thumb screw. R is an arbitrary scale with the normal at "2."

The handwheel S moves the slide B through a rack and pinion gearing.

By means of the grip T, the azimuth tape M may be moved with slide B or released at will. When the grip T is released, an automatic stop comes into play to bring the read pointers to rest at the initial position (Fig. 8) when moved toward the center from either side.

The roller marked "angular travel" (Fig. 8) may be used to compute and apply the correction for the inherent azimuth error, but this is done more conveniently by the Stephens Deflection Board (9-10).

Figure 8 shows the machine in the zero or initial position from which each prediction must be made. Read pointers U (yellow) and V (blue) are directly opposite the set pointer Q at the azimuth reading (229°) last received from the plotter (1) and set by the operator (6).

The directing gun (or point) pointer W (white) is displaced by a total azimuth correction of 1°. The displaced gun (or point) pointer X (Red) carries an additional correction for displacement of 0.°75. Corrections are set by the Stephens Deflection Board (9-10) Operator B (10).

The drum K is set at the range of the expected setforward point, as obtained from the range extrapolator (7). This setting is made by the range extrapolator operator (7).

In Figure 9 a new reading of 230° has been received and set opposite the set pointer Q by the Azimuth Predictor Operator (6) by turning the handwheel S. This operation has automatically extended the read pointers U, V, W, and X to the following readings:

U (yellow) Next "set reading" to be expected or "predicted point" azimuth for mortar firing = 231.°00.

V (blue) Uncorrected azimuth of setforward point for use by spotting section when desired = 232.°50.

W (white) Corrected azimuth for directing gun (or point) = 233.°50.

X (Red) Corrected azimuth for displaced gun (or point) = 234.°25.

When the readings required have been made, the azimuth predictor operator (6) notes the reading of pointer U (yellow), releases the grip T, and moves the read pointers toward the center until the automatic stop brings them to rest in the initial position. He then engages the grip T and sets the expected reading (obtained from pointer U) at the set pointer Q.

