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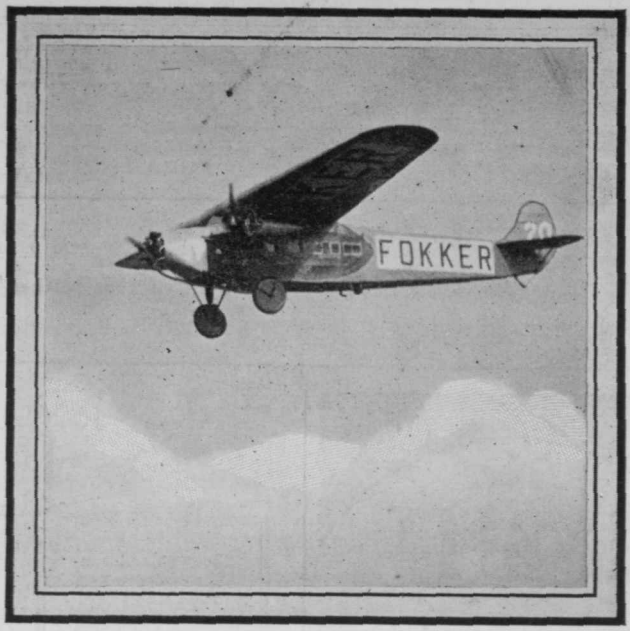

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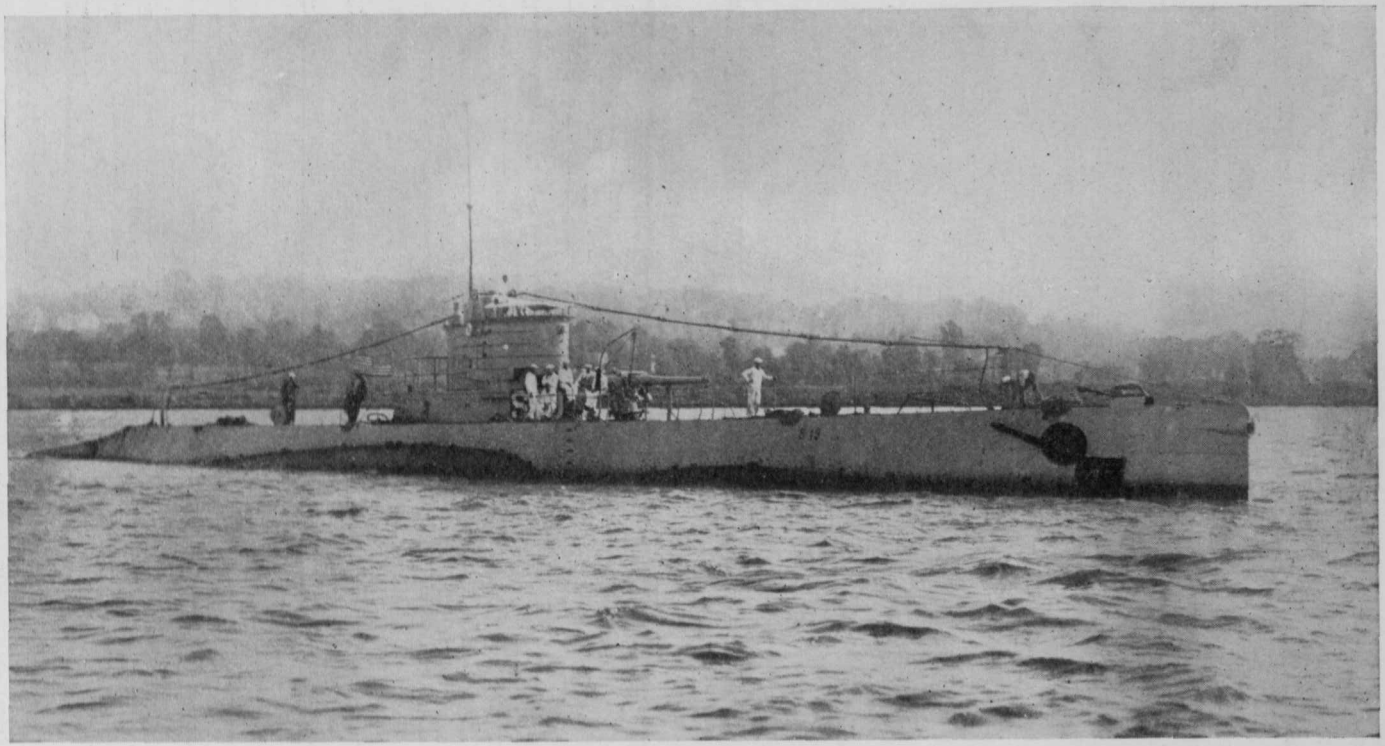

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THE COAST ARTILLERY JOURNAL

Volume 65 OCTOBER, 1926 Number 4

General McClellan's Intentions on 25 June, 1862

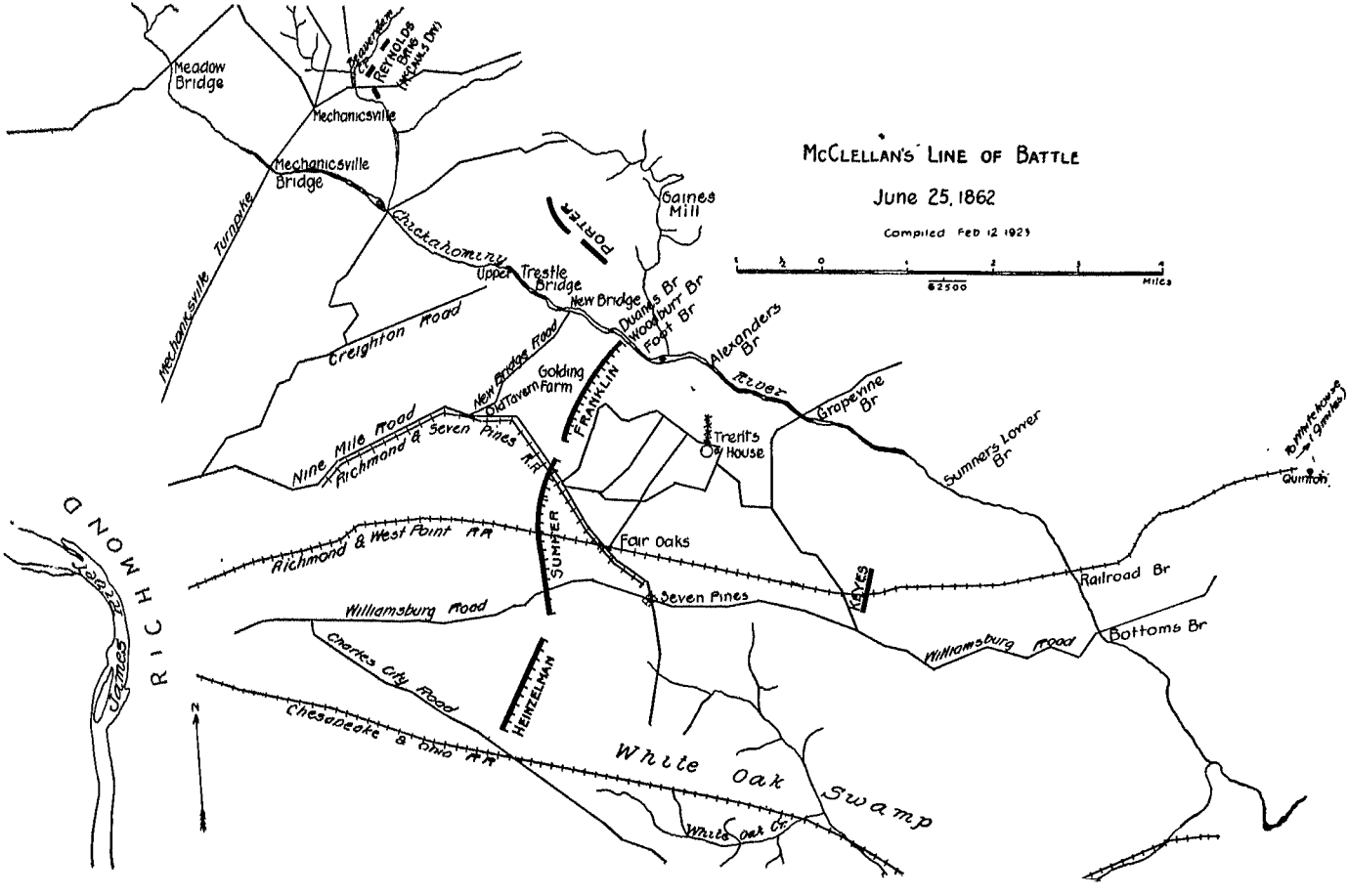
By MAJOR IRVING J. PHILLIPSON, A. G. D.

EDITOR'S NOTE.—*The Peninsula Campaign was an attempt by General George B. McClellan, commanding the Army of the Potomac, to capture Richmond by way of the peninsula formed by the York and the James rivers. McClellan arrived at Fort Monroe on April 2 and, beginning his movement two days later, discovered that the Confederates under General Magruder, held a line of fortifications across the peninsula from Yorktown to the mouth of the Warwick river. Although the Federal force numbered 58,000 men, while the Confederates had but 11,000, regular siege operations were begun. General Joseph E. Johnston, having assumed command of the Confederates, held his line until May 4, when he withdrew. Gen. Hooker overtook the Confederate rear guard at Williamsburg on May 5 and attacked, but was repulsed. McClellan then advanced to the White House on the Pamunkey River, where he established a permanent base on May 16. Johnston, having learned of the evacuation of Norfolk (May 10), the destruction of the Merrimac, and the opening of the James River to the Federals, withdrew across the Chickahominy River and, on May 17, camped three miles from Richmond. To clear the way for reinforcements from Fredericksburg, under McDowell, Gen. Fitz-John Porter defeated a considerable Confederate force at Hanover Court House on May 27, but McDowell did not join. McClellan moved a part of his army, under Keys and Heintzelman, south of the Chickahominy, where it was attacked by Johnston on May 31, in the Battle of Fair Oaks or Seven Pines, and driven back until the Confederates were checked by the timely arrival of General Sumner. For nearly a month both armies remained inactive. Both sides received reinforcements, and in the latter part of June McClellan had about 92,500 men, while General Robert E. Lee, who had assumed command in the defense of Richmond, had about 81,000 men, including Jackson's command. On June 25, Porter was on the right of the Federal line, north of the Chickahominy, and the four corps of Franklin, Sumner, Heintzelman, and Keys were south of the river. On that day, preparatory to a general movement on Richmond, an advance was made in front of Seven Pines, which brought on the Battle of Oak Grove, with no material result; but it marked the beginning of the Seven Day's Battles, in which the siege of Richmond was abandoned. It is at this point that the author begins his interesting study in an effort to determine just what McClellan had in mind when he started the advance of June 25, 1862.*

INTRODUCTION

HUMAN intention, past or present, can be determined, logically, only from a consideration of the actions and statements of the individuals concerned, when examined in connection with the circumstances that surround them. Therefore, it is believed that, if from the materials accessible, we can reconstruct the military situation as General McClellan's distinctive individuality conceived it to exist on June 25, 1862, and can weave into this frame the activities of the Army of the Potomac and its commander as they most probably occurred, there will be a basis for the determination of intentions.

In the larger sense, any particular day in the existence of an army is but one of a series, and the accomplishments thereon of military importance only as they further the general scheme of operations. It is reasonable to assume that General McClellan's intentions on June 25 bear an intimate relation to those he entertained previously. Further-


McClellan's Line of Battle
June 25, 1862
Compiled Feb 12 1929
Meadow Bridge
Mechanicsville
Mechanicsville Bridge
Mechanicsville Turnpike
Beaverdam Cr
Reynolds Drive (Hewlett's Drv)
Gaines Mill
Porter
Chickahominy
Upper Trestle Bridge
New Bridge
Duane's Br
Woodbury Br
Foot Br
Alexanders Br
River
Grapevine Br
Summers Lower Br
To White House & Yorktown
Gumton
Creighton Road
New Bridge Road
Golding Farm
Old Tavern
Franklin
Nine Mile Road
Richmond & Seven Pines R.R.
Trent's House
Richmond & West Point R.R.
Summer
Fair Oaks
Seven Pines
Keyes
Railroad Br
Williamsburg Road
Charles City Road
Heintzelman
Chesapeake & Ohio R.R.
White Oak Swamp
White Oak Br
Williamsburg Road
Bottoms Br
Richmond
James
N

more, changes of intentions are generally more distinctively registered than intentions themselves. Hence, if we can reasonably establish the commander's intentions previous to a certain date and can show that they probably did not change on that particular day, we shall have arrived at a likely determination of our problem. It is from this viewpoint that the discussion which follows must be considered.

THE FRAME

THE DAY OF JUNE 25, 1862

On June 25, 1862, the Army of the Potomac was astride the Chickahominy River facing Richmond as shown in the accompanying sketch.[1] The troops south of the Chickahominy were protected by a line of redoubts,[2] while the right wing north of the river occupied a natural position less strongly fortified.[3] Between 8:00 and 9:00 in the morning, General Heintzelman's Corps on the left, in conjunction with parts of General Keyes' and General Sumner's Corps and in compliance with Army orders issued the day previous, attacked the Confederates in their front in order to obtain ground favorable for later operations.

This was apparently an attack with a limited objective, made with the immediate object in view of extending the Union line of pickets, but probably expected by General McClellan later to assist General Franklin's Corps in an attack on Old Tavern. The attack was halted around noon but was later resumed when General McClellan came on the field about 1:00 P. M.[4] By evening all objectives had been atttained, although counterattacks had been rumored. This fight is known as the Engagement at Oak Grove.

About 5:00 P. M., General McClellan realized from information then in his possession that General Jackson's command, which had previously been operating in the Shenandoah Valley, was probably moving in his direction and had already reached the vicinity of Hanover Court House within twenty-five miles of the Union right.[5] General Jackson's command actually arrived in the vicinity of Ashland that night but twelve miles from the Union Beaver Dam Creek position and a similar distance from Richmond.[6] This confirmed suspicions which had been entertained on the day previous[7] concerning General Jackson's movement. This movement could be construed as a threat against the Union weak right flank,[8] and also against the base at White House and the railroad which was the line of communications to this base (See map). After

[1] PSB 333-34, 415, 596; II RR 221-22; 12 RR 115.
[2] 12 RR 49, 115-16.
[3] 13 RR 20, 222; PSB 334.
[4] 12 RR 50, 116; 13 RR 96-97, 108; 14 RR 25; PSB 174-76, 208, 209; CW, 622.
[5] 12 RR 51; 13 RR 20, 96.
[6] 13 RR 490, 552.
[7] 12 RR 49, 116.
[8] 12 RR 51; PSB 533.

receiving this information, General McClellan repaired to General Porter's camp where he probably remained until after midnight.[9]

GENERAL McCLELLAN'S CONCEPTION OF THE ENEMY SITUATION

The Confederates opposed the Union works with a line of intrenchments which, although of no great importance, enabled them to hold on any part of their front while concentrating on another part.[10] These Confederate works[11] were south of the Chickahominy and commanded the rear approaches of New Bridge and the bridges northwest thereof.

General McClellan evidenced an exaggerated idea of the enemy strength in men and fortifications. This is true not only on the twenty-fifth but throughout the campaign.[12] How much this attitude may have been affected to obtain the reinforcements for which he was constantly asking[13] and how much it was induced by a faulty intelligence system and by the personal characteristics of the commander is difficult to determine. It is probable that General Lee succeeded in deceiving his opponent on more than one occasion both as to troop movements and as to their disposition.[14] Accurate maps were lacking and were improvised during the campaign.[15]

GENERAL McCLELLAN'S PERSONAL CHARACTERISTICS

Certain traits of character seem to dominate General McClellan's military operations. He was exceedingly cautious and apparently disinclined to force combat. At Yorktown he allowed General Magruder with twelve thousand men to force him into siege operations. At Williamsburg his halting pursuit spent itself in vain. At Fair Oaks the Confederates retreated unmolested. His arrival on the battlefield was, on more than one occasion, so delayed as to excite unfavorable comment.[16] There is much evidence to show he was indecisive.[17] His messages suggest considerable instability of character[18] and the existence of vanity in his makeup. Unfavorable intelligence, apparently, particularly upset him and aroused in his mind intense self pity.[19] At such times he waxed grandiloquent and tried to shift responsibility to the shoulders of his superiors. Although, evidently, diametrically opposed to the politics of the Washington government, under whose immediate direction he was operating, he apparently made no attempt to terminate this intolerable situation by resignation.

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[9] 13 RR 20, 96; PSB 208-209.
[10] 13 RR 490; 14 RR 233; PSB 355, 531.
[11] 12 RR 115; PSB 708.
[12] 12 RR 29, 46, 48, 51; 13 RR 231; 14 RR 143; PSB 175, 758, 789.
[13] 12 RR 490; 14 RR 210; PSB 326, 331, 788.
[14] 12 RR 8, 152.
[15] CW 361; 12 RR 129-30; PSB 4, 250-1, 253, 267, 316, 891, 913.
[16] CW 346; 12 RR 118; 13 RR 223; PSB 355.
[17] 14 RR 181-82.
[18] 12 RR 51, 61; 14 RR 280.
[19] PSB 133, 175, 710; Also see footnote (18).

THE PICTURE

GENERAL MCCLELLAN'S EVENTUAL INTENTIONS

1. *Offense or Defense—which?*—General McClellan states[20] that before leaving Fortress Monroe he had hoped "by rapid movements to drive before me or capture the enemy on the Peninsula, open the James, and press on to Richmond before he should be materially reinforced." Such an intention is many times referred to in the succeeding pages of his reports and in his official and personal communications.[21] It is therefore reasonable to suppose that before the twenty-fifth of June General McClellan believed that his intentions were to attack. He seemed to realize that he ought to attack and that any advantage that he had was being lost by each day's delay. On June 2, the Chickahominy was an obstacle.[22] On June 7, he was waiting for McCall and a chance to move artillery.[23] McCall's division arrived on the twelfth and thirteenth[24] and General McClellan hoped to advance about the sixteenth.[25] On the eighteenth, he informed President Lincoln that "after tomorrow" he would fight the rebel army as soon as Providence would permit.[26] During the above period there was considerable picket fighting but no general engagements are recorded.[27]

Official records of this period contain many references to defensive action and to strengthening the position.[28] On June 20, General McClellan informed the President that the defensive works covering the position south of the Chickahominy were about completed and that he was forced to use these in order to make up for his inferiority in numbers and to secure the army against the consequences of unforseen disaster.[29] On June 12, General Kearney had assured General McClellan that two brigades could easily defend the left of the line.[30] General Barnard describes the defensive line.[31] General Porter speaks[32] of the erection of those defensive works which permit large forces to be detached at opportune moments for aggressive action "or the defense of menaced positions." General McClellan states[33] that after the battle of Fair Oaks the troops were directed to strengthen their position by a strong line of entrenchments for protection while the bridges were being built, for security to the trains, and for liberating a larger fighting force. It also offers, he states, a safer retreat in case of disaster. General

[20] 12 RR 8.
[21] 12 RR 24, 27, 29, 32, 35-36, 47.
[22] 12 RR 44.
[23] 12 RR 46.
[24] 12 RR 47.
[25] Idem.
[26] 14 RR 233.
[27] CW 610; 14 RR 215.
[28] 14 RR 256.
[29] 12 RR 48.
[30] 14 RR 225.
[31] 12 RR 114.
[32] PSB 531.
[33] 12 RR 44.

Sumner,[34] testifying under oath during an official investigation, states that he was never in favor of field works as he thought they made men timid and did more harm than good. It is impossible to reconcile these statements with our ideas of pressing on to Richmond by rapid movements.