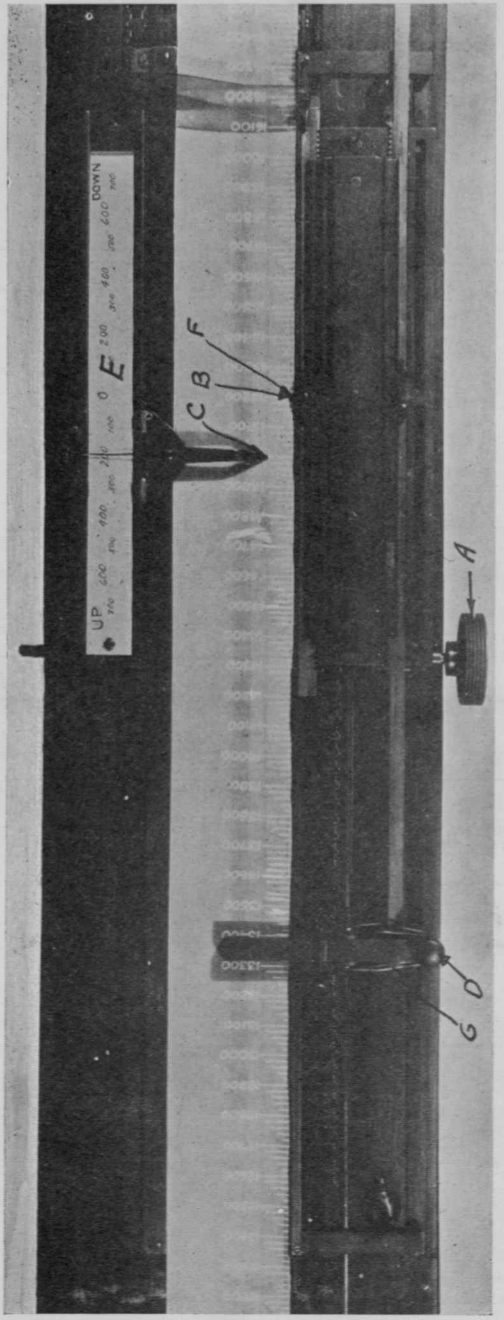

FIG. 10 RANGE EXTRAPOLATOR

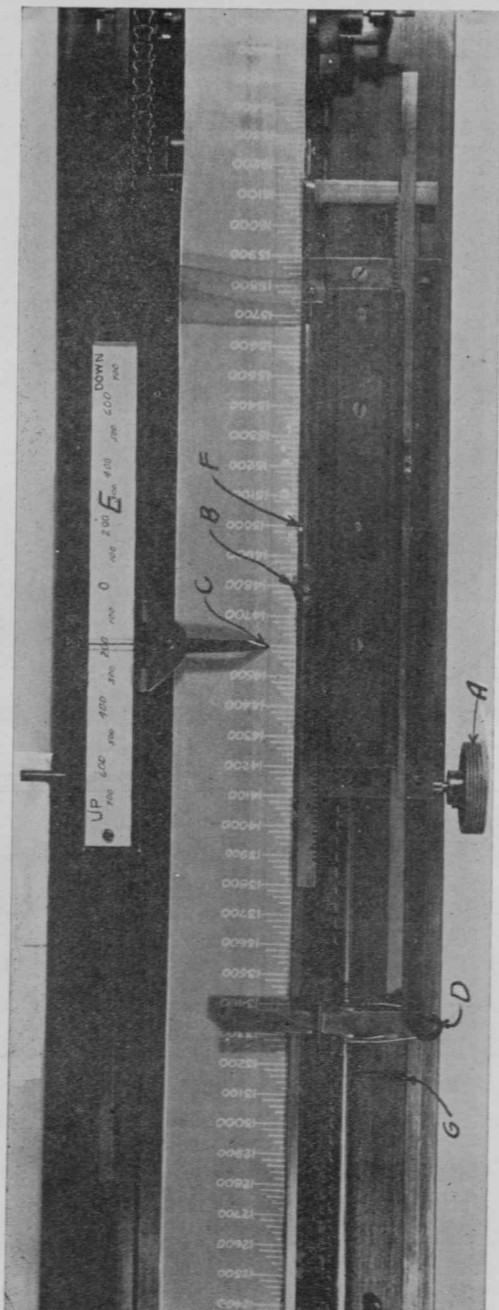

FIG. 11 RANGE EXTRAPOLATOR

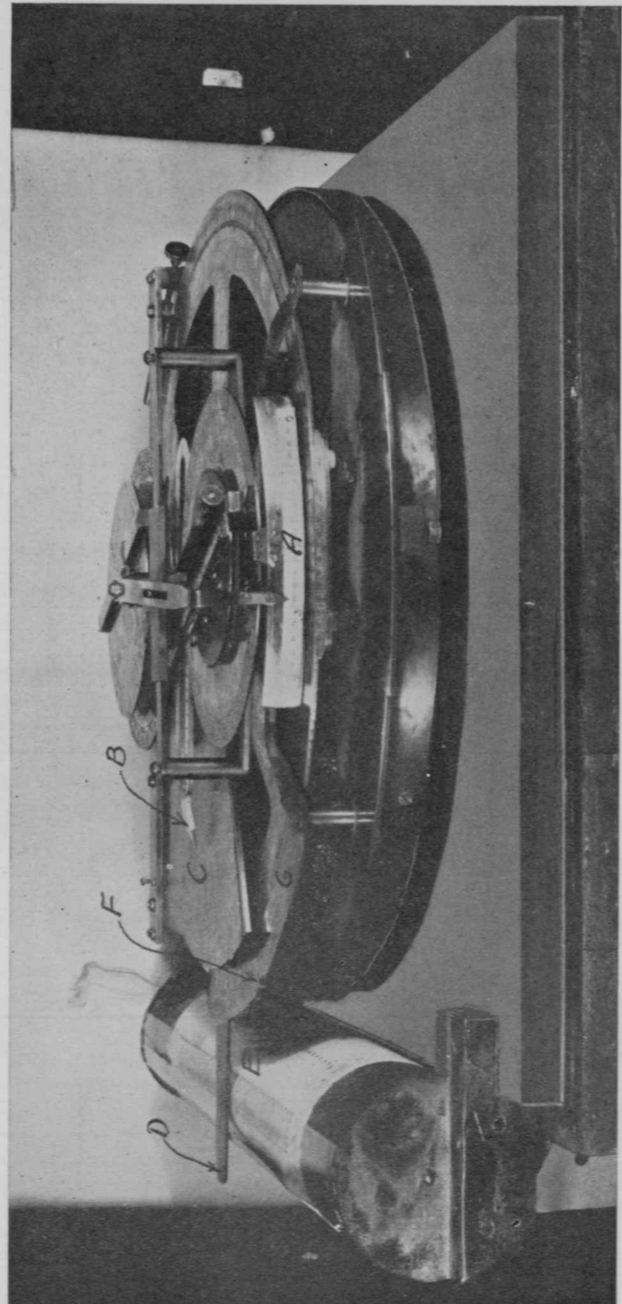

FIG. 12 STEPHENS DEFLECTION BOARD

This operation generates a new set of readings to be corrected by the reading from the plotting board when it is received or to be read directly to the guns when the plotting board fails to furnish the data. This may be done repeatedly (see paragraphs 48 and 49 of this project, and Appendix B).

The range predictor (5) (Fig. 1) carries 125 inches of tape *F*, permitting readings to be made from 0 to 50,000 yards at a scale of 400 yards to the inch or to 25,000 yards at 200 yards to the inch.

Correction scales (1-inch = 200 yards) extend to 3000 yards either side of zero, scale *A* being graduated to 1000 yards and scale *B* to 2000 yards. Scale *E* corrects for the range displacement of a second gun (or point) up to 400 yards (1-inch = 200 yards). This scale is graduated to read in azimuth for the battery with which it is used, thereby eliminating the necessity for a conversion table and avoiding the calling out of additional data in the plotting room.

Corrections for the inherent range error computed upon the slide rule (Fig. 16) are applied by shifting the movable set pointer *C*, which is then used instead of the fixed set pointer *D*.

The read pointers, in order from left to right (Fig. 1) indicate:

Yellow: G—Next "set reading" to be expected.

Blue: H—Uncorrected range to setforward point for use by spotting section when desired.

Red: J—Corrected range to setforward point for directing gun (or point).

White: I—Corrected range of setforward point for displaced gun (or point).

Extrapolator—Interpolator

The mechanical extrapolator-interpolator shown in Figures 3, 10, and 11, may be used interchangeably for range and azimuth by substitution of the proper tapes and correction scales.

This is a geared model with fixed ratios of 1, 2, and 3, permitting extrapolations and interpolations to be made at one setting for 1/3, 2/3 and the whole observing interval, or for 1/2 and the whole observing interval.

As shown in the illustrations, the machine is set up to extrapolate corrected and uncorrected setforward ranges one whole observing interval in advance of the last computed setforward point.

The method of operation is as follows:

a. With the pointers in the initial position (Fig. 10)—the total range correction being set off on the correction scale *E*—the first corrected setforward point range obtained from the range predictor (5) is set by releasing the grip *D* and turning the handwheel *A* to bring this range opposite to the set mark *F*. The grip *D* is then engaged.

b. The range next received is set by turning the handwheel *A*, which extends the read pointers *B* and *C* automatically to the corrected (*B*) and uncorrected (*C*) ranges for the expected setforward point (Fig. 11).

c. After readings are made the machine is returned to the initial position (Fig. 10) by releasing the grip *D* and pushing it against the stop *G* from either direction.

d. Additional intermediate pointers are provided and may be used as desired for 5 or 7.5-second readings.

In Figure 10 the machine is in the initial position with a correction of 200 yards and with 15,200 yards set on the tape.

Figure 11 shows 15,000 yards at the set mark *F*, a corrected extrapolated range of 14,800 yards at *B*, and an uncorrected extrapolated range of 14,600 yards at *C*.