What then is the explanation? General Lee states[35] that the intention of the enemy seemed to be to attack Richmond by regular approaches. General McClellan writes[36] under date of June twenty-third: "It now looks to me as if the operations would now resolve themselves into a series of partial attacks rather than a general battle." No two individuals were in better position to know or were more capable of judging. Siege operations, the battle of limited objectives, the offensive from behind breastworks—call it what you like—characterized the offensive operation under consideration. The tactics of such operations are usually understood to include holding a portion of the line with part of the command behind strong entrenchments, while at another point, an assualt with limited objectives is launched. The ground thus gained is consolidated and the maneuver repeated. In case the enemy attacks, the position is defended from behind the fortifications. Later the initiative is again sought and the "nibbling" process resumed. It is much slower, more indecisive and a less effective type of offensive warfare than open warfare attack and is, usually, adopted only when forced on the attacker. Operations of this description seem to correspond to General McClellan's peculiar temperament and to characterize his military endeavors.[37]

2. *The Change of Base.*—On June 25, General McClellan's base was at White House,[38] on the Pamunkey, eleven miles from the Chickahominy and connected therewith by the Richmond and West Point Railroad (See map). This base was in rear of the right of his line and its protection required the presence of a large force north of the Chickahominy.[39] General McClellan from the first had preferred the James to the York as a line of communications.[40] He accepted the York at the beginning as a matter of necessity.[41] Until now, the York had been looked on favorably by the authorities in Washington for supply purposes because its tributary to the Pamunkey was advantageously located to supply an operation against Richmond from the northeast should the armies of General McClellan and General McDowell unite.[42]

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[34] CW 366.
[35] 13 RR 490.
[36] PSB 176.
[37] 12 RR 18, 129-30.
[38] 12 RR 159, 165; 14 RR 248.
[39] 14 RR 233-4.
[40] 12 RR 28, 53; 14 RR 225.
[41] First the Merrimac and then obstacles blocked navigation.
[42] 12 RR 27-28; 14 RR 286.

General McClellan probably decided that the time to shift his base to the James was approaching about the middle of June, and about June 18 arranged to move some supplies.[43] When did these supplies actually move and what kind of supplies were they? It is reasonable to believe that by this time he was beginning to realize that General McDowell's force was not coming[44] and to contemplate the movement of Porter's Corps south of the Chickahominy. A movement against Richmond from the east must necessarily be preceded by a change of base as such maneuver would uncover White House. General McClellan apparently understood this.[45] Stuart's raid around the Union Army on the thirteenth to fifteenth of June may have further impressed the mind of General McClellan regarding the vulnerability of his existing base.[46] There is little doubt that the movement of this base from the Pamunkey to the James was included in General McClellan's eventual intentions immediately preceding June 25 but that no definite date had been set for the abandonment of White House.[47] Such action was probably taken by General McClellan about June 28.[48]

3. *The Actual Operations.*—It is now necessary to determine whether the operations of the Union Army immediately preceding June 25, reasonably result from such intentions as we believe its commander entertained at this time. If such relation does exist, we have established still greater probability. The Corps of General Heintzelman and General Keyes crossed the Chickahominy before the battle of Fair Oaks. General Sumner's Corps crossed during this battle and remained on the south bank. General Franklin's Corps crossed on June 18 and the days that followed.[49] All these were intrenched. Fighting since the battle of Fair Oaks, where the Confederates attacked, has been confined to pickets. There have been no pitched battles. General McClellan's army is edging forward. The nibbling process is under way.

The next logical step in the operation, provided the advance on Richmond is continued from the east and no serious attack is encountered, would be the crossing of General Porter's Corps to the south bank of the Chickahominy. However, two preliminary operations must precede this crossing. One is the shifting of the base from White House or its adequate protection by other means. The other is the occupation of the ground which commands the bridges in front of General Porter's Corps. The Confederates held a strong position at Old Tavern, which prevented Porter's advance across New Bridge, and similar enemy posi-

[43] 12 RR 52, 59, 169.
[44] 12 RR 53, 131; 14 RR 233.
[45] See footnote (25).
[46] 12 RR 1031, 1036; 14 RR 230.
[47] 12 RR 160; 13 RR 19; 14 RR 249, 253, 258.
[48] 12 RR 160, 165; 13 RR 482; 14 RR 273.
[49] 12 RR 38, 40, 812, 872; CW 346, 622.

tions controlled the crossings to the northwest.[50] On June 23, General Porter was under orders[51] to hold a portion of his force in reserve to watch the right flank and to prevent the enemy from bridging the Chickahominy. Prompt information of hostile movements was desired by the army. If General Porter's Corps was attacked, the troops south of the Chickahominy were to be held ready to support him or to attack the enemy in their front. If the attack against the right was in force, General McClellan preferred the latter course, trusting General Porter's Corps to hold. This order was issued at 10:50 on the evening of the twenty-third and presumably held during the twenty-fourth. Such orders were the natural ones to expect until the White House problem had been solved and an adequate bridgehead had been established to cover the crossing of the right wing. On June 24 orders[52] were issued for an operation south of the Chickahominy which would gain ground on the flank of Old Tavern, thus facilitating the capture of Old Tavern later. It would seem the actions and orders of the army check with the supposed intentions of its commanders. We now come to June 25, the day in which we are primarily interested.

GENERAL McCLELLAN'S IMMEDIATE INTENTIONS

It is believed that General McClellan's immediate intentions south of the Chickahominy until about 5:00 P. M. on the twenty-fifth were essentially as he claims in his report of August 4, 1863;[53] namely, "It was decided to push our lines to the other side of these woods in order to enable us to ascertain the nature of the ground and to place Heintzelman and Sumner in position to support the attack intended to be made on Old Tavern on the 26th or 27th by General Franklin assailing that position in the rear." As already discussed, the capture of Old Tavern was one of the next logical steps in General McClellan's supposed plan of maneuver. Such an operation corresponds in form with those in use by the Army of the Potomac at the time of which we write. A map study reveals that the maneuver is a possible one to accomplish the ends sought. The statements of many persons who were in official position to know,[54] as well as General McClellan's contemporaneous communications,[55] support the accuracy of this belief.

During the same period we are unable to discover any change in the commander's immediate intentions north of the Chickahominy. Combat preparations are proceeding in accordance with the orders issued on the night of the twenty-third with perhaps increased energy on account of

[50] 12 RR 116, 248.
[51] 14 RR 247.
[52] 13 RR 96, 108.
[53] 12 RR 50.
[54] 12 RR 116, 248; 107 RR 691; 13 RR 97; CW 622; PSB 534.
[55] CW 433-5; 13 RR 19; 12 RR 50; PSB 174-76.

a deserter's unconfirmed and slightly credited report received on the twenty-fourth.[56]

After 5:00 P. M. General McClellan learned that General Jackson's troops were probably at Hanover Court House. In his own words: "I immediately repaired to the camp of General Fitz-John Porter, commanding the right of the Chickahominy, to obtain further information and arrange the movements for the morrow. On my arrival, I found there was a strong probability of Jackson's advancing, although not a certainty." The report ends with a description of how he retained McCall's division in its strong position, with Porter's remaining troops in reserve, ready to act "according to circumstances," while the troops south of the Chickahominy "were also to be held in readiness to repulse any attack or to move to the assistance of the right."[57] It must be remembered that General McClellan did not get what he considered full authentic information that the enemy was meditating striking a blow against his right wing until the twenty-seventh;[58] and that Hanover Court House, where Jackson was then reported to be, is on the road to Richmond as well as to the Union right flank and about an equal distance (twenty-five miles) from each. We find no action indicated in the above report different from what General McClellan would be expected to do under his existing plans and the situation as he understood it to exist at the time.

We are now examining the critical period. If any change of intentions were manifested on June 25, this is the period to expect them in. At 5:00 P. M., General McClellan informed Washington that success was complete.[59] At Oak Grove, at 6:15 P. M.,[60] in a succeeding message, he registered despair and disclaims responsibility—a typical McClellan reaction to unfavorable intelligence. He states in this message certain immediate intentions he purported to entertain. One sentence is pivotal. It reads: "I shall probably be attacked tomorrow and now go to the other side of the Chickahominy to arrange for the defense on that side." Wherein is this intention different from those expressed in his orders to General Porter[61] on the twenty-third?

Then follow a series of four messages,[62] sent between 7:00 P. M. and 10:30 P. M., which indicate a state of worried uncertainty concernnig the immediate future and a vague misgiving relative to the safety of the right and the rear. However, at 10:40 P. M.,[63] General McClellan wired the Secretary of War from General Porter's headquarters. At

[56] 12 RR 49; 107 RR 693-6; PSB 533-34.
[57] 13 RR 20.
[58] CW 433-5; 13 RR 222.
[59] 12 RR 50.
[60] 12 RR 50.
[61] 14 RR 247.
[62] 14 RR 252-53.
[63] 14 RR 254.

this hour, though still unable to avoid his usual references to reinforcements and the enormity of his task, he faces the future with more equanimity. We will see later that his confidence with reference to affairs south of the Chickahominy returned about the same time. In the message just referred to,[64] General McClellan states that he has made all arrangements to meet an attack on his front on the twenty-sixth and that he has taken every possible precaution to meet the attack on his right and rear which he considers probable. Such have been his intentions at all times in case of serious attack. We can find no change of intentions here relative to that portion of his army north of the Chickahominy, at least until 10:40 .P M., the hour of this message.

Referring again to General McClellan's report of July 15,[65] he states that, on the morning of June 26, he felt contented to await the bursting of the coming storm, ready to profit by any fault of the enemy and sure that he could extricate his army from any difficulty in which he might become involved, and that he maintained this attitude in the face of unfavorable intelligence.[66] No change of intentions here. The ultimate intention is still alleged to be retained, even if it is admitter that there is a chance of its being deferred. A serious hostile attack has already called for the defensive from behind breastworks at the threatened points, according to General McClellan's form of tactical maneuver.

On the night of the twenty-sixth,[67] General Porter says that the commanding general left them with the intention of deciding whether General Porter's command should hold Beaver Creek or retire toward Gaines Mill. Here we find the first indications of even a pending change of intentions. However, it is apparent then no decision had been reached even at that time. It is, consequently, believed entirely probable that no change of intentions relative to operations on the north bank of the Chickahominy took place on June 25.

South of the river, we find Heintzelman's troops "vigorously attacked" about 5:30 P. M.,[68] and about that time a message from Army Headquarters signed Marcy was sent to General Heintzelman to the effect that the entrenchments were the true field of battle and if the pickets were hard pressed they should fall back to the entrenchments slowly.[69] This message apparently answers an earlier one from General Heintzelman. However, the attacks were repulsed[70] and by 9:00 P. M. all was quiet. During the night there were several stampedes and some

[64] See footnote (63).
[65] 13 RR 20.
[66] Probably from Allen report, 12 RR 269.
[67] 13 RR 223; 12 RR 119.
[68] 13 RR 96.
[69] 14 RR 252.

hostile movement which seemed to indicate an attack in the morning.[71] General Heintzelman so notified Headquarters at 9:00 P. M. Sometime during the night General Heintzelman was again informed that it was General McClellan's wishes that he fight behind intrenchments if attacked in force. At this time, disposition for the mass of General Heintzelman's troops were designated to meet the attack then believed to be threatened in the morning.[72] General McClellan's policy to fight behind breastworks if seriously attacked is clearly set forth. However,[73] at 11:00 P. M., General Heintzelman was informed that General McClellan desired him to hold the forward position if it could be done without undue danger and that the previous orders[74] to fall back were based on the belief that he was too hard pressed. It must be remembered that General McClellan was absent from his headquarters during much of this period and the apparent contradictions in orders can probably be attributed in part at least to poor staff coordination. This is not the first time it had happened in this campaign.[75] McClellan's favorite offensive tactics included a defense from behind breastworks whenever an attack in force was delivered against him, and it is not strange that such measures should be ordered in this hour of uncertainty. An aggressive leader might, possibly, have ordered the new position consolidated and held from the outset, especially as so much stress had been laid on its importance in connection with the attack on Old Tavern. This, however, was not to be expected of General McClellan in the mood he was in. At 11:00 o'clock, this action was apparently directed, but with reservations. Presumably, by this time, some of the doubt and uncertainty manifested earlier in the evening had been mastered. Nor is it believed that a change of intentions can be construed except as in the course of the day's battle the rising and falling tide of conflict compelled such changes locally. Preparations for the capture of Old Tavern were continued on the twenty-sixth.[76] The final orders for the night, issued at 11:00 P. M., directed that the ground gained should be held. This was the logical action to take if the operation was to be resumed later. We can, therefore, state with reasonable probability that General McClellan's intentions relative to operations south of the Chickahominy were unchanged at the end of June 25.

CONCLUSION

It has been probably determined that General McClellan's intentions did not change on the twenty-fifth of June. And it is believed

[70] 13 RR 96.
[71] 14 RR 254.
[72] 14 RR 255.
[73] 14 RR 254.
[74] 14 RR 252.
[75] 13 RR 106, 109; CW 346.
[76] 12 RR 139-40, 162; 13 RR 97; CW 622.

that a reasonable picture has been presented of his apparent intentions previous to that date. It is, therefore, believed that General McClellan's intentions during the period in question were to advance on Richmond keeping his army protected by breastworks and taking the defensive, temporarily at least, whenever and wherever he was seriously threatened with attack. Such tactics are difficult to understand at the present day. They include such an indefinite blending of the offensive and of the defensive as now understood, as to render clear-cut distinction impossible. It is doubtful in my mind, whether General McClellan had or desired any clear-cut visualization of his contemplated maneuver. However, the facts as determined by this investigation entitle him to the benefit of the doubt and it has been so awarded.

As for the immediate intentions on the twenty-fifth, they are believed to be in extension of the operation previously contemplated. Concretely, these intentions would seem to be to defend north of the Chickahominy in conjunction with an operation south of the river calculated to facilitate the taking of Old Tavern later. The tide of battle and the receipt of possibly unfavorable intelligence may have at times during the twenty-four hours threatened the continuity of the existing intentions, but nowhere have I been able to segregate any evidence of an actual change.

A change in actual intentions would in all probability carry with it some tangible evidence of the change. I do not mean to infer that General McClellan did not have a considerable number of alternative plans which he contemplated substituting providing certain contingencies arose. The contrary is true for we know that he had been contemplating a change of base for a considerable period. What is meant is the belief that conditions had not changed sufficiently by the end of the twenty-fifth to warrant in General McClellan's indecisive mind a change of intentions. He certainly had not gone beyond the wavering stage on the twenty-fifth.

Had General McClellan believed himself actually threatened by the enemy on June 25, four plans were open to him:

(a) To concentrate the army north of the river.

(b) To concentrate the army south of the river.

(c) To defend all along the line in his present position.

(d) To hold north of the river and attack south thereof.

There is evidence to show that he, at different times, had contemplated all of these. There is also evidence to show that when he was forced by circumstances to adopt one of them, he showed the greatest unwillingness to make a decision. It is difficult to measure a per-

sonality of the type to which General McClellan evidently belonged by any known standard. As has been aptly stated, he intended to move rapidly on Richmond no matter how many trenches he had to dig.

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Not less than 50 per cent of those who were killed in action or died of wounds were wastefully sacrificed because of inadequate training or no training at all. * * * Every company officer who fought in France, every stretcher-bearer, every member of a burial detail, could tell of men—wounded or dead—whose rifles had not been loaded, of others whose clips were full because they evidently did not know how to operate the bolt, of dead and dying men in testifying heaps. Soldiers who lacked discipline huddled together because of their greenness for that battle companionship which is the natural desire of men who have never learned to fight in extended order. That the machine guns were captured, if not withdrawn, is beside the question. The point is that the captures cost excessively; skilled troops would have done the work without extravagant losses.—*Major Gen. George H. Harries.*

Troop Schools

By CAPTAIN A. W. JONES
Coast Artillery Corps

IN analyzing any system it would appear that, granted a free hand in dealing with the subject, the first consideration is whether or not the system has any theoretical value, then if it is of practical value. In considering the question of troop schools the first thing to look for is the purpose and its soundness and whether or not the troop school fulfills the purpose for which intended or whether it is susceptible to improvement. The purpose of the military educational system, as announced by General Orders of the War Department for many years, and especially by General Order 112, 1919, is to provide officers with the systematic and progressive instruction that will fit them for the highest command and staff duties that their abilities will permit them to fill; to supply the necessary tactical and technical knowledge for officers who have not attended the special service schools and to give further instruction in these subjects to officers who have attended these schools; to increase thereby the general efficiency of the Army and its war preparedness. This, as a whole, is beyond the scope of the troop school, and part, at least, is in the realm of the special and general service schools; but it should be kept in mind in conducting the troop school, for that this purpose is one of infinite value to the service is obvious. After a consideration of our own individual make-up and what we know, it becomes apparent that a system of supervised education is essential if every officer, or even a large majority, are to have the well-rounded military education that is demanded in the successful conduct of modern warfare. I consider this supervised education necessary for this reason: by far the greater number of us, unless strongly urged from the outside, will study either not at all or only spasmodically, and in the case of the few who do study with any degree of persistency, there is a strong tendency to work along some particular line that is of interest to the individual. The result is that the individual officer neglects his military education entirely or else develops it along such limited lines as to render it of little value, for the ultimate object of all military educational systems should be to give the individual officer a complete and well-rounded military education for the future needs of the service, and not for some one phase of the present.

Having indicated that it is necessary to supervise the military education of the individual officer, the present system of supervision and any

changes or improvements that may seem desirable must be considered. No claim of perfection has been made for the present system, but it is designed to carry on supervised education at the minimum of expense, and any system proposed must be based on minimum expense of operation.

The present system provides for the education of the newly commissioned officer in those subjects an intelligent understanding of which is essential if he is to perform his duties properly and benefit by experience. This is called the basic course and provides for two hours of instruction daily during the period from November 1 to March 30 at the post where the officer is stationed, and under instructors carefully chosen from officers on duty at the post. The course is divided into two parts: (1) drill regulations, to include the company or similar unit, and ceremonies; saber manual; administration and mess management, including care of property, preparation of all company papers, accounts, and records, and the conduct of the company mess; nomenclature and use of the pistol; interior guard duty. The post commander is entirely responsible for the conduct of this part of the basic course and determines the proficiency of the student officers in the subjects covered. (2) The second part of the basic course is prescribed by the War Department as to text books to be used, amount of time to be devoted to each subject, and the examination to determine the proficiency of the student. The following subjects are covered: Military courtesy and customs of the service, 5 hours, lectures to be delivered by the commanding officer or other specially qualified officer designated by him; military sketching and map reading, 30 hours, a theoretical and practical course in the preparation and use of military maps, to include the making of road and position sketches; military law, 60 hours, using the *Manual of Courts-Martial* with all published changes, to show the student how discipline can be accomplished by sound principles of leadership and the use of the commanding officer's disciplinary powers, and what should be left to military judicial corrective and coercive measures by preferring charges; to fit the student to prefer or investigate charges, serve as a member of a court-martial or as a trial judge advocate or defense counsel; military hygiene and first aid, 15 hours; use of Federal troops in civil emergencies, 5 hours, lectures to be delivered by the commanding officer or other specially qualified officer selected by him; training methods and principles of teaching, 10 hours; hippology, 20 hours; care, operation, and function of the weapons with which the branch is armed, 20 hours.

No examination is given in the following subjects: use of Federal troops in civil emergencies, military courtesy and customs of the service, training methods and principles of teaching. Graduates of the United States Military Academy are exempted in the following sub-

jects: military courtesy and customs of the service, interior guard duty, military hygiene and first aid, saber manual, and field engineering.

The examinations in the second part of the course are conducted by means of examination papers furnished by the Adjutant General's Office and are held in the presence of an officer appointed by the commanding officer. The papers are graded by a board of three officers appointed by the commanding officer, all of whom must be senior to the officers examined. The findings of the board are approved by the commanding officer and forwarded to the Adjutant General. If a student officer appeals from the findings or the commanding officer fails to approve them, they are forwarded to the Corps Area or Department commander, and his action is final. If an officer fails without fault on his part or is for similar reason unable to take the examination, he may be given a special examination prepared at Corps Area or Department headquarters. If an officer is finally rated as being deficient in a subject, he is notified, and the report is forwarded to the Adjutant General for file with his efficiency report, and he will be required to repeat the subject the following year, thus putting teeth into the course that can bite the lazy or indifferent student in a way that may hurt. When the student has satisfactorily completed the course, a certificate to that effect is made out in triplicate, one copy for the officer, one copy for the regimental file, and one copy for the A. G. O.

All instruction is along the lines followed in all military education, that of the applicatory method. Instruction is by lecture, demonstration, and by problems for the student to work out, which will give him a thorough grasp of his subject and the ability to handle problems on his own account, and not merely a theoretical knowledge which he is not able to put into practice. The method of instruction is good, and as the officer is being educated at his own post in addition to his other duties, considerable progress is made at little, if any, expense.