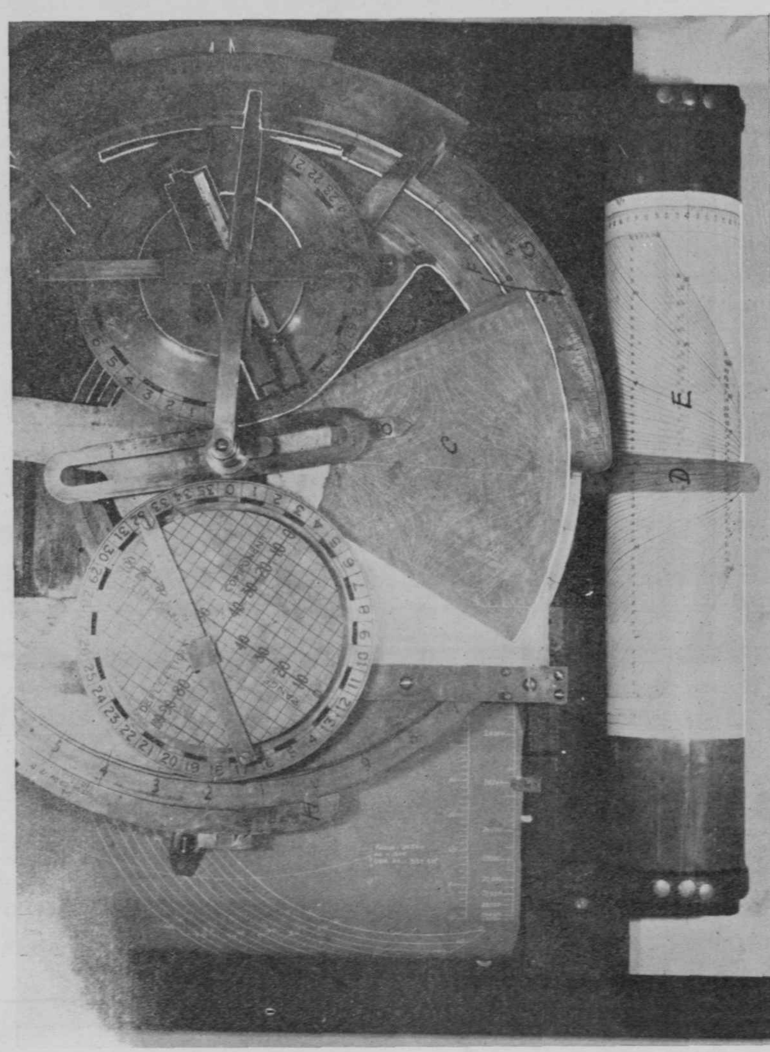

FIG. 13 STEPHENS DEFLECTION BOARD

THE STEPHENS DEFLECTION BOARD

In Case II firing with this system the operation of the Stephens Deflection Board (Figs. 12, 13, and 14) (9-10) is the same as described in Coast Artillery Board Project No. 569, published in the COAST ARTILLERY JOURNAL, Vol. 68, No. 4, April, 1928, the range set upon the correction chart being that of the next or expected setforward point obtained from the range extrapolator (7).

For Case III operation the duties of Operator *A* (9) (Coast Artillery Board Project No. 569) are the same.

Operator *B* (10): (a) Sets adjustment corrector.
(b) Computes the correction for the inherent error in azimuth.
(c) Reads the total azimuth correction from scale *G* and sets it upon scale *O* of the azimuth predictor (6).
(d) Reads the displacement correction for a second gun (or point) from scale *A* (Fig. 12) and sets it upon scale *R* of the azimuth predictor (6).
(e) Reads the angular travel of the target if necsesary.

Modifications of the Stephens Deflection Board (9-10) are shown in the illustrations (Fig. 12 and 13). These include:

a. A scale *A* (Fig. 12) for reading the displacement correction for a second gun (or directing point), graduated to correspond with the displacement correction scale *R* of the azimuth predictor (6).

b. A device, including parts *B, C, D, E, F,* and *G*, for computing and applying the correction for the inherent error in azimuth (see paragraphs 24 and 25 of this project) (Fig. 13).

The displacement corrector scale *A* carries arbitrary graduations from 0 to 4 with the normal at 2. In operation the reading appearing under the displacement pointer is set upon the displacement correction scale *R* of the azimuth predictor (6) by Deflection Board (9-10) operator *B* (No. 10).

The computation of the inherent error correction is illustrated in the illustrations (Figs. 13 and 14). In Figure 13 an angle of course of 60° is set on *B*—this angle is measured clockwise from the gun or relocating arm to the graph of the course of the target upon the plotting board—pointers *B, D,* and *F* are at the normals of their respective scales, the time of flight on *E* is 45 seconds, and the azimuth reading set at *H* is 180°.

In Figure 14 the azimuth reading set by operator *A* (No. 9) at *H* is 181.°50, an increase of 1.°5. The pointer *B* has been displaced to read upon the curve numbered 2.80, an arbitrary number representing the magnitude of the correction for the 10-15-second observing interval.

Operator *B* (No. 10) has set *D* to the same number—2.80—on *E*, thereby multiplying the 10-15-second correction by the dead time plus time of flight factor $\left[\frac{t+T}{15} = \frac{15+45}{15} = 4\right]$ (paragraph 44 of this project) and registering the result (—0.°15) upon scale *G*, where it is added algebraically as a part of the total azimuth correction to be set by him upon the correction scale *O* of the azimuth predictor (6).

The angular travel of the target during the 10-15-second observing interval may be determined from the Stephens Deflection Board for use upon the slide rule (Fig. 16) in computing the correction for the inherent range error in both Case II and Case III operation.

Modified Range Correction Board, Model E, 1923

The modified Range Correction Board, Model E, 1923 (8), has been adapted to this system by the following modifications and changes in the method of operation.

a. The percentage correction scale *A* has been made movable and a pointer *B* has been added so that adjustment corrections may be set and carried as a percentage of the range.

b. The total range correction in per cent is read from scale *A*, opposite pointer *C*.

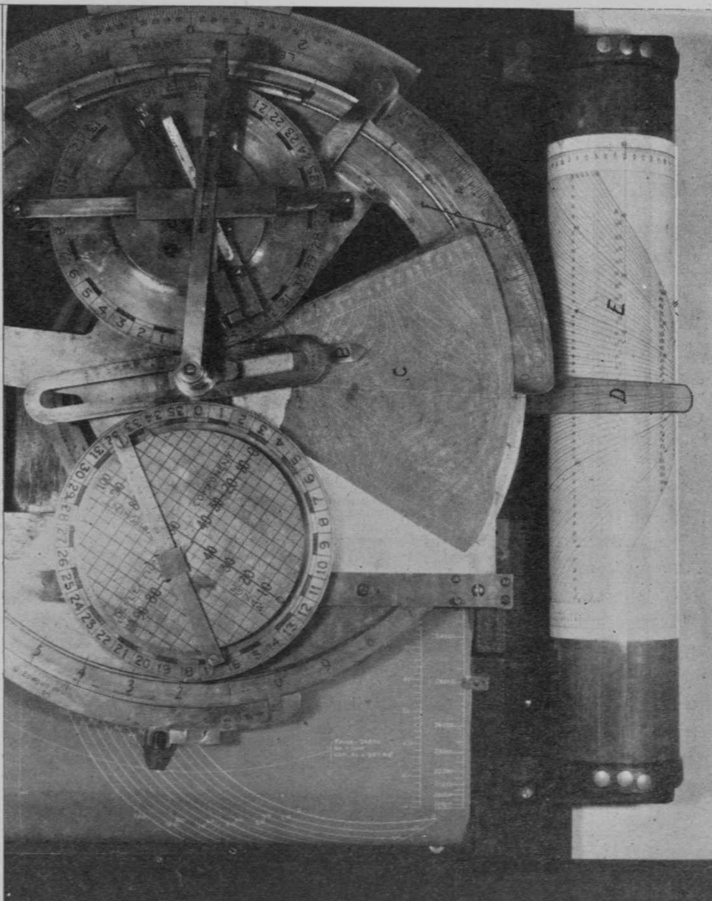

FIG. 14 STEPHENS DEFLECTION BOARD

c. A slide rule *D* is provided to convert percentage corrections to yards or yards to per cent.

d. The correction chart *E* is kept set at the uncorrected extrapolated range of the expected setforward point. This setting is made by the range extrapolator operator (7).

The range correction board operator (8) computes the total range correction in per cent, converts it into yards, and sets it upon the correction scale *A* of the Range Predictor (5).

Adjustment corrections are first applied without delay directly upon scale *A* of the range predictor (5) and next upon scale *A* of the range correction board (8). The total correction carried by each instrument should then be the same.

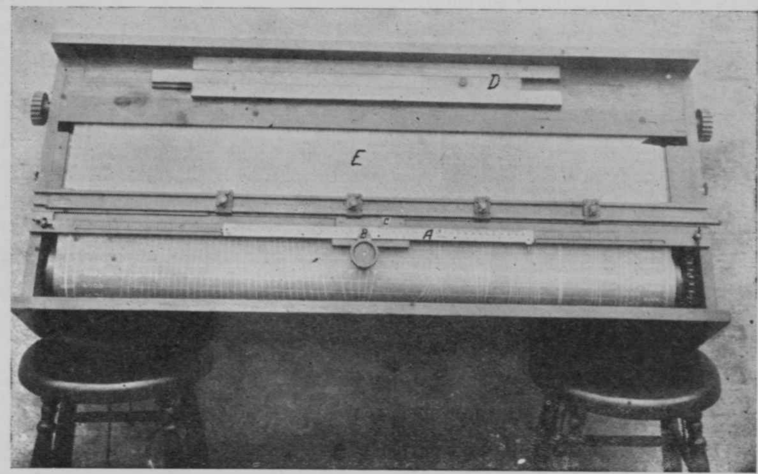

Fig. 15 Modified Range Correction Board

The range correction board operator (8) sets the uncorrected azimuth of the setforward point obtained from the azimuth predictor (6) upon the range predictor scale *E*, thereby applying the range displacement correction for a second gun (or directing point).

The Range Inherent Error Correction Slide Rule (Fig. 16) may also be operated by the range correction board operator (8) as often as this correction is required.

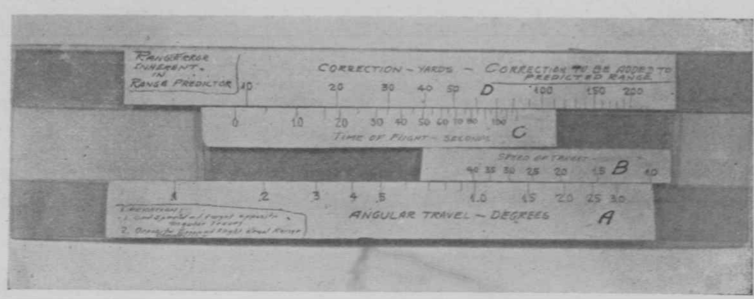

Fig. 16

Range Inherent Error Slide Rule

Figure 16 shows a simple slide rule for computing the correction for the inherent error in range. This device is used by the range predictor operator (5) or by the range correction board operator (8), and the corrections obtained are set upon scale *B* of the range predictor (5), always in the plus direction.

The frequency with which this correction must be computed varies with the range. Beyond 10,000 yards one setting will usually be sufficient so long as the angle of the course of the target does not change materially. For ranges under 10,000 yards the correction should be computed as frequently as convenient.

The magnitude of the correction is small for targets traveling toward or away from the battery and increases as the angle between the line of fire and the course of the target approaches 90°.

In operation, the speed of the target (scale *B*) obtained from the plotter (1) is set opposite the angular travel of the target (scale *A*) obtained from the plotter (1) or from the Stephens Deflection Board (9-10) Operator *B* (10). The correction in yards (scale *D*) to be added to the range is read opposite the time of flight, range or elevation (scale *C*).