There are several phases of the system which might be improved. The first is that the young officer is prone to become discouraged in his attempt to solve the problem of carrying on duties which are strange to him and also go to school daily. The tendency is for him to let everything possible go till the end and then cram enough to put him through the examination, after which he promptly forgets his hastily acquired and undigested information. Further, he receives only twenty hours instruction in the branch in which he is serving and puts in an equal amount of time on the subject of hippology, which, as a coast artilleryman, he probably considers a waste of time, and this tends to make him lose interest in the course. In the Coast Artillery at least, it would appear better to devote the time spent on hippology to Coast Artillery subjects. Finally, a post may be seriously embarrassed in

finding instructors enough to carry on the course and perhaps unable to find enough officers who have the ability to pass on their information to others. Were the number of students sufficient to warrant it, this would be a small matter in comparison to the benefits to be obtained, but when this condition exists the number of students will probably be small. The entire period of instruction amounts to one hundred and seventy hours and may seriously interfere with the functioning of a post for five months, with the net result of one graduate from the course. It would appear far better to have the student report to his special service school for a period of six weeks or two months, or, if appropriations for mileage render this impossible, then to have in each Coast Artillery District one or more schools for officers taking the basic course, send the officer there for from six weeks to two months of uninterrupted study and then return him to his post. This would allow concentration of effort and increased efficiency. The school would be conducted during the indoor period, the student would be losing no valuable practical experience, and the post would also be the gainer.

As matters now stand, many officers in the Coast Artillery may never attend the Battery Officers' Course in the Coast Artillery School, and even if they do, they may have to wait some time. Although, in the future, the matter will largely adjust itself, a little systematic and progressive instruction conducted along lines laid down by the chief of branch, from time to time, would render the services of all officers of more value to the army, pending their completion of their special service school. Further, it would not only make the school easier for them, but it would prepare them to get the most out of it. Under the direction of the chief of branch a course could be given, during the troop school periods, of two or three years which would give the individual the fundamentals of what he will have in detail at his special service school. Only the more important subjects need be covered and only in a general way, and material from the correspondence courses could probably be used to a considerable extent. This method of handling military education would be along the lines followed as early as 1901, when a three-year course was given in the garrison school. This course contained most of the subjects of our present basic course and a few more advanced but highly technical subjects. The proposed course should cover at least gunnery, orientation, electricity, and tactics.

For the officer who has completed the special service school, refresher courses are necessary if he is to keep the knowledge that he has acquired in such shape that it can be readily used, for unless he works with this knowledge continuously or has a refresher course in it, he is bound to forget a great deal. For officers who fall into this class or have completed the fundamental advanced course previously outlined,

special service schools should prepare a few problems in each subject which will not only refresh the officer's mind but will give the latest information. For this purpose, problems judiciously chosen from each year's courses and from the correspondence courses would furnish the necessary material with little added burden on the school. With the problems should go the approved solution as an aid to the instructor and for the benefit of the student officers after the problem has been solved. This instruction should occupy a part only of the advanced course, the remainder being left at the disposal of the Harbor Defense commander, who should utilize it in the solution of local problems and in utilizing local opportunities of instruction. In this period the officers should be prepared for the ensuing outdoor season and the schedule of instruction coördinated throughout the entire command. Subjects such as gunnery and the actual conduct of fire should be reviewed by conducting one or more problems. In mobile regiments one or more problems in orientation should be worked out as well.

The schedule of instruction laid out by the special service schools should not confine itself to purely technical matters of the particular branch, but should give the officer as large an amount of training of a general nature as possible. Map problems and maneuvers are of great importance, for they keep clear in the mind of the officer the proper coördination of the different branches of the service, the functions of command and staff, and continue him in the habit of estimation and decision. This is of particular importance to the Coast Artillery where the use of such knowledge in the lower grades is comparatively recent, and is of utmost importance in the general preparedness of the officer.

The advanced course for officers, in the troop school, can be made one of great value, but in order to gain the most from it, supervision by the chief of branch is necessary; otherwise, the subjects covered may not be of any great benefit to the officer or he may find himself taking the same thing over again at his next station, with the expected loss of interest which he will probably communicate to his fellow students. Supervision and coördination are necessary, but it is believed that the best results will be obtained when the matter prescribed by the chief of branch and that chosen by the local commander are combined as indicated above. The successful conduct of the troop school must rest largely with the local commander, and his correct application of the methods previously outlined, assisted by his chief of branch and special service school, will go far toward the achievement of the ultimate object of military education—war preparedness. The war preparedness of the individual officer is achieved through his well-rounded and constantly freshened and increased fund of information, and through him the war preparedness of the Army of the United States can be assured.

Coast Artillery—Fixed or Mobile

By LIEUTENANT ALLAN CYRUS
Royal Coast Artillery

Translated from *Svensk Kustartilleri Tidsskrift*

EDITOR'S NOTE.—*This article gives an interesting reaction from a Swedish standpoint toward problems facing the American Coast Artillery, and is particularly valuable by reason of its reference to European authors and experience.*

THE use of stationary coast defenses is grounded upon the proved fact that artillery on land is superior to the artillery of ships on account of its greater accuracy of fire and because it is cheaper to provide such coast defense than to provide local floating defense. Though Napoleon's expression that "one gun on land is equal to one ship afloat" may no longer be true, the superiority of land defenses over fleets is still regarded as considerable.

However, the stationary coast defense has the great disadvantage that it is restricted to a certain locality, and no matter how great its latent power may be, it can display this power only against an enemy who attacks this locality. As strategic reasons do not allow the use of a stationary defense extensive enough to cover all points of a coast, the use of stationary coast defense is limited to those points whose protection is a vital necessity, especially naval bases. Like the stationary (passive) defense of mobile forces, the stationary coast defense has the tactical advantages of favorable firing conditions, protection, and ease of preparation for action, while, in a similar manner, it has certain tactical disadvantages.

Among these disadvantages may be mentioned the difficulty of producing concentrated fire upon a threatened point inside the extended defensive district, the impossibility of concealing from the enemy the location of the defenses (even though the enemy may not have obtained this knowledge before hostilities begin, it is impossible to conceal the fixed defenses from aerial observers), and last, but by no means least, the inability to take the offensive, which has an enormous moral value.

The World War has further shown certain disadvantages of permanently emplaced artillery. It has proved that by giving a relative mobility to the classes of artillery that were formerly stationary, their tactical and strategic weaknesses are greatly reduced.

The Mobility of the Artillery within a Harbor Defense from a Tactical Viewpoint

THE SEA FRONT

Heretofore it has been the practice, as a rule, to give mobility to only the small and medium caliber weapons employed on the sea front.

The principal types of stationary emplacements for these calibers have been protected emplacements and unprotected positions in the open. At places where heavy artillery, outer mines, and torpedo batteries afford means of keeping hostile ships at such a distance as to prevent accurate fire on the protected emplacements, there is no reason to abandon this type of installation; but the emplacing of these weapons in unprotected positions must be condemned, at least where these positions are exposed. The excessive expense renders it impossible to emplace all the small and medium caliber artillery in protected emplacements.

Those which are not so emplaced can be made mobile by mounting them on railway carriages which travel on tracks inside the defenses between the frontal positions and positions which are withdrawn so as to escape the fire of attacking ships, but from which the mine fields can be covered. In addition, there should be secluded support positions, protected from high-angle fire. Movement between different positions must be rapid, and the railway carriages must be so constructed that they can be locked in the firing position, or released therefrom, by the operation of a single lever, and can fire from any point along the track. A solution of the problem of emplacement of small and medium caliber artillery would appear to be a combination of fixed emplacements and railway mounts, thus effecting both protection and fire efficiency.

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The experience gained at the Dardanelles shows the tenacity which light artillery of high mobility can lend to the defense of a sea front. A relatively large number of 5.7-cm. to 8-cm. gun batteries appeared on the shore (alternating with railway guns), and the searchlights also continually changed position. These methods enabled the defenders to hinder greatly the attempts of the attacking forces to destroy the mine fields, without themselves suffering much loss. According to Sir Maurice Hankey's statement to the Dardanelles Commission, concerning the negotiations of the War Council held on January 13, 1915, when the attack on the Dardanelles was decided upon, Mr. Churchill especially emphasized that "there was nothing to fear from field-pieces and rifles, which can do only slight damage—the chief point is to silence the forts." A few months later he must have held a different opinion.

Brassey's Naval Annual, 1916, says of this subject: "Faced with the inability of the Fleet to inflict decisive damage against the forts, or to silence the mobile batteries on shore, which were annoying, and in consequence of which mine-sweeping became extremely hazardous, Mr. Churchill was nerved to greater determination, and the process of gradual reduction gave place to one of a *tour de force*." The task of March 18 was thus executed in desperation, so to speak, and the artillery protecting the mine fields was no slight factor in the Turkish victory of that day.

During the big March attack the mobile artillery played a prominent rôle. Admiral Guépratte says in his report, among other things: "Light mobile batteries, the number of which was continually increased, fired at us at such close range that the guns hardly needed pointing. These pieces changed positions so often that even had we been able to transfer our attention from the big guns to these light guns, we would not have been able to silence them."

It is evident that these batteries were quite troublesome, although they presented no serious menace of sinking the ships, or of seriously lowering their fighting efficiency. Had these batteries consisted of medium-caliber guns, they would have inflicted serious damage.

There is therefore every reason to agree with an eye-witness of the Dardanelles battle when he says: "These battles illustrate the great advantages that accrues to a coast defense by the possession of a large number of medium and small caliber artillery and searchlights, and that both of these should be made as mobile as possible."

THE LAND FRONT

While the sea front of a coast defense can be given a very high power of resistence, the land front will always be the weaker part of a coast defense. Experience shows that, as a rule, coast fortifications are taken from the land side, as were Port Arthur in 1894 and 1904. Wei-Hai-Wei in 1894, Santiago in 1898, Tsingtao in 1914.

In view of this fact efforts have been made to strengthen land fronts by using the sea front artillery as a fire reserve. Thus the heavy pieces are now arranged to give all-around fire.

The moving of pieces from the sea front to a land front can often be accomplished. At Port Arthur, in many instances, the sea-front batteries gave assistance to the land front, and more than twenty pieces —from 57-mm. guns to 23-cm. mortars—were moved during the siege from the sea front to be placed in position on the land side. At Tsingtao the sea front artillery participated in the land defense. The Dardanelles fronts, on the other hand, were so arranged that such fire support was impossible. However, such concentration of fire as indicated

above has not proved fully satisfactory. As a result of the experience at Port Arthur, suggestions for the arrangement of rail connections on the land front, with railway mounts for the pieces, so as to unite sufficient firing power at a threatened point, were made, especially in Russian military literature.

The French had what they called *affut-trucs* which consisted of a carriage which could be transported on railroads of 60-cm. gauge, which connected the different works and batteries of French forts for the purpose of transporting ammunition. In 1893, the French had mounted a 15-cm. gun in this manner.

The World War has shown that through the development of ordnance used in attacks, the defenses of land fronts has been rendered extremely difficult. In view of the developments during the War it appears reasonable to suppose that permanent forts are a thing of the past. Such an assumption may perhaps be somewhat hasty. However, it seems that Von Schroter's saying: "The technique of fortification is never at fault in solving the question of the passive defense against the most perfect attack," no longer holds good. Military men have lost confidence in the protective ability of concrete, and neither Schaumann's elastic armored plates, Marullier's spring turret constructions, or other modern inventions can prevent the military man from feeling his way out of the forts. Yet the land forts will continue to be an important factor in a country's defense system, though new means of attack will cause changes of the defensive arrangement.

The powerful modern artillery and the weapons of the air service require the holding of the enemy at a distance and the concealment of the forts. In order to effect the former, heavy, long-range guns are necessary; for the latter it is necessary to reduce the size of the targets and entirely camouflage them, which latter may be accomplished in part by dividing the fortifications as far as possible into separate elements.

Lieut. General Von Freytag-Loringhofen predicts in *Folgerungen aus dem Weltkriege* (*Lessons of the World War*) that the forts of the future will be fortified zones constructed in time of peace, to which will be added more works at the outbreak of war.

A primary measure for concealing heavy artillery and strengthening the defenses is to make it mobile so that it can move frequently between the different elements of the fortified zone. Though these measures are intended primarily for land fronts, they apply with equal force to the defenses of coast fortifications.

Before the Japanese attack against the land front of Port Arthur, a farsighted man, Colonel R. F. Johnson, of the English Artillery, in a lecture in 1904, said about the land defense of coast defenses: "In

nine cases out of ten we do not wish any forts. The guns should be mobile, and fired from concealed positions, and the infantry should fire from rifle shelters. But these fortifications and shelters, with communications and arrangements for reinforcements, should be prepared in peace-time and should not be overlooked." A powerful effort in the foreground requires mobile field pieces as a support for the infantry, and mobile long-range artillery of heavy caliber should also be included in the preparations for the land defense of a coast fortification. Only a few pieces on the flank should be allowed permanent position on the land front.

The Mobility of the Artillery from a Strategic Point of View

It may often happen that a coast defense, on account of its location, may be forced to remain inactive. For example, if it is assumed that Sweden had been forced into the World War on the side of the Central Powers, Karlskrona Fort would then hardly have been exposed to attack, and in war against England with Germany as an ally, Hernsö, Vaxholms, and Karlskrona forts, which together possess considerable defensive power, would be of very little use.

If the mobile system is adopted for coast defenses, the possibility of transporting artillery from one fort to another, so far as circumstances will allow, can be considered. If the coast defenses include artillery of the motor-drawn or horse-drawn types, it will be possible to include them in the field army in case of need. In order to cause the least confusion, it would perhaps be of advantage to organize and train these batteries along lines similar to that of the Field Artillery. There is another means of transportation which is possible. It is known that the Japanese, in 1904, brought 28-cm. howitzers over from the coast defenses of Japan and used them against the Russian fleet in the harbor of Port Arthur, and included the same pieces in the siege artillery used against Tsingtao in 1914. During the present war the Germans are said to have moved some howitzers from the Cuxhafen forts to the Belgian coast. In the same way it is possible to reinforce a threatened fort with heavy artillery from some other fort which is located outside the theater of operations. Such movement could not be accomplished in a moment, but must be prepared in peace-time, so that such reinforcements would not arrive too late. In an article in a Russian artillery magazine in 1908, "Coast and Harbor Defense in Relation to the Experiences of the Russo-Japanese War," which at that time attracted very much attention, Treidler tries to show that "the coast defense must not only have a passive and defensive character, observing the activities of the enemy fleet, but it should, during

peace-time, be so organized as to be able to prevent landing attempts at any point along the coast." It was his opinion that this would be possible if some of the heavy artillery of the forts were placed on railroad mounts, and tracks were built to exposed points.

As has been mentioned, the number of permanent fortifications has been reduced to the minimum on account of their excessive cost. There are, therefore, many points on our own coast which are believed to be very tempting to an enemy, as certain parts of the coast have no Archipelago and therefore at these points it is more difficult for our fleet to participate in the defense. It is believed that great advantages would accrue if parts of the heavy artillery of the forts could increase their sphere of action so as to meet landing attempts and other undertakings outside of the present defensive districts without endangering the forts' own battle preparedness. At the 1907 meeting of the Defense Committee, the Chief of Coast Artillery, at that time Major General H. Wrangel, emphasized that it was desirable that two or three heavy, mobile mortar batteries should be procured for the coast defenses in order that they could take part in the defense of those portions of the coast which are not protected by the fixed fortifications. Later in 1912 the General developed his proposition in detail.

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It seems to be necessary that the heavier mobile Coast Artillery should be mounted on railroad mounts. A further reason for this is that our own road system is such that it is only on the good roads that heavy mobile artillery could travel without extensive bridge building and road-repair work. As far as can be seen, for most points from which the artillery would desire to operate it would be cheaper to build small complements to the already existing railroad net than to construct permanent fortifications.

In France, General Peigné in 1883 proposed a scheme of railroad transportation for artillery, which was actually used in the World War. Schneider and Company and Creuzot constructed "movable forts" for the coast defenses which have been talked about a great deal. These consist of 20-cm. railroad howitzer batteries composed of a locomotive and four cars, namely, observation car, two howitzer cars, ammunition car. The piece is prepared for action in thirty minutes by raising the load from the wheels by means of jacks which are a part of the equipment.

In France during the War a number of heavy pieces—naval and coast guns and mortars—were mounted for railroad transportation. The 19-cm. railroad mount is a complete armored car, of which the movable part consists of a rotating carriage, which holds the gun.

Before firing the brakes are put on and the car is locked to the track by a special device, and also the wheels are to some extent relieved of their load by means of jacks. The 24-cm. gun and 29-cm. howitzer recoil in their cradle, and the top carriages recoil on inclined slides on the car, both of these movements being checked by brakes. In a similar way the 27-34-cm. guns and 37-cm. howitzers are constructed, though these require, for firing, foundations of a more elaborate character.

The problem of railroad transportation thus appears to be technically solved.

For use in coast defense, it is especially important that the preparations for firing shall require very little time.

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At the German coast defenses built on the Belgian coast during the War, heavy railroad artillery was used.

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With our extensive and exposed coast, it is necessary that we should heed the experiences of the World War and observe the tendency to mobility which is becoming increasingly evident in the coast defenses of foreign nations.

A large part of our railroads pass near the coasts. This circumstance may be of great use in coast defense if railroad artillery is adopted. The landing places which are most attractive to an enemy are near the country's richest districts, and these districts are especially fortunate in possessing favorable rail connections, thus inviting a system of railroad artillery.

Railroad batteries should consist of two guns each, and be arranged according to the following principles. The motive power is a locomotive, perhaps a motor car. The battery train is arranged so that the wheels can be changed to travel on tracks of different widths. Around the coast defense is installed a belt line with side tracks to suitable gun and searchlight positions. In certain districts, ferries for the transportation of railroad trains should be available. These ferries will be useful, not only for transferring railroad artillery between islands and the mainland and between islands, but also for use where the rail connections with the belt line may not be suitable. The railroad artillery is put up in temporary forts, but the positions in the "home fort" should be permanently fortified. For the heavy guns, it would be advantageous to arrange turn tables for the sidetracks at the various battery positions in time of peace. The railroad mount can then be lowered on the turn table, and fastened to it, thus giving all around fire. With heavy howitzers and medium-caliber guns on railroad mounts

the turn tables could be transported with the battery for economical reasons, which is feasible because the carriages of these pieces will naturally be much lighter than those of heavy guns. Defensive measures prepared at temporary positions will be restricted to breast-works, traverses between gun positions, and bomb proofs for the personnel.

Each battery train should include cars for ammunition, fire control and searchlights. Ammunition cars should be so constructed that the ammunition can be transferred directly from the car to the piece. The fire-control car should include a plotting room and be so arranged that when necessary it can be used as an observing station, being equipped with bases for range finders and other instruments. Antiaircraft guns and radio equipment should also be included in the battery train.

Permanent base end stations should be prepared beforehand. As these must be stationed in advanced positions in order to obtain a good field of view, it is essential properly to camouflage them, and their location should be kept secret. This can be readily accomplished by constructing them in such a manner that, when not in use, they may be covered with earth and turf.

* * * * *

SUMMARY

The advantages of mobile artillery over that of stationary artillery for coast defense may be summed up as follows.

TACTICAL ADVANTAGES

1. It is possible to camouflage and protect mobile artillery from aerial observation as well as from fleets and to change to new positions when the enemy has located a position which is occupied.

2. The artillery can surprise the enemy by appearing at unexpected points.

3. It is possible to concentrate against a certain point in the enemy lines, for defensive purposes or preparations for counter-attack, a greater concentration of fire.

4. Mobility makes it possible to take the initiative to a certain extent, and to increase activity, which is of great moral value.

5. If the defense succumbs to a superior attacking force, the mobile artillery can retreat to successive new positions, thus giving elasticity to the defense. If the enemy is retreating, the victory can be crowned by pursuit.

STRATEGIC ADVANTAGES

1. The artillery of the coast defenses, which is now tied down to harbor defense, is given the opportunity of participating to a greater

extent in the defense of the coast by appearing at points which are of strategic importance, but which for economical reasons can not be permanently fortified.

2. A coast defense which is so situated that it is outside the sphere of activities in a particular campaign, can transfer its artillery to reinforce a threatened coast defense, to reinforce threatened land forts, or to reinforce the field army, the latter especially when that army is on the defensive.