The illustration (Fig. 16) shows an angular travel of 1° and a target speed of 40 miles per hour, which gives a correction of plus 30 yards for a time of flight of 35 seconds, or plus 40 yards for a time of flight of 50 seconds.

APPENDIX B

BATTERY B
TWELFTH COAST ARTILLERY
Fort Monroe, Virginia

May 31, 1928.

SUBJECT: Report on the Coast Artillery Board system of fire control.
To: President, Coast Artillery Board.

1. The Coast Artillery Board experimental system of fire control was used by Battery B, 12th C. A., in target practice at Battery *DeRussy* on March 6, 1928, and at Battery *Pennington* on May 14, 1928, and May 23, 1928.

2. This system worked very satisfactorily at all times.

3. It is believed that this system possesses the following advantages:

a. It reduces the predicting interval, thus increasing the accuracy of the data. From the time the base-end stations read on the target until the guns fired with the corrected data of this reading, was only fifteen (15) seconds.

b. Does not require the plotter to predict on the plotting board, thus relieving him of a large part of his work.

c. Requires less time to train a range section due to the fact that all operations are more simple than with the standard system. In this connection it may be noted that the target practice on March 6, was fired with only five days of drill on these new devices.

d. The men using this system in the range section like it better than the standard system.

e. Furnishes a satisfactory method of supplying displacement correction when guns are widely separated, . . . Corrected ranges and azimuths are read simultaneously to both guns.

f. The target can be obscured from the base-end stations without interrupting the flow of data to the guns. In the practice on March 6, 1928, the last shot was fired on extrapolated data after the target had been obscured from B″

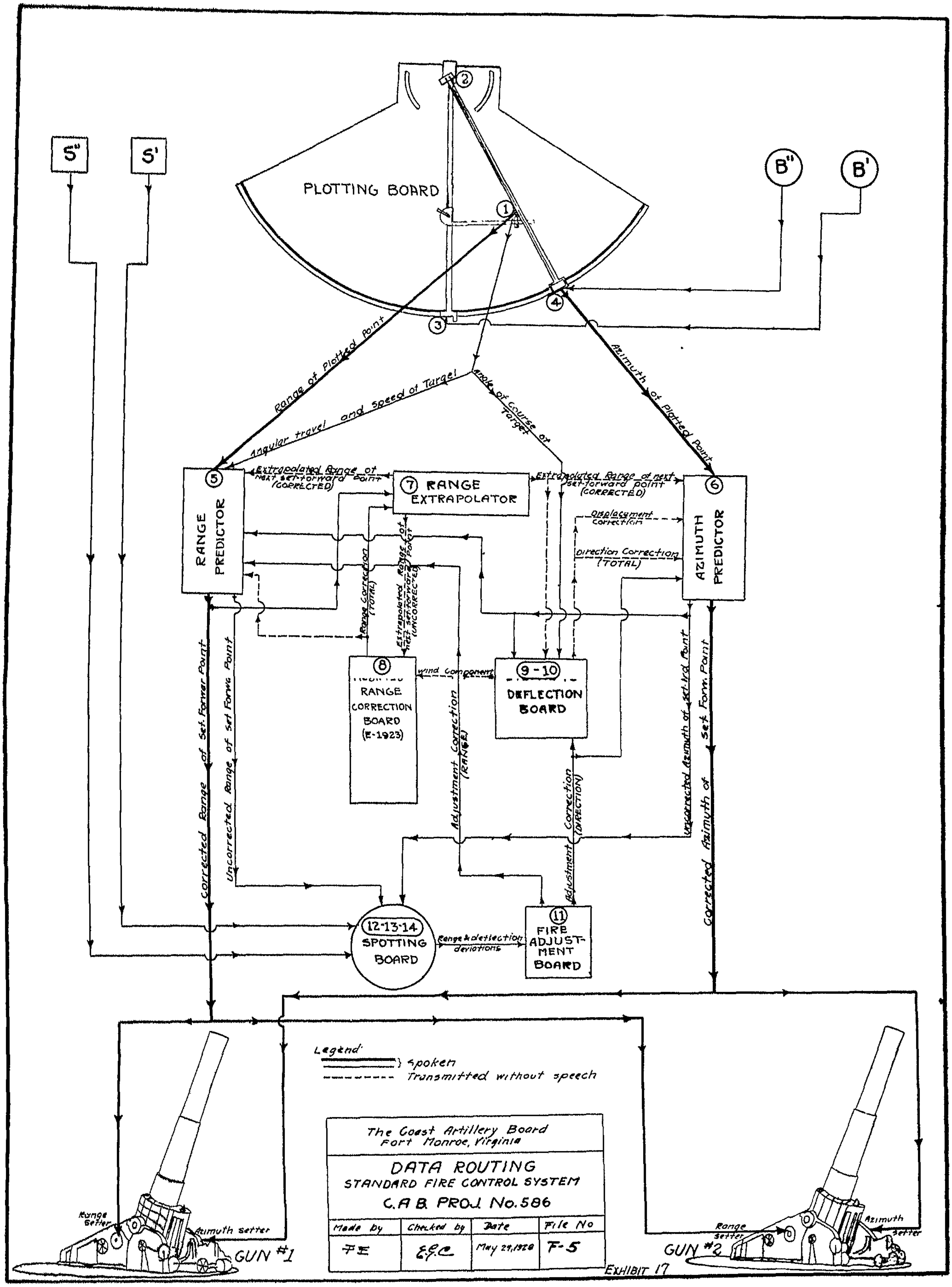
PLOTTING BOARD
S"
S'
B"
B'
Range of Plotted Point
Angular travel and speed of Target
Angle of course of Target
Azimuth of Plotted Point
RANGE PREDICTOR
RANGE EXTRAPOLATOR
AZIMUTH PREDICTOR
Extrapolated Range of next set-forward point (CORRECTED)
Displacement Correction
Direction Correction (TOTAL)
Range Correction (TOTAL)
Extrapolated Range of next set-forward point (UNCORRECTED)
RANGE CORRECTION BOARD (E-1923)
wind component
DEFLECTION BOARD
Adjustment Correction (RANGE)
Adjustment Correction (DIRECTION)
Corrected Range of Set-Forwar Point
Uncorrected Range of Set Forwe Point
Uncorrected Azimuth of set-frd Point
Corrected Azimuth of Set Form. Point
SPOTTING BOARD
Range & deflection deviations
FIRE ADJUSTMENT BOARD
Legend
Spoken
Transmitted without speech
The Coast Artillery Board
Fort Monroe, Virginia
DATA ROUTING
STANDARD FIRE CONTROL SYSTEM
C.A.B. PROJ. No. 586
Made by
Checked by
Date
File No
F.E.
E.G.C.
May 29, 1928
F-5
Range Setter
Azimuth setter
GUN #1
GUN #2
EXHIBIT 17