3. The fact that permanent coast defenses are restricted to a given location, and thus may be doomed to inactivity in time of war, has aroused doubts as to the advisability of spending money on a system of permanent fortifications, so that in many cases the condition of our coast defenses is truly alarming. By making the coast defense system mobile, and thus greatly extending its field of activity, these doubts may be dispelled.

The Swedish Coast Artillery should make full use of these advantages without hazarding preparedness. In order to accomplish this the following steps should be taken.

THE LAND FRONT

The artillery of the land front, with the exception of a few pieces, should be made mobile, the field batteries being horse-drawn and heavier artillery motor-drawn or, in the case of the heaviest, mounted on railroad mounts. Arrangement should be made so that great ranges may be attained, for which purpose the guns should be arranged so that they can be elevated to forty-five degrees. The light pieces should be so constructed that they can be used for antiaircraft work. In regard to the organization, horse-drawn artillery should be handled by troops of the artillery corps stationed at the land forts and under the command of the fort commanders, while horse-drawn machine guns should be manned by the coast defense infantry.*

THE SEA FRONT

Certain parts of the artillery on the sea front should be of a permanent nature, enough to insure the safety of the sea front fortifications; these would correspond to our present fixed batteries. This does not detract from the fact that mobility inside the fortifications and between the fortifications would be more suitable in many cases. The remainder of the sea front armament should be mobile, the heavy artillery being preferably arranged for transportation by railroad. All light artillery should be so arranged that it can be fired at aircraft.

* Certain infantry companies are attached to coast defenses in Sweden.—*Editor.*

THE DEFENSIVE DISTRICTS

The territory along the coast, in which the mobile artillery of a certain coast defense is intended to be used, is organized into a "Defensive District." As an example of such a district can be mentioned, for Vaxholms, the coast between Radmanso–Landsort. Inside as well as outside the forts' defensive territory, heavy artillery emplacements are selected and prepared.

Existing railroads are supplemented by the necessary extensions of the railroad net.

So far as possible all preparations are made in time of peace; plans are made for certain tracks to be constructed upon mobilization. Railroads should not be constructed when ferries can be used.

It remains now to rekindle life in the dead body, which our coast defenses should not be. During later years several hopeful movements of the limbs have been noticed. But until steps have been taken to make our defenses truly mobile, we can not talk about "Coast Artillery in being"—the logical complement of the strategic plans accordingly to which our fleet should operate in time of war.

The average American Soldier who went to France received six months of training in this country before he sailed. After he landed overseas he had two more months of training before entering the battle line. The part of the battle line that he entered was in a quiet sector and here he remained one month before going into an active sector and taking part in hard fighting.—*L. P. Ayers, the War with Germany.*

Fire Control and Position Finding

By COLONEL RORERT S. ABERNETHY, C. A. C.

GENERAL DISCUSSION

1. *a. Fire Control.*—Fire control is the exercise of those tactical functions which determine—

(1) The objective of fire.
(2) The volume and concentration of fire.
(3) The accuracy of fire.

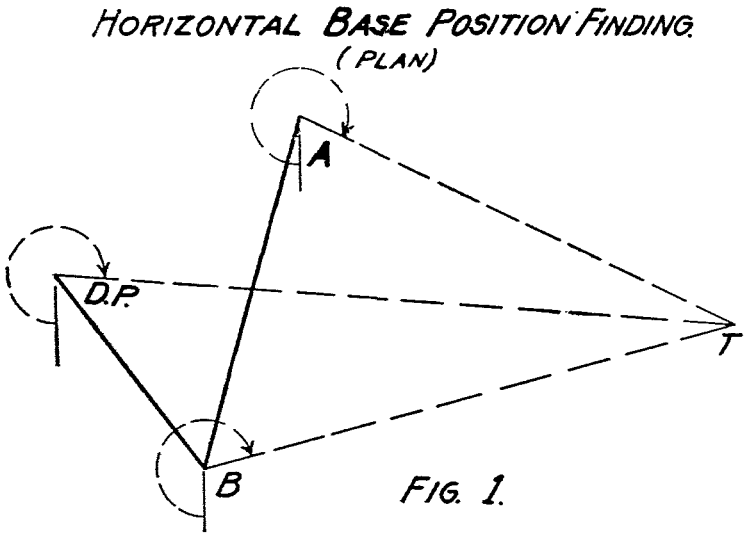


FIG. 1.

b. Position Finding.—Position finding is the determination of the range and direction of any target from a directing point or station.

2. As may be seen, position finding is technical, while fire control has both tactical and technical features.

3. All Coast Artillery position-finding and fire-control methods are adapted to moving naval targets, fire at a fixed target being taken as a limiting case.

4. Position finding is accomplished by two basic methods:*

a. The measuring, simultaneously and at fixed intervals of time, of the direction of the moving target from two accurately located

* There is a third and more complicated method which will be taken up later. It is applicable to the case when the target can be seen only by aircraft.

stations. Solution of the triangle involving known distance between stations and adjacent angles, and then solution of triangle involving known distance from one station to directing point of battery, known distance from same station to target, and included angle. (Fig. 1.)

b. Measuring simultaneously distance and direction from a single observing station, then solving two sides and included angle problem. (Fig. 2.)

5. The visual measurement of the horizontal angles in the first method is accomplished by azimuth instruments mounted on vertical axes and reading from south clockwise in degrees and hundredths.

6. In the second case direction is read by a separate instrument or by the range finder which measures distance by—

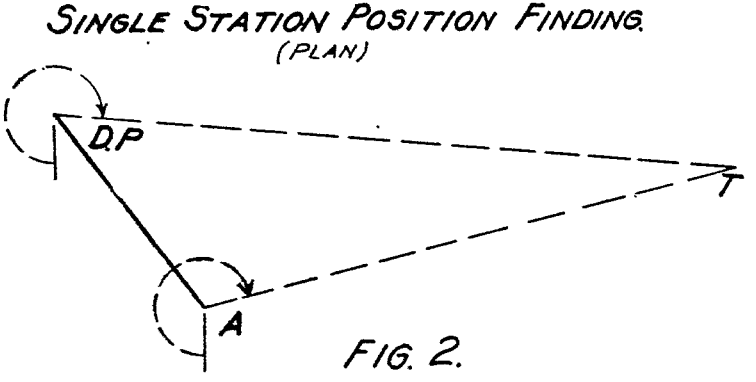


FIG. 2.

NOTE: A AND B, OBSERVING STATION, T, TARGET; D P, DIRECTING POINT

a. The vertical base method. Here an instrument reads directly the range as determined by the divergence from horizontal of the visual ray to a comparatively elevated station from the target at its water line. Corrections must be made for change in level of water line due to tides, for refraction, and automatically for effect of earth's curvature. (Fig. 3.)

b. By self-contained horizontal base instruments (bases from 15 to 33 feet) of coincidence, inverted coincidence, or stereoscopic type. (Fig. 4.)

7. Horizontal base position finding by visual observation from terrestrial stations may be called the normal, depression position finding exceptional, and all others emergency systems.

8. At this point it seems advisable to point out that the necessity for certain means of communication has been indicated.

a. A means of synchronizing observations, called the time-interval system. This is ordinarily accomplished by means of an accurately regulated motor which periodically closes an electric circuit and

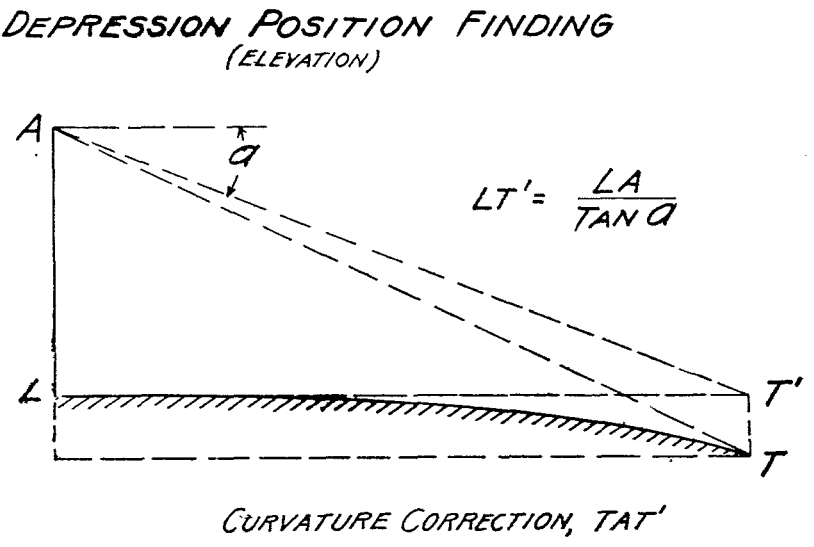


FIG. 3.

rings a bell in each observation station. The usual interval is 30 seconds, and a warning stroke is given.

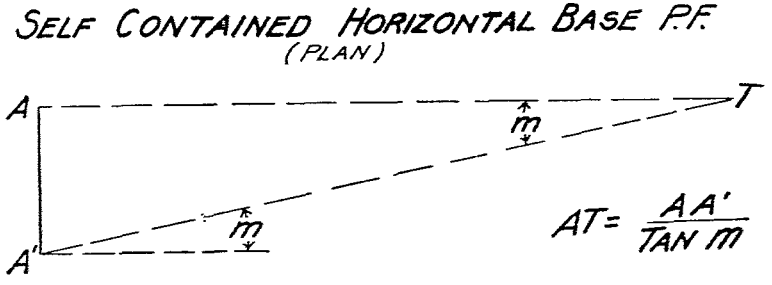
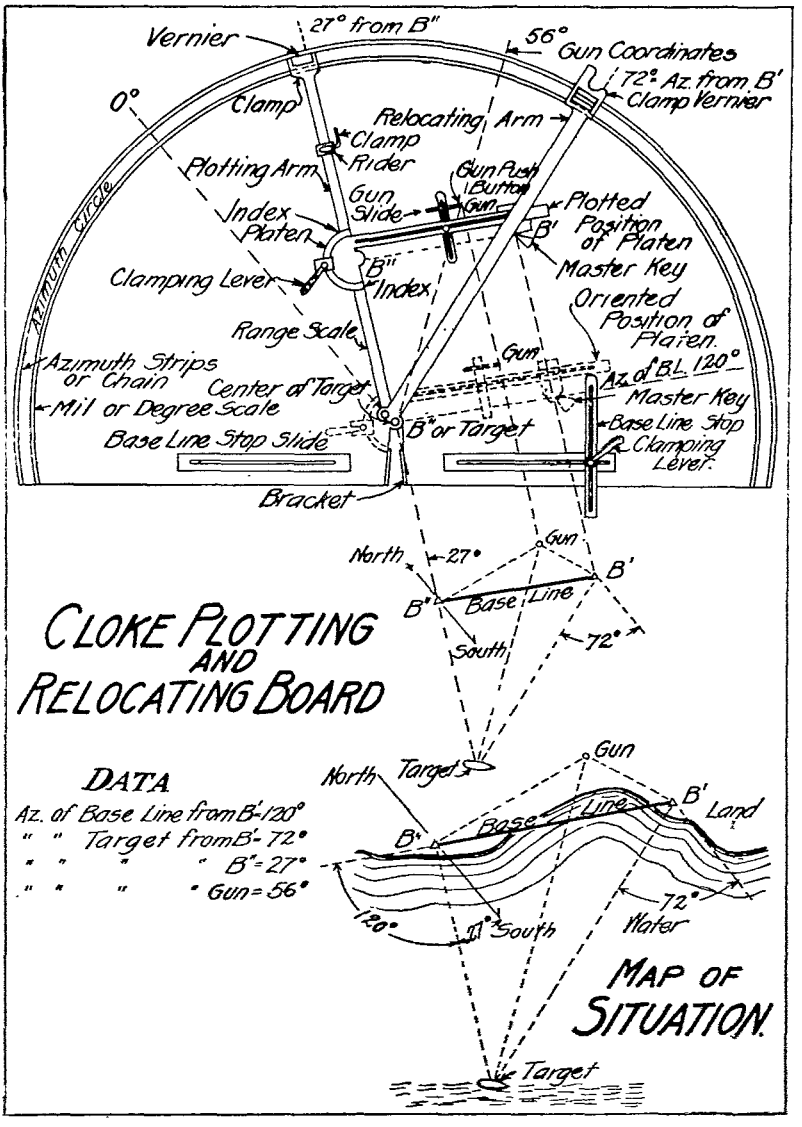


FIG. 4.

b. Telephones for communicating observed azimuths, or azimuths and ranges, to a central station called the plotting room where the various triangles are solved by graphic methods and the technical operations of fire control accomplished.

Plotting Boards

9. This brings us logically to the plotting room, the essential feature of which is the plotting board. This board is designed—



a. To solve triangles graphically as indicated.

b. To represent successive positions of target from which its course and speed can be determined.

c. To predict the position of the target at a time later than the latest observation by—

(1) Time required for reading and sending angles, plotting inter-sections, and predicting.
(2) Time required for calculating data and sending it to guns.
(3) Time to lay and fire gun.
(4) Time of flight of projectile.

The total of times (1), (2), and (3) may be averaged into a standard dead time, or the firing of the gun may be arranged to precede by time of flight the time [late enough to assure completion of operations (1), (2), and (3)] for which prediction is made.

10. The plotting board problem has had numerous solutions, each with advantages and disadvantages. In its simplest form it consists of a protractor centered at each plotted position of an observing station and a protractor with range-reading arm centered at plotted position of battery directing point (or directing gun). To permit reading of azimuths to one one-hundredths of a degree a large protractor circle is required. Large protractor circles interfere with each other. This led to construction on board of fixed protractor circles, one centered at each observation station and one at directing point. But this required reconstruction of circles for each change of location of observation station or directing point and led to confusion of circles.

Aiming and Laying

11. Before taking up the other operations in the plotting room, let us examine the methods of aiming or laying guns and mortars. In the Coast Artillery service we consider pointing under three cases.

a. CASE I. Direction and elevation given by sight pointed at target. For this case the plotting room must furnish sight elevation, corresponding to the predicted range with corrections for—

(1) Variations of muzzle velocity
(2) Density of atmosphere
(3) Elasticity of atmosphere
(4) Effect of wind
(5) Variations in projectile's weight
(6) Effect at long ranges of earth's rotation

and sight deflection to correct pointing for—

(1) Travel of target in time of flight
(2) Drift
(3) Wind effect
(4) Effect at long ranges of earth's rotation.

b. CASE II. Direction by sight pointed at target, with deflection set on plotting room data as before; elevation measured *above horizontal* by quadrant with level bubble, or (in case level of carriage can be assured) by fixed elevation are on carriage. This elevation is dependent on the predicted range corrected as indicated in *a* and, in addition, for angle of site as affected by height of tide and earth's curvature.

c. CASE III. Direction by azimuth circle in case of fixed guns or by sight laid on aiming point other than target, and elevation as in Case II. Plotting room azimuth (or deflection in case aiming point is used) of predicted point must be corrected for—

(1) Wind
(2) Drift
(3) Earth's rotation

It is to be noted that when either range or azimuth is predicted, the corresponding travel of target in time of flight is included in predicted travel and omitted from sight deflection.

12. Sight, quadrant, or gun elevation may be read in *degrees* and *minutes*, in *mils*, or in *corrected range* units (with range graduations corresponding to standard condition elevations). Azimuth may be read in degrees and hundredths from true south clockwise; sight deflection in mils or arbitrary units.

PLOTTING ROOM

13. Communications required from plotting room to guns are:

a. Data telephone line to battery, usually a party line to several closely grouped guns from plotting room, for elevation or range, and azimuth or deflection. In our service tactical commands are usually sent to guns over data lines.

b. Time-interval signal when guns are to be laid by Case III for firing on time interval.

c. Firing and ready bell when Case III firing is controlled by such signals.

d. Check-back lines in important fixed batteries.

e. Mechanical or electrical data transmitters to supplement telephone data by visual means in important batteries.

14. In the foregoing I have omitted the application of corrections based on observation of fire which I intend to discuss under the head of spotting, and so far have discussed only the corrections required for initial laying.

15. We are now ready to consider plotting room operations somewhat in detail. We have there—

a. An armsetter corresponding to and connected by telephone to each observation station, who sets the azimuth (or azimuth and range) read from the observation station.

b. A plotting board operator who plots successive intersections, predicts and reads "uncorrected" azimuth and range of "predicted" (we call it "setforward") point from guns.

c. In some cases time of flight for prediction is estimated or calculated by plotter, in some cases by separate man.

d. A percentage corrector by which there is added to the uncorrected (or map) range, a percentage correction and from which elevation corresponding to corrected range is read over telephone to guns.

e. A range correction board for computing value of percentage correction for use on percentage corrector. (See paragraph 11 *a.*)

f. A deflection board which computes sight deflection to be sent to guns, or for Case III computes azimuth correction and adds it to uncorrected azimuth, so that sight deflection or corrected azimuth can be sent to guns. (See paragraph 11 *b.*)

g. A wind component device which from wind azimuth and predicted azimuth of target computes value of components of wind affecting range and azimuth respectively.

h. Visual data transmitter, preferably mechanical.

i. In case check-back system is used, elevation and azimuth, or elevation and deflection, are recorded as read and compared with those posted at battery as read by checkman there.

SPOTTING

16. Observation of fire and the application of corrections based thereon are essential features of fire control. We call the process which includes observation of fire and computation of range and azimuth deviations, "Spotting."

17. In its simplest form, spotting consists in reading the angular deviations from the target, or the azimuths, of the splash by horizontal angle-measuring instruments at either end of a base line; in plotting relative position of splash and target at instant of impact, or of splash and setforward point (which is preferable since guns are actually laid on the latter point) and in computing range deviations in yards and direction deviations in angular units. By application of the law of probability, a range percentage and deflection correction based on the mean of a number of deviations is determined. These corrections are applied respectively by range percentage corrector and deflection corrector men, with special scales. In many of our batteries spotting and position-finding observers are located in the same stations.

18. Trial shots are supposed to be fired before an action at a fixed point (marked on plotting board) preferably in the expected field of fire. Four is the usual number. When trial shots are used, it is customary to take the mean point of fall, assume entire range deviation to be due to velocity variation, and, by working range-correction board backward, find a velocity for the day. All elevation corrections are thereafter computed for this velocity and subsequent observation corrections applied as range percentages independently.

19. We have no standard spotting system or devices, and various short cuts and simplifications have been worked up to fit local conditions. I shall not discuss the general theory of adjustment of fire but note that where location of splash is difficult the bracketing method (in which the correction is computed by comparing the number of overs and shorts) is used, and its application is quite simple. It is unsuitable for heavy guns because a comparatively large number of shots is required to permit adjustment. It should be noted further that adjustment of fire on moving targets is complicated by the fact that an adjustment correction which fits one position of the target may not fit another position to which the target moves. It follows, in moving target fire, that adjustment is a continuous progress, that an adjustment may be lost, and that added weight should be given to the more recent shots.

20. Plotting in connection with observation of fire is performed in the plotting room.

Battery C. P. and Tactical Operations

21. The battery commander's station (battery command post) is primarily a tactical station and is preferably sited so as to permit observation of the field of fire and still be reasonably close to plotting room and guns (which should be as near together as proper protection of plotting room will permit). It is not always possible to meet both these requirements, and the proper siting of the station is a special problem in each battery.

a. The battery commander has telephone connection—

(1) To next higher (group) commander.
(2) To plotting room.
(3) To observers (party line).
(4) In important batteries where station is distant from gun to battery executive at guns.
(5) To post administrative switchboard (in the case of important or isolated batteries.

b. Certain technical operations of fire control may be performed in the C. P., *e. g.*—

(1) Study of deviations and ordering of adjustment corrections. A device for graphic record of range deviations is provided.

(2) Signal for firing where guns are fired by bell signal as is usual in mortar batteries.

Resume

22. Let us look further into the matter of communications. Telephone connections from each spotting station to spotting device in plotting room are indicated. A telephone from chief spotter to C. P. may be needed. In the case of batteries which use several charges and projectiles there are required also—

a. Telephone or electric signal from plotting room to each magazine.

b. Similar connection to each shell room.

23. Space limitations have forced me to omit some refinements not essential to a grasp of the whole. Some operations of which mention may be made are—

a. Making corrections for displacement of guns sensibly separate from directing points.

b. Applying calibration corrections to guns which manifest anarchistic tendencies and do not shoot alike.

c. Keeping a time-range relation or continuous setforward point in Case II firing so that guns may be fired as soon as loaded.

d. Interpolating between setforward points to shorten interval between times for firing.

e. Synchronizing time of firing with data on which guns are laid.

f. I pass over searchlights.

Aerial Observation

24. Two important matters are the use of aircraft in observation of fire, and, when other means fail, airplane position finding.

25. Airplane observation of fire at naval targets is quite efficient and, at longer ranges, more dependable than terrestrial visual spotting. The airplane observer spots the fall of shot with reference to the target and radios the result to the battery where the spotting detail computes range and azimuth deviations. Various methods of measuring deviations from airplane have been tried and simple radio codes devised.

26. The radio observer signals the direction of deviation by clock-face numerals and the estimated linear value by hundreds of yards. He bases his estimate of the linear value on his known altitude. Twelve o'clock on his clock face may be—

a. On gun-target line, which often is difficult to locate,

b. Along course of target, at which he can make a fair guess,

c. Toward magnetic north, which is preferable if dependence can be placed upon his compass.

27. Position finding by airplane observation depends on the performance of the gun as an auxiliary range finder.

a. The aerial observer transmits by radio the estimated range, azimuth, course, and speed of target. This is a great deal to ask, and the estimates may vary from rough to wild. If he is free to fly directly over the target, the observer can furnish useful information by dropping flares or making signals at instants of passage above target. In fact, all possible means of supplementing his estimates are employed.

b. From all the information thus obtained, a setforward point is plotted and the gun laid and fired thereon.

c. Aerial observer sends in deviations of splash.

d. If the location of splash is known the position of target at instant of splash is readily obtainable. In the usual case the splash must be located by neglecting accidental gun deviations and assuming that projectile struck point on which laid.

e. By repeating *b*, *c*, and *d*, an approximate course of the target may be plotted, and by smoothing out and arranging this course for a series of shots some sort of adjustment may be effected. If instead of single shots, centers of impact of simultaneous battery salvos are used, much time can be saved.

Tide and Meteorological Stations

28. For the corrections required, we must make certain observations and two stations are provided, each connected by telephone to group and higher commanders. They are—

a. The tide station with a simple float tide gauge whose reading must be corrected for difference in tide level at station and in field of fire.

b. The meteorological station which determines—

(1) Atmospheric pressure.

(2) Temperature.

(3) Relative humidity.

(4) Wind direction and velocity at earth's surface and at fixed altitude intervals up to maximum ordinate of highest trajectory of any gun used. The upper wind velocities are ordinarily obtained by observing flight of small free balloons.

It is to be noted that the projectile's flight is affected by the density and elasticity of the atmosphere, that density depends on temperature, pressure and amount of water vapor present, and that elasticity depends on temperature.

Sites for Observation Stations

29. The following are some considerations governing selection of sites.

a. Observation stations are located for most favorable observation of possible targets. Considering horizontal-base position finding, it is desirable—

(1) That direction of base line should be as nearly as possible normal to probable direction to target.

(2) That length of base should be not less than $\frac{1}{5}$ of range from center of base to expected target.

b. To make effective use of guns at extreme range, observation stations should be pushed as far forward as possible in every direction where targets can be expected.

(1) If the coast line is approximately a straight line and the battery located at the beach, distance toward targets not directly in front of battery can be gained by stations pushed to the flanks.

(2) Emphasis on this point is demanded by the fact that even the most favorable weather permits day observation to little more than 25,000 yards. At night the range of visibility will rarely exceed 15,000 yards.

c. To facilitate identification of targets, horizontal bases should not be too long, and ordinarily should not cross field of fire. The reason for this is that naval formations do not appear the same when seen from widely different viewpoints.

d. Observation stations should be concealed, reasonably protected from fire, and, in general, separated from defensive elements which may draw fire.

e. To sum up, the stations must be located with reference to the *field of fire*, not the guns.

Sound Ranging

30. To supplement terrestrial and aerial visual observation, the service is engaged in the conduct of experiments with sound.

a. Sound location of airplanes by binaural observation in all antiaircraft regiments.

b. Sound ranging on report of enemy guns, together with observation by sound of burst of our shells in First Sound Ranging Battery, at Fort Eustis.

31. Theoretically, this work is divided into two classes:

a. Direction finding by binaural observation. [Subparagraphs 30 *a* and 30 *c* (1).] This applies to continuous sounds such as propellor noises.

b. Point plotting by difference in time of receipt of sound impulses as recorded by chronograph. This is applicable to sudden reports, explosions, and impacts.

32. The so-called *binaural sense* is our means of sensing the direction of a sound source. When we hear a sound we judge the approximate direction of its source—

a. By the shielding effect of the head which caused decrease of intensity in shielded ear.

b. By the binaural sense which notes the phase difference in the pressure waves received by the two ears. This phase difference results from the difference in length of path from sound source to the respective ears, and the physciological effect is an apparent increase of intensity in nearer ear. It has been found that most persons will detect a phase difference corresponding to a few hundred-thousandths of a second and some have actually detected less than ten micro-seconds. Taking 20 micro-seconds as a good average, and 1150 f. s. as the velocity of sound, we find that our least reading may be expressed as about 0.28 of an inch difference of path in air.

33. As our natural sound base is but a few inches we cannot measure small angles binaurally. All binaural sound-ranging devices increase this base artificially. The sound locator is arranged to connect to the respective ears sound-collecting trumpets with sound base of from five to eight feet.

34. Binaural balance is obtained when the two sound paths are of equal accoustic lengths, as when we turn our heads toward a sound and point our noses. The sound locator works on this principle, the trumpets having rotatable mountings. One observer is connected up for horizontal and one for vertical pointing, and when both have binaural balance the instrument is pointed in azimuth and elevation.

35. It may occur to you that the locus of points whose distance from two fixed points differs by a fixed amount is not a line of direction, but an hyperbola. It is important to remember this in connection with the other kind of sound ranging. Where ratio of sound-base length to sound-source distance is less than 1 to 20 the right line is a sufficient approximation.

36. One sound base gives one line of direction, so two are needed for an intersection.

37. The binaural sense does not give satisfactory readings on sounds of short duration. Reports, explosions, and impacts are located by recording chronographically the times of arrival of initial disturbance at fixed points. The difference between times of arrival at two points permits calculation of difference in distance to the sound source, and construction of an hyperbola which is the locus of possible sound sources. The intersection of two hyperbolae fixes the location of the source.

38. *a.* Sound location of aerial targets has not yet reached a satisfactory state of development for laying guns..

b. Sound ranging through air on enemy guns will provide data sufficiently accurate for laying our guns, after listening to a minimum of three reports.

Antiaircraft Artillery Position Finding and Fire Control

39. Position finding and fire control for antiaircraft artillery fire is complicated by—

a. Movement of target in three dimensions.

b. High linear and angular speed.

c. Necessity for use of time fuze.

40. As a result, a lesser degree of accuracy is possible, a greater volume of fire is necessary (and fortunately practicable), and certain aproximations and assumptions are made. It is necessary to provide predictions which will permit guns to fire at any instant—that is, as soon as loaded and aimed. At present we assume—

a. Rectilinear flight, and

b. Constant altitude.

It is to be noted that these assumptions are the more permissible because of the short time a target is exposed to fire and because such flight for at least thirty seconds is essential to execution of bombing missions.

41. Our present method of pointing is by Case I with P. F. and F. C. equipment located in immediate vicinity of battery. The same data is sent to all the closely grouped guns of a battery, but partial displacement correction is affected by sight aiming.

42. Briefly, our installation consists of—

a. A stereoscopic altimeter which reads directly the altitude in yards—it being dependent on the angle of elevation of the instrument and the slant range.

b. An instrument known as the R. A. Corrector which has two pointing telescopes, yoked together,

(1) One with vertical cross hair to follow target continuously in direction, and

(2) One with horizontal cross hair to follow target continuously in elevation.

c. The telescopic sight with scales for offsetting it from gun in elevation and azimuth.

43. Readings of the altimeter are made as often as possible and are set on the R. A. Corrector. By means of a speedometer arrangement which predicts travel in direction and elevation at the rate the two telescopes are moving, the R. A. Corrector will then read—

a. The lateral deflection to be set on gun sight so as to point gun off target by—

(1) Travel in time of flight,

(2) Wind correction.

b. The fuze setting for the distance along trajectory to target.

c. The vertical deflection to be set on sight so as to point gun off target by—

(1) Travel of target in time of flight,

(2) Wind correction.

44. You will note that so far we have not provided a setting of gun above target to correct for the curvature of trajectory, *i. e.*, the fall of the projectile below the line of departure. This is called the *super-elevation* and is taken care of at the gun. It is dependent on—

a. Distance to target,

b. Target's elevation above horizontal.

45. Values of lateral deflection, fuze setting (called fuze range), and vertical deflection are called to gun every four or five seconds. They are kept set respectively on—

a. Lateral deflection scale of sight.

b. Fuze range scale of fuze setter.

c. Vertical deflection scale of sight.

Note that the fuze range must include prediction for travel not only in time of flight but also in *dead time* which is given an average value of eight seconds and includes—

d. Time required to read, send, and set fuze range on fuze setter.

e. Time to set fuze by use of fuze setter.

f. Time to load fuzed projectile in gun and discharge it.

46. In view of the fact that the vertical elevation and superelevation must be aggregated in getting total elevation of gun above the line of sighting, and since the superelevation depends on distance to target and total elevation of gun, a complicated follow-the-pointer system is necessary.

a. The indicating pointer is connected to the sight and moves with sight in elevation.

b. The follow pointer is actuated by the movement of the gun in elevation and is kept on indicating pointer by the elevating detail.

c. With no vertical deflection or superelevation set, the follow pointer is on when gun and sight are at same elevation.

d. Setting vertical deflection offsets superelevation index.

e. The superelevation index as offset by the vertical deflection moves lineally, as gun moves in elevation, over a cylinder or disc upon which is engraved a family of curves each of which corresponds to, and is marked for, a particular fuze range. The follow pointer though moving with the gun in elevation can be offset by rotating the cylinder or disc.

f. Rotation of cylinder or disc to bring superelevation index opposite proper fuze range curve now offsets follow pointer by amount corresponding to superelevation plus vertical deflection.

47. A wind and parallax computer is provided for computing values of wind and for parrallax resulting from appreciable displacement of P. F. equipment from guns. Computed values are set in R. A. corrector and by it added to lateral and vertical deflections.

48. Drift corrections are taken from range table and added to lateral deflection.

49. Arbitrary corrections as result of observation of fire may be added in by R. A. corrector or made directly on vertical and lateral deflection scales of sight. Observation of fire during action is rarely employed, but trial shots are fired at fixed points at convenient times when action is expected.

50. This is the method with present equipment. Materiel under development is expected to provide—

a. Automatic drift correction.

b. Continuous fuze setting.

c. Case II or Case III fire.

d. Automatic correction for variations in muzzle velocity and atmospheric conditions.

51. Reverting to the assumption of rectilinear flight at constant speed and constant altitude, it may be estimated that a plane with speed of 100 m. p. h. can in 8 seconds dead time plus, for example, 12 seconds time of flight, move into any one of a million volumes of effective

shell bursts. Our development must not only improve our accuracy but must also—

a. Reduce dead time.

b. Reduce time of flight.

c. Increase effective volume of shell fragmentation.

52. All these ends are being sought.

a. It is hoped by new methods with continuous fuze setter, with Case III or Case II fire and mechanical transmission of all data to follow-the-pointer system, to reduce dead time to about two seconds.

b. Initial velocity has been increased to 2800 f. s.

c. A gun of 105-mm. is under test as is also a new type of shell with segmental scorings to produce better fragmentation.

53. Further development in A. A. fire has been—

a. Substitution of cal. .50 for cal. .30 machine gun.

b. Development of 37-mm. machine gun with percussion fuze sufficiently sensitive to explode on impact with airplane wing fabric.

c. Improvement of tracers. The tracer is used in connection with, and remains our main reliance for, machine gun fire control. We are experimenting with—

(1) A sight to take care of target travel and superelevation.

(2) A self-contained stereoscopic or coincidence range finder.

(3) A quick-action fire-control system for 37-mm. machine gun.

54. Our present antiaircraft guns fire at rate of 15 shots per minute (one per second for four-gun battery) and are giving better than 5% of effective hits at target practice. Machine guns approximate 1.5% of actual hits on targets of about 1/6 area of an airplane.

We have as brave a people as live, but bravery unarmed means useless sacrifice of the best men. We are ready to fight, but an unarmed people cannot fight a fully armed and equipped body of men. How are the bravest people in the world to spring to arms when they have no arms to spring to?—*Senator Henry Cabot Lodge.*

Organization and Mobilization of a Railway Unit*

By LIEUT. COL. FRANK GEERE, C. A. C.

WHEN it comes to mobilizing the regiment, it is necessary to have a general understanding of its complete organization, in addition to a full knowledge of that of your own battery, both as to personnel and equipment. Only so can the personnel be built up in groupings according to their technical capacities, and classified for training. It is not merely a matter of recruiting so many men, but of obtaining the best basic material out of which may be developed the highly skilled personnel for the technical operation of the equipment, and of the ultimate "team" that they compose. Electricians, machinists, railway operatives, engineers, clerks, mechanics, etc., cannot be made in a day and in order to obtain an efficient organization in the shortest time it is necessary to recruit in proper numbers men of those classes of skilled or semi-skilled occupations from civil life. For that, we must know what is needed, both as to functions and numbers.

The training regulations prescribe that the basic tactical unit is the battalion, and that the battalions are distributed according to objectives to be engaged, rather than with any view to employing the regiment as a tactical unit; hence, in general, they may be expected to be widely separated. A rough study of the organization of a heavy artillery railway regiment shows us that it is so designed that each battalion may readily become an independent unit.

The regiment is composed of the Headquarters, Headquarters Battery, Service Battery, Medical Detachment, three firing battalions, and an Ordnance Maintenance Company. The latter may be considered an adjunct, although part of the regiment, because it is not adapted for breaking up into lesser provisional units for attachment to battallions, being manifestly designed for a traveling repair depot, operated in rear of the combat units. On the other hand the Service Battery and Medical Detachment are capable of being divided into three self-contained parts available for attachment to battalions. This must be kept in mind in recruiting and training. It is not enough to have in the Service Battery one competent engineer, supply sergeant, chauffeur, cobbler, fireman, etc., and two others of each class of indifferent quality, but to have three well-qualified men in each capacity who can function on their own. This is equally true of the Medical Detachment.

*Lecture at Unit Camp, Fort Andrews, Mass.

The battalion is composed of the Headquarters, a Headquarters Detachment, and two batteries, each of four guns or mortars. A study of the personnel tables will show that the regimental staff scheme is carried out in the battalion, and that the battalion operative groupings are similar to those of the regiment. Nor do we stop there, for in the battery itself we find the functions of the battery officers distributed in general conformance with the staff functions.

Regimental Staff Functions

Executive. Second in command; sees to the execution of the plans and instructions of the regimental commander, acting for him in coordinating and supervising the supply, maintenance, training, and operation of the unit.

Adjutant. Functions are purely administrative; he keeps the records, including the war diary; prepares orders and instructions for the Commanding Officer for issue; drafts outgoing correspondence and routes communications within the unit; and generally is the C. O.'s aide.

Intelligence Officer. Collects and collates enemy information, forwards all data gathered to higher headquarters, and disseminates within the command information received from proper sources essential to promote the success of operations, including the elaboration of maps and charts, to which end he interprets air photographs, etc.

Operations Officer. Prepares plans for training, movements, and combat; keeps the trackage record, firing record (assisted by the Orientation Officer) and miscellaneous record (assisted by the Communications Officer.) T. R. 435-25 gives a general explanation of those records.

Supply Officer. Commands the Service Battery, and is accountable for all equipment and supplies within the unit and responsible for their procurement and issue.

Communications Officer. Commands the Headquarters Battery and operates the message center; responsible for the installation, maintenance, or operation of telephone, radio, visual, and other means of communication with the supported and auxiliary units and with the battalions; responsible for the instruction of all communications specialist personnel, and exercises supervision over the communications system of each subordinate unit.

Orientation Officer. Determines and compiles all data as to positions, stations, base lines, etc., necessary for the regimental command and to be furnished the battalion communications officers as initial data for their missions; keeps the regimental "orientation record."

Munitions Officer. Has direct supervision over all matters pertaining to ammunition supply; responsible for current record of state of

ammunition supply and daily reports of expenditures to next headquarters; estimates requirements for an action and is responsible for the procurement of ammunition from the proper depots and delivery to battalion munitions officers; exercises supervision in the regiment over the storage and care of munitions.

Liaison Officer. Is the direct representative of the regimental commander with a higher or lower command, accordingly as he is attached during or preceding an action, and keeps his own commander and the commander of the unit he is with informed of each other's plans, the progress of operations, and other details essential to cooperation.

Battalion Staff Functions

Turning to the battalion, we find a corresponding staff organization, with certain exceptions. There is no separate executive; the adjutant combines that function with his own. The Supply Officer is attached (with a section of personnel) from the Service Battery. There is no munitions officer, those duties being performed by the battalion supply officer. There is no liaison officer. With the latter exception, all staff functions exist as in the regiment and correspond generally, so that the battalion in this respect may readily operate separately if need be.

Organization Groupings

Let us now regard the organizations within the regiment, each of which has its definite functions, and we find again how the battalion derives its independence as the "basic tactical unit."

The Headquarters Battery is the pool for the enlisted personnel who assist the staff officers, with the exception of the Supply Officer. First there is the personnel for its own administration—mess, supply, and record. Next there is the personnel for the Headquarters mess. Then we find the clerical personnel of the staff offices, that for operating Headquarters motor transportation, messengers, orderlies, color bearers, postal clerks, etc. As the officer in charge of the message center and responsible for maintenance of communication with all subordinate organizations, it is proper for the Communications Officer to command this battery, as he must deal more or less with most of those composing it.

This organization is not susceptible of splitting up, as in the case of the Service Battery, hence the battalions each have their own separate headquarters detachments.

The Service Battery is a multifold organization. The regimental section furnishes a self-contained party for the Supply Officer's operations. The band section explains itself. In addition, there are three

"battalion sections" each commanded by a first lieutenant who is supply officer for a battalion. Each of these sections is alike in composition and a diminutive of the headquarters section. These accompany the battalion whose designation they bear.

At this point we will introduce the Medical Detachment, made up of Medical and Dental Corps personnel. This detachment is susceptible of being, and is designed to be, split up among the battalions. The major is regimental surgeon, and is in the capacity of a staff officer, though not listed as such because he is non-combatant — as also is the chaplain. He is the adviser of the regimental commander on all matters of sanitation and health, an inspector in those matters, is supervisory in all things concerning the equipment and operation of Medical personnel, and directs the evacuation of sick and injured. The second senior officer commands the Medical Detachment, except those portions detached with a battalion, and is the attending surgeon for Headquarters, Headquarters Battery, Service Battery, and the Ordnance Company. The remaining three medical officers are battalion surgeons. The enlisted personnel is composed of a staff sergeant, three sergeants, and thirty-two privates, first class, or privates, and may readily be apportioned in four sections, the cooks being at headquarters, where the infirmary would be. The Dental Officer and his assistant technician are with the headquarters section.

The battalion Headquarters Detachment has pretty much the same class of personnel provided as the Headquarters Battery, but in lesser degree. Its functions are similar. It is not specially provided who shall command it. Logically it would be the communications officer, but as he is a second lieutenant and a pretty busy man otherwise, and as the adjutant has no administrative duties, the command usually goes to the latter.

Thus we find each battalion of four batteries provided with a full working staff and a headquarters, supply, and medical detachment—all the elements of a self-contained unit.

The Ordnance Company is a purely specialist aggregation, outside of the personnel necessary for its self-support. It has more ratings allotted than any other organization, which is because of its highly technical character. Most of these call for men skilled in special trades. This means that the company commander has a difficult recruiting and training problem. All are strictly Ordnance personnel and this company therefore, though part of the regiment, is in the category of "attached troops." It comprises five sections: headquarters, for supply and administration; service, for general maintenance and repair of instruments and equipment; artillery, for repair and maintenance of guns and carriages; automotive, for the same purpose re-

specting motor stock; and armory, for the same purpose with respect to small arms, including machine guns. As stated, it is not susceptible of splitting up, as it is a self-contained repair arsenal for operation behind the combat units.