Fig. 17

for three readings and the shot was a hit. At Battery *Pennington* the data from the plotting board was withheld on several occasions for ten readings and then checked against the extrapolated data and found to have very small errors.

4. It is believed that the construction of the machines may be improved by increasing the scales in the improved models.

5. The predicting interval can be cut to ten seconds if a 110° plotting board is used to furnish the plotted range and aziumth, or a Ford data computer furnishes this. With the Cloke plotting board the interval can not be less than fifteen seconds.

A. H. Bender,
2nd Lieut., 12th C. A.,
Range Officer.

MAXIM XXV

When two armies are in order of battle, and one has to retire over a bridge, while the other has the circumference of the circle open, all the advantages are in favor of the latter. It is then a general should show boldness, strike a decided blow, and maneuver upon the flank of his enemy. The victory is in his hands.—Napoleon's Maxims of War.

BOOK REVIEWS

Europe: A History of Ten Years. By Raymond Leslie Buell. The Macmillan Company. 1928. 5¼"x 8". 428 pp. Ill. $3.00.

The conclusion of the Spanish-American War saw the United States embroiled in the politics of the Far East. Not that the people of the United States desired any such condition—there is plenty of historical evidence to show that they did not. It was forced upon them by the exigencies of the times and there has been no escape from it. From that date we have taken a leading part in the formulation of Oriental policies. So it was with the World War; that struggle embroiled us in the maelstrom of European politics, and whether we like it or not we are there to stay. The interests of Europe are likewise our interests. Our failure to join the League of Nations simply means that we refuse to be coerced, that we reserve freedom of action; it does not mean that we have no concern in European happenings, because we cannot escape from being vitally interested in European affairs. Whether we like it or not we constitute a most important factor in the peace and prosperity of Europe. It therefore behooves the American voter to keep acquainted with international European politics, and Mr. Buell's new book is admirably fitted for that purpose. Not only is this book of value to the man who frankly admits that he knows nothing of the subject, but also to one who believes he has kept himself informed by daily reading of the foreign news. To evaluate properly news items appearing from time to time over a period of several years is beyond the capacity of any man. It is necessary to segregate the items appearing on any one subject, to analyze and study them before an opinion of any value can be formed, and few have the time or opportunities for such work. Herein lies the value of Mr. Buell's book; it sets forth clearly and concisely the important events of the past ten years, segregated according to subject matter, starting with the Treaty of Versailles and concluding with the Kellogg anti-war pacts, signed this past August. The correlation of events which, to the casual reader have no connection with each other, is shown and analyzed, and deductions drawn therefrom.

Recently the papers have mentioned an approaching commission on reparations, one which will determine how much Germany must pay annually and for how long a period—in other words, to determine the total amount of reparations, a figure which was not included in the Versailles treaty. The results of the commission's labors will not be thoroughly comprehensible without a knowledge of the provisions of the Treaty; of the effect on Germany of the loss of the coal fields in Upper Silesia and of the iron mines in Alsace-Lorraine; of the temporary loss of the Saar valley, with its industrial resources; the loss of her colonies and her merchant marine as provided for in the Treaty; and the establishment of international commissions to control the four principal German rivers. Obviously, such losses greatly affect Germany's ability to pay, as Mr. Buell says "both England and France demanded reparation payments; but neither country wished to see Germany build up a huge industrial machine which would become a military danger to France and which would deprive Britain of her overseas markets . . .

the Allies could not have their cake and eat it too." This matter is important to Americans likewise. As a result Germany defaulted and France, contrary to the wish of the other Allies, occupied the Ruhr valley, resulting in the complete financial ruin of Germany and a financial crisis in France itself which almost put that country on a par, economically, with its defeated enemy. Then followed the London agreement on reparations and then the Dawes plan of 1924, which was based on an economic assistance to Germany. All these matters are shown in detail by Mr. Buell, as is also the improved condition of Europe which resulted from the acknowldgement of the fact that payments cannot be expected from a ruined country. The chapters bearing on this matter should be studied in order that the work of the forthcoming commission can be properly appreciated.

In discussing Germany's eastern frontier Mr. Buell shows apparent inconsistencies in the attitude of the Allies, the Polish corridor and Upper Silesia being awarded to Poland on the ground of self-determination, but Danzig was taken from Germany and made into an autonomous free city, although the population is overwhelmingly German. In other words, in case of doubt, the vanquished paid, as has been the custom from time immemorial. The Vilna question could not be settled thus easily. Poland and Lithuania were both carved out of Imperial Russia, being restorations of mediaeval countries. Vilna was the ancient capital of Lithuania and was recognized by both Russia and Allies as a part of that country. But in 1920 the Poles took forcible possession of the city, claiming that the majority of its inhabitants were Poles. There seems to be a general misapprehension regarding the old status of Poland and Lithuania. The latter country never was a part of Poland; the two were joined as the result of the marriage of the sovereign Prince of Lithuania with the Queen Regent of Poland in the fourteenth century, and they remained under the same sovereignty but as coordinate states. That the Polish capital housed the royal court was simply due to its greater importance and culture, just as James VI, of Scotland, chose London for his residence when he became king of England. Never make the mistake of telling a Scotchman that his country is a part of England; the case of Poland and Lithuania is the same. Mr. Buell says that "no one knows the actual wishes of the population of Vilna, but it seems to be now generally agreed that Vilna is inhabited neither by a majority of Poles nor of Lithuanians, but of Jews." Which indicates that it should be annexed to New York.

Lest it be thought that Mr. Buell is partial to the Lithunanians, the case of Memel must be mentioned. This town, like Danzig, is German in every way, but Lithuania needed a port, so, following the example of Poland with respect to Vilna, Memel was captured and "after some grumbling the Allies accepted the accomplished fact, and transferred Memel to Lithuania." It is no wonder that sore spots exist in Europe and that wars happen when nations can get away with events like those of Vilna and Memel.

The internal administration of Soviet Russia and the evolution which has taken place in the economic policy of the Communists since the overthrow of the Kerensky government is well told in the chapter on "Soviet Russia," which Mr. Buell concludes in these words: "If Communism is destroyed, it will be destroyed by forces not outside but within itself—by the weaknesses of bureaucracy and autocracy . . . But the day of such weakness is not yet. The Communists are still masters in their own house."

The final paragraph of the book refers to the Kellogg treaties. "Altogether so many 'interpretations' have been made by the leading parties to this treaty that it is difficult to see just how wars are really prohibited by it." Just prior to that Mr. Buell says, "the most important of these (interpretations of the treaty) declared that self-defense was not prohibited by the treaty and that each state might decide what constituted an act of self-defense." On page 13 Mr. Buell quotes another author as saying, "So great are the psychological resistances to war in modern nations that every war must appear to be a war of defense against a menacing, murderous aggressor." Mr. Buell's difficulties in comprehending the value of the anti-war pacts are easily understood. Notwithstanding the many disputes which his book shows are still existent an improvement in international relationships is clearly discernible, the feeling of insecurity which followed the war is gradually becoming less thus rendering more likely the solution of problems upon their merits, rather than upon the exigencies of the moment. This will tend towards removing the causes of war and do more for the peace of the world than all the anti-war treaties ever written.

This book should be read by all who make any pretence of keeping up with international affairs.—R. E. W.

MAXIM LXIV

Nothing is so important in war as an undivided command; for this reason, when war is carried on against a single power, there should be only one army, acting upon one base, and conducted by one chief.—Napoleon's Maxims of War.

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July to December, 1928

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