We find the battery divided into three principal components. These are: *Battery Headquarters,* composed of three sections—headquarters, range, and communications; *Firing Section,* composed of two firing platoons, of two sections each, and an antiaircraft machine-gun section; and a *Maintenance Section.* The B. C. controls the headquarters section directly and the others through subalterns, as follows: range officer, the range and communications section; battery executive and assistant executive, the two firing platoons; battery executive, the M. G. section; and railway officer, the maintenance section.

The last named officer is a new appearance, and fills a most important position. T. R. 435-25 provides that "One officer in each railway artillery organization should be charged with the supervision of all matters pertaining to the rail movements of the organization, and is designated the railway officer. He should supervise the entrainment and detrainment of the organization, including all operations incident to loading, unloading, making-up, and breaking-up of the trains." It goes on to state that each organization handles for itself all operations pertaining to its own movement.

Railway and Motor Equipment

That we may have an idea of the magnitude and highly technical character of so important a unit as a railway artillery regiment, without going into the details of its equipment, let us regard only its rolling stock to gather some idea of the operation required. In a battery there are, besides four guns, a fire-control car, six ammunition cars, one gondola, three store cars and a tank car—a total of fourteen railway cars, to which we might add an engine. The battalion headquarters has a fire-control car, a power-plant car, a machine-shop car, and a store car. The regimental headquarters has a fire-control car and a gondola; and the Ordnance company has three railway repair and three railway shop cars. These aggregate one hundred and four railway cars of all sorts, not including engines. Besides these there are, all told, sixty-five motor vehicles, not including motorcycles.

Present Mobilization Policy

Formerly the scheme was to complete the recruitment and equipment of the unit in its local mobilization area, and to give it there as much elementary training as possible. This was based on the experience with the 1917 draft, which was poured direct into central can-

tonments that were not prepared to receive them, congesting the passenger traffic of the railroads, and otherwise complicating and delaying mobilization. It was thought that by localizing things as much as possible it would simplify that problem. Supplies and equipment were to be shipped in bulk from depot to central supply points by train lots and from there by carload lot and truck to the local rendezvous. The present scheme calls for the reverse. Speaking of first phase units, the peace cadres are to be sent direct to the concentration mobilization point just as soon after M-day as possible, each leaving a recruiting detail in its locality. That detail recruits by voluntary enlistment for a time, sending the recruits direct to the concentration point, where it rejoins at the end of the period. Thereafter all personnel is derived from the draft, within the home area, and shipped to the regiment.

This reversal of policy is based on two important considerations—supply and training. It was realized that the real cause for traffic congestion was freight shipment, and that supplies could be shipped more speedily and conveniently, as well as more economically, in bulk direct to concentration centers, and that the units could be better equipped there. It was also apparent that training could proceed more expeditiously and systematically if the unit was together. To offset the passenger problem, as well as to ameliorate the disturbance to civil affairs, it is planned to fill units by increments. This further simplifies the question of production, because in no circumstances could a full supply of equipment and supplies be obtained at once, since plants must also expand, re-organize and develop, which also must be gradual.

The net result of this will be to effect a gradual, steady, and efficient development of first phase units, at less cost, and, in the long run, more quickly. It means that all will have to work fast in their local areas, and every man of the peace cadres will be needed to do some very active but discriminative recruiting in the first month if the organization is to start with the right kind of human material.

Therefore while the present plan seems to be a bit copious in detail, when we consider what little will be required as to shelter, subsistence, medical attention, and other things, in the home towns, it is intended to answer every question that may arise and to furnish complete information so that every one may be able to go ahead without calling on Headquarters for help or information, and so make a quick and successful get-away on the mobilization road.

Post Schools

By LIEUT. A. L. LAVERY, C. A. C.

CONTRARY to the usual belief that the post schools were a result of the World War, a War Department general order in 1904 states that "post schools for the instruction of enlisted men in the common English branches of education, and especially in the history of the United States, shall be established at each post under such regulations as the division commander may prescribe. These schools will be inspected by him and reported in his annual report. Enrollment of enlisted men in the schools in the common branches of education is not compulsory but once enrolled it becomes a military duty." (G. O. 115, W. D., 1904.)

Authority for the establishment of the post schools today is found in the National Defense Act of 1916, as amended by the Act of June 4, 1920, which states, "In addition to military training, soldiers while in the active service will be given the opportunity to study and receive instruction upon educational lines of such character as to increase their military efficiency and enable them to return to civil life better equipped for industrial, commercial, and general business occupations." Pursuant to the above law, schools are established and maintained, in time of peace, at each post, camp, or station, unless exempted by the Secretary of War, and are designated as "Post Schools."

The post schools have for an objective the giving of general educational and vocational training to enlisted men, to increase their efficiency as soldiers and their value as citizens upon their return to civil life. To develop training technique and equipment suitable for wartime instruction of the citizen army and to build up a reservoir of enlisted specialists are further objectives.

You will remember the shock that was given the world when, during the first operative periods of the Selective Service Act, this highly educated nation of ours turned out an amazingly large number of draftees who were illiterate and unable to write their names on the pay-rolls or other army papers requiring their signatures. It was for this reason, no doubt, that Congress saw fit to educate at least those who were in the army, and it was about this time that the recruiting posters loomed with large letters "LEARN — EARN — TRAVEL."

The commanding officers of posts, camps, and stations are directly responsible for the general supervision and conduct of the post schools, but Departmental and Corps Area commanders have general control

over the post schools within their commands. The commanding officers will make such inspections as deemed necessary to insure their efficiency and analyze the needs of the organizations of their commands for technicians and vocational specialists, and will see that the necessary courses are conducted to insure not only these needs but other educational requirements as well. They are also responsible that necessary equipment is on hand for these courses and that competent instructors are made available.

Regulations require that post schools be in operation during the entire year, except for not to exceed five months set aside for field training and combined exercises. These schools are under the direction of the post school officer who is detailed by the commanding officer and is responsible for the administration, supply, and general conduct of the schools. He supervises and coordinates the work of the instructor personnel under his control and is furnished such assistance as the commanding officer may deem practicable and necessary.

There are three classes of instructors—senior instructors, instructors and assistant instructors. The senior instructors function as the heads of the educational and vocational departments and are responsible to the post school officer for the efficient instruction in the subject under their respective supervisions. Instructors are officers, warrant officers, or enlisted men, and, when authorized by proper authority, civilians, selected because of their knowledge of, and ability to instruct in, their particular subject. They perform their duties under the supervision of the senior instructors or the post school officer if not senior instructor has been designated. Assistant instructors are enlisted men having a thorough knowledge of the subject taught. They are given specialist ratings if such are allotted to the post.

Commanding officers, on or before May 15 of each year, submit to the Corps Area commander an estimate of the needs of their schools for the second succeeding fiscal year. These are consolidated by the Corps Area commanders and submitted to the War Department on or before June 1. These estimates are then the basis for the estimates submitted by the War Department to Congress. Funds appropriated by Congress for educational purposes are subject to the control of the Secretary of War and are by him apportioned to the Adjutant General of the Army. The Adjutant General, in conformity with regulations and orders makes sub-authorizations to the Departments and Corps Areas and to independent posts, camps, and stations where post schools are maintained. However inclusive and painstaking might be the post commander's estimate, the net result usually assumes the form of information to him that he will use the facilities already on hand.

The commercial machinery that the government acquired during the war has been dumped on the different posts and held on the E. & R. officers' papers for use in the post schools, though how some of these huge lathes, milling machines, grinding machines, and other equipment could be used on some of the small posts has been a problem. Gradually this surplus equipage has been transferred to posts and depots where it could be utilized or turned back to the proper supply branch and there held on their papers as "Vocational Training Property," to the relief of those E. & R. officers who could do nothing but watch it rust on their hands. Under more recent and saner regulations, equipment and supplies are now obtained as other property from the supply branches, which branches carry the property as "Vocational Training Equipment and Supplies."

Courses in the post schools are offered under two main subdivisions, namely, General Educational and Vocational Training.

General Educational is divided into three classes.

(1) Compulsory primary education of illiterates and non-English speaking recruits. This course, known as Educational I, contains the fundamentals of education corresponding to those taught in the first three grades of the public schools.

(2) Compulsory advanced education for enlisted men who need it in connection with their military duties, or in connection with or preparatory to vocational courses. This course is called Educational II, and it embraces subjects taught in the third to the seventh grades. Educational II is highly important from the military viewpoint as it is here that the very necessary "key men" are qualified to hold responsible positions in the post military and administrative systems. This course is also available to some men who desire to take vocational courses but were found lacking in the proper basic educational knowledge to pursue the courses intelligently.

(3) Optional for enlisted men who volunteer. This course is designated as Educational III and is for those who desire to continue their education and are generally interested in the enlisted specialist course at the Coast Artillery School. Subjects taught in this course are more advanced, corresponding in general to the basic high school subjects.

Vocational Training is divided into two classes.

(1) Compulsory instruction for enlisted men to fit them for the performance of technical and vocational duties within the major unit of the branch to which the organization belongs. It is made mandatory for commanding officers to make full use of the post schools for the

training of soldiers of their commands who are designated for the duties requiring vocational skill. The post commander is responsible that sufficient numbers of men are trained to fill the quota of technicians and vocational specialists required by peace strength tables of organization of their commands and, in addition, to provide a reservoir of "key men" for war mobilization.

(2) Optional training and instruction to enlisted men who volunteer for courses that are given at the Post.

You are familiar no doubt with the amusing manner in which the early post school vocational courses were inaugurated. The War Department sent around a list of suggestions for courses to be instituted which looked like an I. C. S. directory of vocational trades. Colonel A, commanding Fort X, had been trying for some years to squeeze money out of some source for building sidewalks and curbings on his post. As the Wise Men of the East were guided by the Star of Bethlehem, so this other wise man sees the great light in the Vocational Training Circular and immediately he institutes a course in concrete construction and watches with pride as the curbings and sidewalks appear.

The next year, however, the commanding officer is chaffing under the report of the Department Inspector that a certain portion of the reservation appeared "exceedingly unkempt, with apparently no effort being made to improve its appearance." Consulting his bosom friend, the Vocational Training Circular, the course in landscape gardening appears to him to be printed in blacker type than the rest. The wasteland becomes a flower garden, the inspector becomes a booster, and a lot of good concrete mixers from last year's course become expert landscape architects, to the benefit of all concerned. From the viewpoint of the post commander vocational training circular becomes the modern counterpart of Aladdin's magic lamp, and in most cases produces magic almost as startling.

The principal things that the commanding officer must consider in the establishment of post school courses are: facilities available, what may be given, what is needed, what materials and supplies are on hand, and whether there are available the properly qualified instructors The main thing is not to have too large a number of courses but to have a few that are thoroughly and efficiently conducted.

There is, of course, a tendency to have practically all the men in the battery enrolled in the course so that the battery is left without sufficient men after the noonday meal to police the kitchen and dining room. As a natural result battery commanders sometimes become antagonistic to the post schools. Once in this frame of mind it is necessary for someone again to do missionary work to convince them of the actual

good to be derived by the organization from the post schools and to acquire their whole-hearted support for the schools.

Reports of progress of each student are required so that upon satisfactory completion of the course the student may be given a certificate of proficiency. A diploma will be issued upon discharge to the enlisted men entitled thereto which will contain a list of all the educational and vocational courses completed by the soldier during his enlistment. Once enrolled, attendance at the post schools is compulsory. Enrollments, either compulsory or voluntary, upon evidence of neglect or unsuitability or upon application with satisfactory reason, may be terminated.

There is a recently developed tendency to adopt some of the subjects formerly taught in post schools under troop schools, thereby eliminating the necessity for keeping the detailed reports required in the post schools. This is a common practice in many places at the present time, being considered under the item of current training since the specialists considered are required in all Coast Artillery posts. This shifting applies usually to electrician helpers, 25-KW set operators, clerks, radio men, and searchlight operators and such men as may constitute a reserve from which the artillery engineer, adjutant and other staff officers may replace casualties with competent substitutes.

The following example is taken from the course at Fort Monroe showing this division. Under Post Schools the following courses are given: Educational I, Educational II, Printing, Auto-mechanics. Under troop schools: Electrical, Radio, Clerical, Photo-Engraving, and Master Gunners' Course, the latter of which includes drafting and map reading, mathematics, and the elements of surveying.

Post schools can be made interesting and good results obtained if proper care is taken in detailing the Post School Officer and the instructors and instilling interest of the students in their work by showing them exactly what they will gain by proper application on their part. I understand that at Fort Monroe, where they have the example of the Enlisted Specialists' School, at which the student may complete his training and increase his pay and rating, there is very little trouble with the malingerer, and, as a result, thirty-nine of the one hundred and one men taking the course in that school this year were from the Harbor Defenses of Chesapeake Bay.

Unsuccessful schools are usually traceable to a failure of the course itself or of the instructors to hold interest, but if the commanding officer makes his inspections and supervises the schools, noting the progress and defects, he can quickly tell whether proper results are being obtained and can take the proper corrective measures.

Battery commanders should be made to realize that the detailing of their "dead beats" and malingerers will not be countenanced. By giving the men who desire the courses the opportunity to take them the battery commander will in the end derive his share of the benefit by having these men in his organization.

Since the post schools are laid down in the law and good results can be produced if wholehearted cooperation is obtained, the sooner that the general apathy of the battery commander is corrected the sooner everyone will begin to realize the fine field for bettering the command that is opened by the post schools. By having educated specialists in all outfits it will soon be apparent that the Army can reach a higher plane of general efficiency and *esprit de corps* that all are striving to obtain.

All of our wars have been prolonged for want of judicious and economical preparation, and often when the people have impatiently awaited the tidings of victory, those of humiliating defeat have plunged the nation into mourning. The cause of all this is obvious to the soldier and should be no less obvious to the statesmen. It lies partly in the unfounded jealousy of not a large, but even a small standing army; in the persistent use of raw troops; in the want of an expansive organization, adequate for every prospective emergency; in short and voluntary enlistments, carrying with them large bounties; and in a variety of other defects. * * * Every battlefield of the war after 1861 gave proof to the world of the valor of the disciplined American soldier; but in achieving this reputation the nations were nearly overwhelmed with debt from which we are still suffering, while nearly every family in the land was plunged in mourning. Already we are forgetting these costly sacrifices, and unless we now frame and bequeath to the succeeding generation a military system suggested by our past experience and commended by the example of other enlightened nations, our rulers and legislators in the next war will fall into the same errors and involve the country in the same sacrifices as in the past. It has been truly remarked by one of our philosophers that "we follow success and not skill." * * * In every civilized country success in war depends upon the organization and application of its military resources.—*Emory Upton, Military Policy of the United States.*

EDITORIALS

Pacifism

IF we are to believe the newspapers from many sections of this country, pacifism—downright militant pacifism—is rampant throughout the United States. Scarcely a day passes without editorial notice of some phase of pacifistic activities in one or more of the leading newspapers; and it is encouraging to note these are, almost universally, anti-pacifistic.

It is quite probable that the vast majority of active workers for pacifism are serious-minded, patriotic citizens. Undoubtedly, most of them really believe that they are promoting conditions which will ultimately tend to bring about perpetual peace. They do not realize that they are more than attacking the Army, that they are undermining the foundations of the nation itself. And it is very likely that they have forgotten or never knew that the first pacifistic propagandists in this country were almost without exception foreigners, usually of Austrian or German origin.

While there are many ways in which the military preparedness of the nation may be attacked, the present move is against compulsory military training in schools and colleges. Activities against the military have been persistent in recent years, and whenever they have shown signs of making no headway or have been brought to a halt after some initial successes, the point of attack has shifted, apparently with a view to finding some vulnerable phase in the scheme of preparedness.

The recent renewed violence of the attack indicates that the pacifists believe they have found a vulnerable spot in the "compulsory" feature of the military training in a small number of our educational institutions. It must be admitted that the present-day trend in education is dangerously away from any "required" courses. It is here that the danger lies; but it must be remembered that we live in an age of compulsions. Education, itself, is and will remain compulsory; physical training is a required part of college curricula; certain educational subjects will always be prerequisite to certain other subjects. And a reasonable amount of compulsion is beneficial to the individual; it teaches discipline, and above all else discipline promotes understanding, forbearance, and smooth progress.

It would seem that the whole matter is one of internal administration at the college concerned. A limited number of educational institutions desire to offer instruction along military lines. Some require that the entire scholastic life and education of its students shall be military. Others require that its students take a specified minimum amount of military training. The rest offer the military courses as subjects to be taken voluntarily. Very well! who, outside the authorities of the institutions concerned, has any right to protest?

The slacker, the conscientious objector, the lazy, who are so unpatriotic as to object to devoting a few hours or a few days of their lifetime to preparations that will enable them to be of assistance to their country in her hour of need, are under no compulsion to attend these institutions. Whether they, being unwilling to give of their time to their country, can be considered entitled to demand an education at state or federally controlled institutions is another question. At any rate, there are plenty of private institutions that do not offer military instruction. Any citizen who receives military training in this country does so voluntarily. We have no "compulsory" military training.

Pacifism of the Past

It is interesting in these days of active and militant pacifism—for that is what it is since without militancy pacifism could never grow nor develop—to read again what was said by the pacifists of yesteryear.

It was during the trying days of 1860 when the Southern states were becoming serious in their attempt at secession and in their establishment of a Confederacy that the silly Seward admonished the country to "let the erring sisters depart in peace." "What could be worse than a fractricidal war?" questioned Horace Greeley, then went on fervently to declare, "I do not wish to live in a country that has been pinned together by bayonets!"

What would have happened to this country, to our prosperity, and to the general economic status of the world, if Lincoln had not been endowed with a long and stiffly rigid spine? What would have been the outcome of acquiescence to pacifism at that crucial time when rigidity of conviction meant so much? It requires no great stretch of imagination to see that submission to pacifistic balderdash in 1860 would have meant the complete relinquishment of all the ideals that had been crystallized into a reality "four score and ten years" before. Nor is there anything to indicate that the war would not have been fought eventually—and in this age of progress any delay of war means the involvement of a longer, more expensive, and more destructive conflict because of the rapid development of machines and implements

of warfare. With this country two nations instead of one, with the South forming the Confederate States of America with the capital at Richmond, and with the North forming the United States of America with the capital at Washington, it is too much to say that we would have been in endless conflict, for such is not the case between us and our northern neighbor, Canada. But it is not too much to say that fifty per cent of our commercial, industrial, and political strength would have been sacrificed; that the Bank of England would still be the financial center of the world; that the economic level of every citizen would be much lower; that we might very conceivably have fought our part of the recent World War right here on American soil; that we would be utterly incapable of economically benefitting the rest of the world in anything like our present degree.

Pacifists seldom have good ideas or exercise sound reasoning. In nine cases in ten the reasoning of a farmer's illiterate hired hand is fundamentally more sound. This is well shown by the story our grandfather was wont to relate when he was yet with us. On the Fourth of July, 1861, a "copperhead" was making a stump speech at a celebration in a small Ohio town. In the midst of his pacifistic talk he shouted, with suitable oratorical gestures: "Oh that I were a bird—a bird with great white wings! Were I a bird I would fly over the Northern army and cry, 'Peace! Peace!' And then I would fly over the Southern army and cry, 'Peace! Peace!' " Whereupon one of the young men in the audience piped up: "Ye-ah, and you'd be shot for a crow before you got forty rod!"

Pacifism is the visible demonstration and audible expression of cowardice. As in the past so in the present—it is entirely inimical to our general warfare.—*New York Commercial.*

How Our Army Keeps Fit for Defense

About 240 miles west of San Antonio, the other day, a 12-year-old boy, struck by a rattlesnake, lay in the shadow of death. In San Antonio was a vial of anti-crotalus serum, which if obtained would give the boy a fighting chance for life with the odds in his favor.

Word was flashed to San Antonio. Three hours later an airplane from Kelly Field had landed at Sanderson with the serum. * * *

Our Army, in all its branches, is entitled to more recognition for its services in research and pioneering work of indispensable value to civilian life than is accorded it. Most of this work is less spectacular than that which is performed in cases of emergency. That is the reason the Army does not receive full credit for its contributions to progress.—*San Antonio Light.*

College Radicalism

According to recent advices from Germany, propagandists of the third internationale in Leningrad are planning to build intellectual communist groups in all the large universities of the world, with the intention of utilizing them to sow seeds of radicalism among other students. As the information reaches Berlin, funds will be provided poor students in the form of subsistence, thereby making them grateful and dependent. The individuals will be encouraged to enter student activities, particularly those having to do with college newspapers. The groups will cry out against capitalistic professors and teachers, and collect and disseminate information.

In this country the scheme would be entirely feasible were it not for the students themselves. Fundamentally, the American student is a conformist. He wears the same style clothes as his brother. He joins the same societies; he smokes a pipe one year, and the next year, as a group, abandons it in favor of a cigarette; he speaks the same language, and he thinks the same thoughts. The reactionary, or the radical, is set apart from his fellows. He is frowned upon and laughed at. Finally, in self-defense, his own group is formed, and happily he expounds his philosophy and bows down before his dogma in a manner which can do harm to none save himself. It is true that many changes have come over the American institutions of learning in the last ten years. Surely the college is not, however, the fertile field for propagation of radicalism which many alarmists would have us believe.—*Washington Post.*

National Air Commerce

The United States is about to develop air transport on a continental scale. The enactment of laws fostering aviation and providing government assistance in the form of charters, lighted airways, mail contracts, etc., and the rapid development of dependable aircraft, together with the organization of strong commercial air transport companies, insure the prompt establishment of airways upon which passengers, mail, and express will be conveyed with the regularity of railroad traffic. * * *

The discoveries and improvements made by military and naval aviation experts, here and abroad, will, of course, be available for commercial transport by air; but experience indicates that private enterprise, entering the field of air transport for gain, will make more rapid progress than military or naval aviation. Commercial air systems will develop aviators and machines capable of immediate use in case of war, and will constitute a bulwark of national defense, as the railroads and merchant marine are on land and sea.—*Washington Post.*

Honor Schools

The War Department has designated twenty-four high schools, among those having junior units of the Reserve Officers Training Corps, as "honor high schools." It usually is supposed that there is more resentment against military training in the West and Middle West than anywhere else in the country. The theory is that there is more pacifism in those sections than in the East. Curiously enough twenty-three of these twenty-four "honor" schools are west of the Alleghenies. Twelve of them are west of the Mississippi. The lone Eastern school is in Gloucester, Mass. Evidently certain notions about sectional fear of military preparedness have been wrong. These "honor high schools" are all public schools, and the people who support them apparently feel there is no great danger in high standards of military training and soldierly discipline.—*Philadelphia Public Ledger.*

The people of this country have a great false faith in the fighting qualities of their citizen soldiery, improvised in time of war. They point proudly to the War of the Revolution and the War of the Rebellion to prove how our volunteer soldiers can fight. They overlook the fact that fighting was then mostly done by hand; that now it is mostly done by machinery, and that it is just as foolish and absurd to think of taking untrained men off the farm to operate the guns and machinery of war as it would be to try to operate the factories with them where the guns and machinery are made. It takes as long today to convert a farmer into a skilled soldier as it does to convert him into a skilled mechanic. Battles are no longer decided merely by the patriotism and personal bravery of the rank and file, nor even by their numbers, but by the efficiency and sufficiency of machinery and materials of destruction and the science and scientific experience of the commanding officers. There is no time to build fire-engines or to train fire brigades after a conflagration has broken out. A citizen soldier without training in the discipline and weapons and mechanism of modern warfare is only a mob, as easily scattered by a few real soldiers as chaff by a whirlwind.—*Hudson Maxim, Defenseless America.*

Colonel and Brevet Major General William F. Barry
Commandant Artillery School, November 28, 1867–March 1, 1877

PROFESSIONAL NOTES

The Washing-Out Plant for Amatol-Filled Shells

By COLONEL DOCTOR ENG. M. KOSTEVITCH

The below-stated rules and regulations presuppose the shells already broken down and, particularly in case of such projectiles as the 9.2-inch English 80/20 amatol-filled shells, the following components absent: paper collar, millboard washers, felt washer, two batiste discs, TNT exploder "C," and cardboard disc. The shells are plugged with "transit" wooden conical plugs. To obtain efficient working of the plant, the following method of dealing with the shells should be carefully noted and followed.

1. The plant should be so designed that the shells, after leaving the truck, will go through the various operations with a minimum of handling, as the first rule in Ordnance.

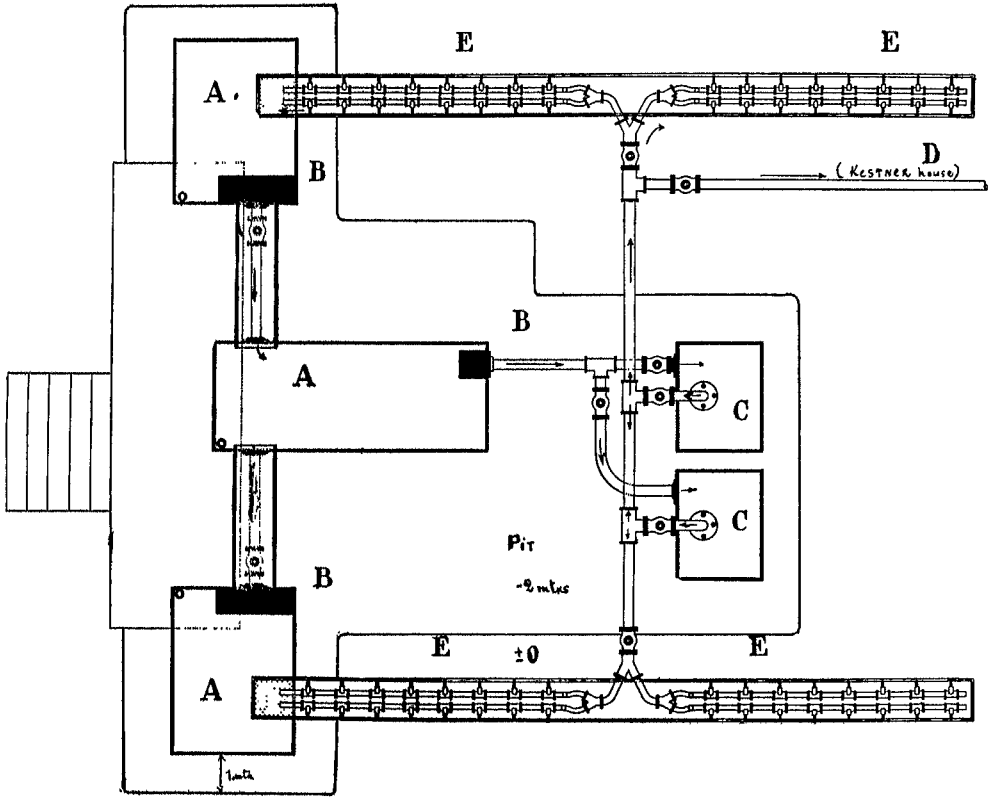
2. After unloading, the shells should be rolled down a gravity conveyor or planks with the plug of shell towards the operator.

3. When the shell has reached the platform at the WOP (Washing-out plant), it will be raised so that it rests upon its base, and filling inspected. The inspector should be previously and carefully trained to differentiate between Amatol, different high explosive mixtures, and lyddite. The latter is easily noted, especially in daylight, as it is distinctly green in color, as compared with the two former. (*Trinitroanisol-filled shells may also be washed out, but we do not consider them* here.) If it be not certain by examination, the finger should be wetted, and by rubbing slightly on the surface of the filling, the finger will be stained a greenish yellow. Every effort should be made to make sure that no shell filled with lyddite reaches the plant while amatol-filled shells are being dealt with; otherwise, quite apart from the danger of removing this filling in the below-mentioned manner, the bath of ammonium nitrate will be spoiled.

4. An effort should be made to keep the output of the *Breaking-down Shop* (disassembly) of shells ahead of that of the WOP to the extent of the number of jets on each side of plant (reserve shells waiting to be washed out).

5. These reserve shells should be unplugged and filled with hot water (about 90° Centigrade) supplied from a steam-heated tank fixed above the shell level and having a short piece of pipe to which is connected a piece of rubber hose. The action of the hot water is to help soften and break up the explosive, thus materially assisting the work of the jets. Then plug the shells, using the transit plugs; and when the shell has reached the place inside the WOP where it is to be washed out, remove the above-mentioned transit plugs and place in a separate receptacle constructed especially for this purpose only. It is the duty of every one to inform the factory officers at once of any shell found "unplugged," no matter how short or long the distance may be or by what kind of explosive the shell is loaded.

6. The amatol-filled shells must always be washed and never steamed out.


E
E
A
B
D
(KESTNER house)
B
A
C
C
PIT
-9 mtrs
B
E
±0
E
A
1 mtr

7. To commence work, the three tanks (see sketch) should be filled to within about five inches of the overflow pipes and heated by steam to not less than 95° C. The temperature of water is most important, and unless it is kept up endless troubles will be experienced through TNT solidifying and, further, the shells will not be emptied efficiently unless the temperature of the water, when it reaches the shells, is well above the melting point of crude TNT. When steam was used in the study of this question of washing out the shells to remove the explosive, it was found that the time taken was much longer, that the process was unsafe, and that it was also almost impossible to recover the amonium nitrate as is necessary for military purposes. On the other hand, the amonium nitrate is very soluble in water, and after circulating hot water for several hours the liquid contains a large percentage of A. N., which is easily recovered by the Kestner of other A. N. Recovery Plant.

8. The shells to be placed in position directed downwardly, with their plugs in fuze holes, and the plugs to be withdrawn. When the WOP is in operation the charge of the shells will drop from the fuze hole in the form of liquified TNT to the bottom of the troughs, being immediately removed by a stream of A. N. water solution directly to the tanks. This TNT should be run off continuously by means also of special ejector valves so as to avoid any accumulation of explosive in the troughs. This is very important from the point of view of safety.

9. With the desired shells in position, verify them from the safety point of view; *i. e.*, the shells must be placed over the jets never in an upright position, but always at 60° to the horizontal, being supported by means of a specially constructed device. On no account must they touch the jets or metal fittings. If the cavity of the shell (or minnies, for instance, or airplane bombs) is of great length, the water pressure must be sufficiently increased, and never may the jet be introduced inside the shell.

10. When the desired temperature has been reached in the tanks and the shells placed in position, the cocks controlling the sets of jets (see sketch—troughs E) to be used will be opened and the pump started. It will pay to work on a time schedule which means that all shells would be removed from the jets at the end of a definite time. If one or more shells are felt to be warm at the base (and experience will teach the operators to know by feeling the shell whether it is empty or not), the standard shield made from the corresponding metal and special rod should be placed over the jets, the shells plugged by means of wooden transit plugs taken from the receptacle), and a new shell placed in position, after which unplug the new shell and remove the cover of the jet.

11. When the batches of shells have been washed out, the cocks will be shut, and the cocks on opposite side of troughs opened, thus allowing new batches to be washed out.

12. The density of liquor will rise as each batch of shells is dealt with, and at the same time more molten TNT will be collected in the system. The density or specific gravity of the latter being greater than that of the A. N. solution. the TNT can be run off. Some men should be engaged in keeping the three tanks clear of TNT by opening in due time the corresponding valves and allowing the dark liquid to run off into other tanks (see sketch—C) containing water. meanwhile agitating water by means of a suitable tool.

13. As soon as the A. N. liquor starts to run off, the valve should be closed, and the water in tanks C (or sometimes simply in bins) poured back into the washing-out system. As soon as the A. N. liquor reaches the desired density or degree Twaddle (approximately 45° Tw.) the cock leading to the A. N. storage

The Log Book

Data	Start Time	Time			Boiler Pressure pounds	Temperatures		Quant. of shells washed out	Type of		Jets Working	Liquid pumped to Kestner				Hours		Reason for delay	Motor trouble	Fuzes Blown	Time			Men/Women employed	Temperature of earth in pits near tanks (number)			
		Pump				Tanks (number)	At end of shute		Shells	Explosive		Time	Gallons	$T_w°$	Temp.	WOP should have worked	WOP actually worked				Steam				Morn.	Noon	Even.	Midnight
		Start	Stop	Total																	Start	Stop	Total					

sump should be opened to allow some of the liquid to be pumped to the storage sump trough special settling tanks or pumped directly to the Kestner Plant where the A. N. is to be recovered (see sketch—tube D).

14. A tank capable of holding approximately 500-1000 gallons of fresh water (depends on capacity of the WOP) should be placed as close as possible to the WOP and connected to one of the three tanks. This tank should be kept full of water heated to 90-95° C. The water from this tank will be run into the washing-out system to replace the liquid pumped to the A. N. Recovery Plant, thus reducing the density of the liquid in the system.

15. The time at which the liquid should be pumped over will depend upon the tonnage handled, but, for instance, doing 60 tons of shells in the hour's work, the density of the liquor should rise at the approximate rate of 4-5° Tw. every hour with 2000 gallons of water in the system. Consequently at the end of the first 10 hours after starting from water, a quantity (say 500 gallons) of the liquor should be pumped over the sump, and 500 gallons of hot water added to take its place, thus reducing the density to about 30° Tw. This operation should be repeated approximately every three hours (function of the tonnage and the quantity of water in the system).

16. The temperature of the liquid in each tank will be registered by a self-registering thermometer, and the density will be taken every hour—Twaddle hydrometer to be immersed in the sample of liquid taken from the system in any suitable vessel.

17. The form supplied must be filled in correctly by the foreman in charge, with the data stated above; *i. e.*, temperature, etc.

18. The tops of the tanks always to be covered by thick wooden shields and Building Safety Officer to inspect the condition of these lids so as to change in due time. The height of the liquid level inside the tanks to be governed by direct observation of the level (especially adapted to the tanks) in a water-level glass tube on one side of each tank.

19. Keep the troughs unveiled so that the foreman in charge may see at any moment the running water and regulate the height of the liquid level inside.

20. The temperature of water in the nearest and the most distant jets in each trough to be investigated by means of ordinary thermometers.

21. If at any time it is desired completely to empty liquid from system or simply, say, to stop and clean the WOP, all the TNT will be run off; and when this is done the cocks leading to jets will be closed, and the cocks on pipes connecting the bottoms of tanks, together with the cock leading to sump, will be opened ond only afterwards pump started up. Generally speaking all tanks and troughs in the system must be thoroughly cleaned of all sludge every evening after the day's work is finished, and all sludge of TNT will be sent either to the Burning Ground in special boxes to be burned under supervision of the Building Safety Officer or to the TNT Recovery Plant. The Factory Safety Officer will superintend the cleaning of the whole system, using a steam jet, if necessary, brush, cotton rag, or tow, but never metallic tools. Lastly, to cool down the temperature of the pipes, jets, etc.. cold water to be pumped for ten minutes throughout the whole system.

22. Very strict attention must be paid by everybody to see that no shell with a gaine in place is allowed to reach the WOP, owing to the bad construction of some of English fuzes, viz., 100, 103, 106, etc. Often it was found that the cap (for instance, fuze 103) has remained in the bottom of cavity in filling and, in this event, it was also found that the C. E. pellet and the detonater have fallen from

the gaine into the cavity. Therefore, is was essential to introduce drastic regulations in all factories as regard this phenomenon; beyond this each tank was provided with mesh wire (see sketch) also to catch the smoke bags of different kinds, which were picked up and burned on the Burning Ground without delay.

23. The inspection of the empty shells must, on no account, be done inside or around the WOP, but in a quite separate place distant from WOP (absence of any trace of high explosive inside and on the exterior surface of the body of the shell and on the treads of fuze holes). This is done by a wooden rod with electric lamp attached and connected with portable battery (accumulators): in no case with a long loose lead from the electrical main line. Debanding only after "O. K." inspection.

24. As regards the floor inside the WOP, the following historical data may be useful. The ammonium nitrate does not affect concrete very much. The cement bonding of the brick work, as well as the brickwork itself, around the traverse pit (which has on many occasions, thanks to negligence, been practically full of liquid) has not suffered at all. The concrete also at the base of the pits has not deteriorated. Trial pits were dug at different points around the tanks to a depth of about five feet. In none of these pits could the presence of A. N. be detected. There also were no fumes and little seepage collected. They did not appear to be in any way discolored.

On beginning the work, the floor was at first earth, in view of emergency, and the whole atmosphere in pits became impregnated with pungent A. N. fumes. When the pits, by my order, were being cleaned out and prepared for concreting, the temperature of the earth around the pits and in pits and of the seepage which collected in them was so high that the bare hand could scarcely touch them. When the tanks were lifted, a hard solid mass of TNT was exposed. This layer was in some place four inches thick and was removed with the greatest care. The high temperature of the layer would not permit of its being handled at all during the first day. Even after three days the accumulation was so hot that it could not be picked up with the bare hand. Therefore, at the beginning of duty as Chief Safety Inspector when this investigation was being carried out, we introduced in factories the inside pit floor of concrete. The tanks were fixed on a firm bed of concrete with grouting in the same so as to prevent any collecting below the tanks. Around the feet of troughs and rolling bank-supports cement fillets were placed, as the drippings and spillings of liquid accumulate sometimes around the supports and TNT solidifies. With the fillets it is much easier to keep the floor clean. In any case a long thermometer was always buried in the earth inside the pit in close proximity to the tank, and as soon as the temperature of the earth was raised to 25° C., the earth was immediately picked up and burned on the Burning Ground, and a new portion of fresh earth was put in place of the old. Naturally, it was only a temporary measure and afterwards we turned over a new leaf and availed ourselves of all advantages. It is also quite manifest that the surface of the earth at the exterior of the WOP is to be kept in full order, and there is no authority to have any pools of water round the WOP which contain traces of high explosives or any components of high explosive mixture in a soluble state. It may be added that inside the WOP the floor must be slightly sloping (also the bottom of the troughs) so that it may be conveniently washed up at frequent intervals.

25. The WOP unit must be surrounded by artificial mounds, thickness being two meters at least and height four meters, having the corresponding gangways for Decauville Railway and a sufficient number of entrances for workmen, as well

as a special emergency exit. It is also quite easy to see that the shells waiting to be washed out (reserve shells) are to be kept plugged outside the WOP, though in close proximity, but in any case being separated from WOP by means also of artificial mounds or traverses.

26. All electrical motors (motor switches, starting switches, double poles, fuses, etc.,) must be enclosed (never in close proximity to the tanks, troughs, or shell storage) and covered with an asbestos structure having glass windows which will allow the foreman or person in charge to see, for instance, that there are no sparks on the collector brushes during the running, etc. The starter must also be enclosed and fixed outside the WOP. All wires to be carefully insulated; electric lamps enclosed in watertight (bulk-head) fittings. Motors should be so placed that no unprotected woodwork is within a distance of twenty-five inches (measured horizontally) and five feet measured vertically above them. If in case of necessity the motors are mounted on a wooden floor, a sheet of asbestos should be placed beneath them. Do not allow near the motors any inflammable material, and no petrol, oil, etc., inside the WOP.

27. The special boiler to be placed outside the WOP (at least fifty meters) and provided with the exterior and interior spark arrestors and also a good ash tray with corrugated iron sheets to keep the hot cinders off the ground. Only enough oil for one day's work may be stored for the boiler (outside, at least three meters distant).

28. Direct sunlight should never be allowed to penetrate the WOP.

29. Full ventilation to be provided inside the WOP.

30. Inside the WOP: complete absence of any textile materials, steel tools, copper and brass tools.

31. Telephone station not to be inside the WOP.

32. Lightning conductor to be erected.

33. The fire scheme should be examined twice per month, and the special fire-fighting train must be placed fifty meters outside of WOP and always ready, day and night.

34. The transportation of shells, explosives, etc.: only fireless locomotive to be used, being charged (at special charging station) with superheated steam injected into the boiler or the locomotive functioning by compressed air.

35. Never on any account will the shell filled with a high explosive mixture containing nitroglycerin as one of the components be washed out.

36. Never on any account will explosive limits and man power be exceeded. It is a duty of Building Safety Officer to install these figures in full accordance with local conditions, capacity of the WOP, and also the capacity of people.

39. In case of a thunderstorm, work should cease at once without waiting for special order.

40. In case of shells filled with amatol-block charges, the latter must be removed in accordance with quite separate instructions.

In case of 9.45-inch English trench howitzer bombs, filled with "stemmed filling" and "pitch" lined, it is evident that temperature of wash-water must not exceed 25° C., and the water in the tanks may be afterwards heated up to separate the explosives. But if they are filled with sabulite, for instance, there is no room to wash them in WOP and only traces of H. E. inside the bombs may be washed having the temperature no more than just mentioned. In the same manner the German 24-cm. heavy minnen (*schwere Fluegel-Mine*), as well as English 20-lb. Cooper bombs, may be washed out. In case of English 550-lb. aerobombs, the bombs were suspended at a convenient angle (never in an upright position)

over the tank and emptied with a special injector. To wash the German 76-mm. Minnenwerfer shells the wash-water must never exceed a temperature of 65° C. and resulting sludge to be burned at once on the Burning Ground. Only in case of very powerful fan in WOP, installed to draw off the fumes, the wash water may have the T= 85° C. if this is absolutely necessary in view of other very important reasons. The washing-out process of dinitrobenzene must be done only by cold water. If the dinitrobenzene is mixed with other ingredients it is necessary to maintain as much as possible full ventilation in the shed and even sometimes to take away partially the roof (one square meter) in chess order. But nevertheless, in this case the T. is not to be higher than 40° C. and all people are to be provided with the corresponding gas-masks.

41. The treatment of Ammonium Nitrate liquid in the Kestner House or other special system must be done very carefully until the military specifications are reached, particularly when it is desirable to make at once the amatol charge and to keep it for a long time in Ordnance Magazines. Many authors have already published this specification but the correct military specification is as follows: (1) Si ..... 0%; (2) Fe_2O_3 ..... traces only; (3) Organic matter..... 0% (a very important point for Ordnance); (4) Oils ..... 0%; (5) Nitrates and nitrides like F_2O_3 $(NO_3)_6$ ..... 0%; (6) Pb..... 0% (also a very important point); (7) Cl..... 0.003% maximum (like: NH_4Cl; Fe_2Cl_6; KCl); (8) Sulphur..... traces (like: $(NH_4)_2SO_4$; $Fe_2(SO_4)_3$; $MgSO_4$; K_2SO_4); (9) Thicyanates ..... 0%); (10) H_2O ..... 0.50% (to be reduced to 0.05% just before making the corresponding mixture with TNT).

Some Special Points for Building Safety Officer

42. The first safety duty is to divide the explosives on the workshop line and inside the WOP as far as possible, no matter what state the explosive is in.

43. The WOP must be kept in a clean and tidy condition and the sludge must not be allowed to accumulate in the plant or outside the plant.

44. Any explosive spilled must be immediately swept up by means of a soft hair brush (dry) and a wooden shovel, being placed in a special receptacle.

45. The special boxes referred to here for holding explosive must be of wood, fitted with good lids, and have rope handles and rope hinges, and be free from projecting nails, screws, metal fittings. Keep the wooden boxes always in a strictly humid condition and change in due time. They must be kept closed at all times when not in use. Receptacles awaiting removal with the high explosive (spilled) to the Burning Ground must be placed at least twenty-five meters outside the WOP and in a special place in accordance with local instructions.

46. It is convenient to construct the floor of tanks somewhat sloping, provided with a stop-cock by means of which in due time the liquefied TNT is to be removed by special pail (make a special design for this purpose).

47. It should be noted that as fire reaches even a small store of TNT, the latter tends to become explosive after being partially burned. See that no store of TNT, even in a small quantity, is allowed inside the shop at any time.

48. If any traces even of dry Ammonium Nitrates are seen on the surface of any "necessary wood construction," wash it immediately. Owing to the hygroscopical and deliquescent properties of A. N., nitration of wood, bags, etc., will take place, and if direct rays of the sun are falling, fire may very easily occur. This phenomenon has been proved many times in direct practice, and particularly when A. N. did not correspond strictly to military specifications (organic matter, etc.).

49. All wooden parts (which it is always very desirable to exclude as far as possible) to be impregnated with fireproof chemicals (avoid alkali, as for fire extinguishers, for this special case) if possible. But in any case, wash windows, walls, etc., at the end of each week (grit, traces of H. E., etc.).

50. Never allow the system to get choked up with TNT, smoke bags, C. E. pellets (English shells), caps (English shells), detonators (English shells), etc. Keep the strainers free from obstruction. Any accumulation of H. E., etc., should be removed immediately, placed in a special wooden box and sent to the B. G., never scraped into the tanks.

51. The jets must always be in line with the shell axis so that the liquid enters the center of the fuze hole, and does not go onto the outside of the shell.

52. Before placing a fresh shell in position opposite the jet, the latter should be examined to see it is quite free from explosive, etc. This can be done by a piece of wire (aluminum, etc., and never copper, etc.).

53. Examine previously: self-registering thermometer, glass maximum thermometers, aerometers, etc.

54. Always maintain the temperature of the liquid as indicated so that when it reaches the shell it is between 80-90° for English amatol-filled shells.

55. The pressure of hot water depends upon the construction of WOP, the length and interior diameter of the shells, etc. No dropping of resulting liquid outside the troughs.

56. Only authorized tools and equipment should be present inside and outside of the WOP.

57. Fire appliances, automatic sprinklers, special fire-fighting train, extinguishers, fire buckets: examine each day, as well as hydrants; they must be ready for use always and not removed from their allotted places, nor used for other than specified purposes.

58. Special clothing, boots, goggles, masks, etc., for men and women to be in full order and each person to use only his own; each has his own cloth, etc., in a special place in a special cupboard.

59. The usual precautions (safety and health) have to be taken for guarding the workers.

60. The Foreman and Building Safety Officer are responsible that these instructions are not only understood but acted up to by all workers concerned. On the other hand: workers who ignore these or other instructions compiled with a view to "safety first" will be liable to instant dismissal.

ACKNOWLEDGEMENT

The above-said rules and regulations were written by us and introduced in all MM. F. N. Pickett and Fils' War Ammunition Breaking-down and Explosive and War Gas Recovery Factories in France and Belgium (12 factories) in 1920-1923, and more than a million shells (naval and military), bombs, minnies, grenades, etc., of different States have been successfully washed out without an accident. These rules and regulations have been approved by the French War Office General Inspection of Ammunition as well as Technical Ordnance Committee and Central Commission of Recovery of Belgium War Office Ordnance Department, to whom I give my hearty thanks, in my very difficult task during these years as Chief Safety Inspector of the above mentioned factories. Particularly I give thanks to Lieutenant General Le Pelletier, Lieutenant General Vinet, Lieutenant General Tollens (Belgium), Major Saint Sauveur, and their staffs.

Fuze Range Percentage Corrector

By First. Lieut J. E. Reierson, C. A. C.

The following additional information relative to the fuze range percentage corrector (see July Journal) is submitted:

1. To overcome any confusion in the use of graduations a movable pointer is used. This pointer will coincide with the graduation which is to be used as an index. This pointer will travel in a slot which is an arc of a circle whose radius

Sector of Percentage Fuze Corrector
Showing Movable Pointer.

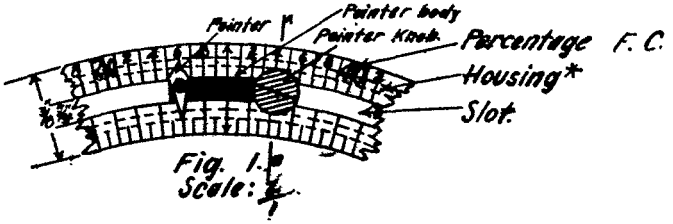


Fig. 1.
Scale: ½

Cross Section of Housing and Pointer.
Fig. 2.

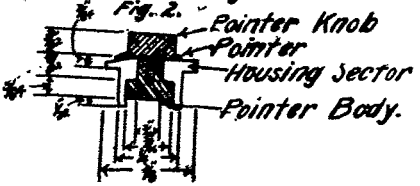


Fig. 3.
Top View of Movable Pointer.

Note: Screw head (Pointer Knob) Bears on a Spring Washer to Keep Pointer, When Set, from Moving.
To allow the Pointer to be used for all Indices, ½" more of the housing, on the right of the "45" index, must be Machined.

Bracket Fuze Setter, Mod. 1916.

is approximately two and one-sixteenth inches. The slot will be milled in that portion of the housing cover which contains the range percentage correction indices (see figure).

2. The tables, as constructed, can be used for any trial shot point within several hundred yards of the altitude of the "ideal TSP" and for all fuzes which reach these limiting altitudes. For example: Were it more desirable to use a TSP: H = 2991 yds., i = 800 mils, S = 739 mils, B = 9, than the ideal TSP (at the summit of trajectory); namely: H = 2886 yds., i = 600 mils, S = 390 mils, B = 19, it could be done without error, so far as the table is concerned, as follows:

Enter the table with the T. S. fuze and read opposite the same fuze in the table the index which gives the correction equal to "C," the T. S. Corrector. The correctness of the above is shown as follows: The indices in the table give, for any fuze, corrections equal to the T. S. Corrector obtained from firing a T. S. problem at that point. The point (represented by B), in the table, is within a few yards of the TSP shown for the same fuze; they therefore have the same corrections.

Additional T. S. Points which can be used for Zone 2:

B	A. R.	i	S	H	t
6	3230	1200	1179	2945	5.90
7	3670	1000	964	2881	6.99
8	4080	800	748	2749	8.07
9	4480	800	739	2991	9.27
10	4840	700	625	2792	10.34
11	5230	700	613	2962	11.59
12	5600	700	600	3117	12.88
13	5830	600	485	2677	13.73
14	6180	600	471	2755	14.97
15	6490	600	456	2816	16.21
16	6815	600	441	2859	17.46
17	7115	600	425	2885	18.72
18	7400	600	408	2894	19.98

By interpolation in the Firing Tables the exact fuze and elevation for any point having a 2886-yard altitude can be obtained; however, this is believed to be unnecessary. The actual range to any of the above TSP's is within a few yards of the actual range for the same fuze (in the table) for a 2886-yard altitude.

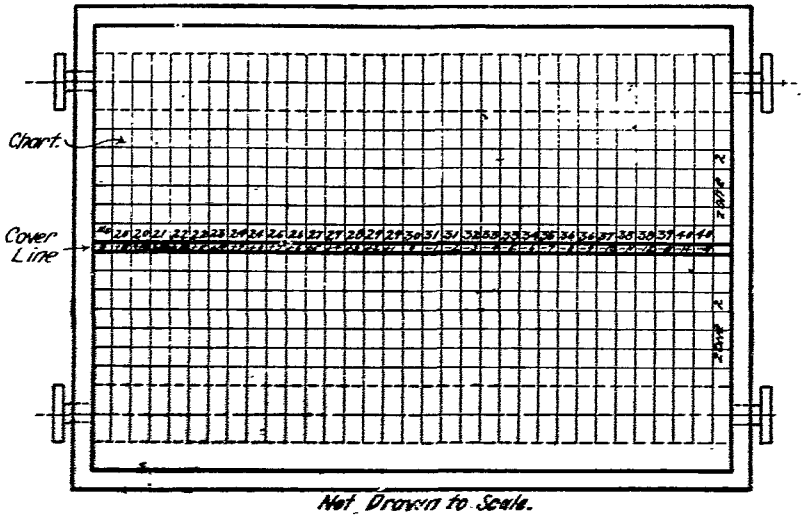


Fig. 1

3. To overcome any errors in reading the indices the tables have been replaced by a board know as the Fuze Range Percentage Correction Board. The

ZONE 2 (H = 2000 — 4000 yds.)

For T. S. Points: B = 6, i = 1200, S = 1179, H = 2946, t = 5.90; B = 7, i = 1000, S = 964, H = 2981, t = 6.99; B = S, i = 800, S = 748, H = 2749, t = 8.07; B = 9, i = 800, S = 739, H = 2991, t = 9.27; B = 10, i = 700, S = 625, H = 2792, t = 10.34; B = 11, i = 700, S = 613, H = 2962, t = 11.59; B = 12, i = 700, S = 600, H = 3117, t = 12.88; B = 13, i = 600, S = 485, H = 2577, t = 13.73; B = 14, i = 600, S = 471, H = 2755, t = 14.97; B = 15, i = 600, S = 456, H = 2816, t = 16.21; B = 16, i = 600, S = 441, H = 2859, t = 17.46; B = 17, i = 600, S = 425, H = 2885, t = 18.72; B = 18, i = 600, S = 408, H = 2894, t = 19.98.

B	+15	+14	+13	+12	+11	+10	+9	+8	+7	+6	+5	+4	+3	+2	+1	0	−1	−2	−3	−4	−5	−6	−7	−8	−9	−10	−11	−12	−13	−14	−15	
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11.5	20	20	21	22	22	23	24	24	25	26	27	27	28	29	29	30	31	31	32	33	33	34	35	36	36	37	38	38	39	40	40	Fiducial Edge
B	+15	+14	+13	+12	+11	+10	+9	+8	+7	+6	+5	+4	+3	+2	+1	0	−1	−2	3	−4	−5	−6	−7	−8	−9	−10	−11	−12	13	14	15	
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	o	.	.	.	.	.	.	Cover Line

ZONE 2 ZONE 2

Explanatory notes on operation of Chart: . Marker hole. o Marker.

The Chart is operated as follows:

To find: The Range Percentage correction index for a T. S. corrector correction of —9 in Zone 2 for fuzes; B = 11.3 — 11.8.

Solution: Turn Chart until B = 11.5 is just above upper edge of "cover line." Read index on Chart just above —9 on cover line; therefore the Range Percentage index is 36.

NOTE.—Use the zone corresponding to the altitude of the target regardless of the zone the T. S. problem has been fired in. If the T. S. corrector correction for a TSP in zone I is —9 for a fuze of 11.5 use —9 and enter zone 2 and find the column which has —9 for a correction for the same fuze. This is easily found by adding 9 to 30 getting 39. 39 is in column headed "—13." Therefore use column "—13."

tables have been put on a chart and those indices corresponding to certain altitudes are in a certain Zone on the chart.

For example:	*H*	*Zone*
	0 — 2000	1
	2000 — 4000	2
	4000 — 6000	3
	6000 — 8000	4

Example: The Trial Shot Point, being any of those tabulated above, is in Zone 2. Therefore the Fuze Range Percentage Correction Board Operator turns to the indices under Zone 2.

The board is constructed as follows: two cylinders of suitable size are placed in the same plane with their axes parallel and are held in place by a waterproof box. The ends of the chart are attached to the cylinders, which are capable of being revolved about their axes; the revolving of the cylinders causes the chart to move. The cover of the board is of transparent material and has drawn on it a straight line parallel to the axes of the cylinders and horizontal lines on the chart. On this line are printed from left to right: "B + 15 + 14 + 13 + 12 + 11 + 10 + 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 0 — 1 — 2 — 3 — 4 — 5 — 6 — 7 — 8 — 9 — 10 — 11 — 12 — 13 — 14 — 15."

Figures left of zero are plus corrections; on the right minus corrections. To find the range percentage correction for any fuze in any zone: (1) turn the chart for this zone so that this fuze is on the edge of the cover line; (2) read the range percentage correction (index) above the proper T. S. corrector correction on the line. The chart will have only one fuze column and all columns will coincide with the corresponding figures on the "cover line."

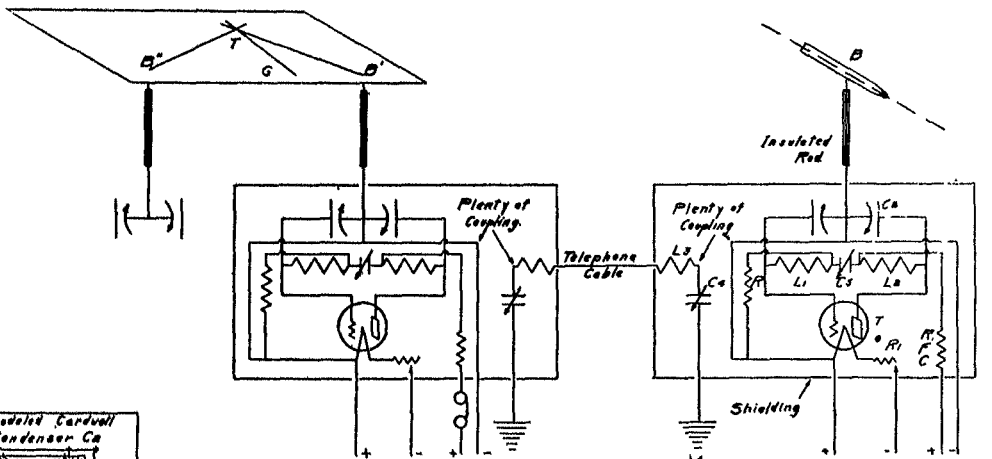
The Heterodyne System of Communication for Position Finding

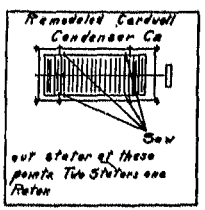
By LIEUT. V. C. STEVENS, 4TH C. A. (H. D.)

In our endeavor to deliver a heavier and more accurate volume of fire we have overlooked one fact: the inability of our present position finding system to deliver accurate data at the time the guns are ready to fire. Any attempt to interpolate data introduces error and helps very little on a fast moving target. We need more observations to cut down the errors of prediction. The ideal system would be one in which the only prediction would be for the travel of the target during the time of flight. It is an approach to such a system that I shall try to describe.

Before I go any further it might be well to explain to those who are not radio fans what is meant by heterodyne. If a body vibrates at a rate of speed greater than sixty thousand vibrations per second it cannot be heard by the human ear; but if another rapidly vibrating body of slightly different speed is brought near it, a beat-note equal to the difference of their respective notes can be heard, provided that the difference in frequency between the two notes does not exceed sixty thousand vibrations per second. The system in radio whereby the receiving set is really a small sending set, sending an interferring note, is known as the heterodyne circuit. It possesses three unique qualities, the need of which will become evident in my explanation. First, the receiving set is entirely independent of the size of the aerial. Second, it is extremely selective, especially at the lower wave lengths where the vibrations in the circuit become very great. Third, the set requires but a single control.

Radio Control





Receiver duplicate of Transmitter.
Condenser Dials synchronised.
Series 200 Tubes and Equipment recomended.

Ca -Cardwell Double Unit .0005 M.F.
Cg -Blocking Condenser.
Cg -Grounding Condenser
T -Low power Oscillating Tube.
R -Grid Leak. R1 -Rheostat
R.F.C.-Choke Coil.
L3 -Coupling Coil 6 Turns #8 bare 1¾" Diam.
L1-L2-For 80 M band 12 Turns each #14 bare 3" Diam - Spaced ¾th".
For 40 M band 6 Turns each #8 bare 2 ½" Diam. - Spaced ¼"

Referring to the diagram you will see that the general idea is this: The readers at the base end stations, B′ and B″, have a dial on the double condensers C^2 which reads in azimuth and which they keep synchronized with the reading of their instruments at all times. This might be accomplished by means of a prism whereby the instrument dial and the condenser dial could both be seen simultaneously, as in a Belgian Aiming Device. I might add here that this dial should not be on the condenser itself, but connected by an insulated rod several feet long, to eliminate body capacity, since it is necessary that the set operate on the low wave length which is very sensitive. It is necessary that the transmitters emit a steady note from maximum to minimum which would require a perfect straight line condenser, impossible to construct. Therefore, the azimuth must be divided into quadrants and only the central limits of the condenser put into use. The change of quadrants in plotting rooms would be a simple matter of moving the condenser back to the starting position. The working limits of this condenser can best be determined by experiment. It may also be necessary to gear the condenser up to tune as fine as 1/100 of 1°, although experiment shows it to be this selective with an experienced listener.

The medium of transmission to the plotting room is the telephone cable, already installed, which is grounded at both ends through a blocking condenser. Since the vibrations are beyond the range of audibility the line can be read simultaneously for a telephonic conversation. This would not affect the set in the least for it is independent of aerial length. This method eliminates static and affords a check by the telephones now installed. But, by putting in transmitting tubes in the base end stations, an isolated station could be reached with communications cut, or shot away; check could be had by a wireless phone in circuit.

In the plotting room there are two receivers—one for creating a beat-note with B′, the other for creating a beat-note with B″. Couplings at both ends must be very loose so that the operator (arm-setter), either hears the beat-note very sharply, or not at all. The arms on the plotting board tune the circuit by being connected with the condenser C^2 which is synchronized with the reader's condenser. The arm must be so connected that the condenser can be released and turned back at the end of every quadrant. If the arm-setter has his arm at the correct azimuth he will hear a hum-note in his receiver and by always keeping this hum-note in his receiver it is evident that a continuous track of the target will result from which data can be taken at any instant. Check reading can be sent from the base end stations every so often.

It is desirable in this system that the arms be not cleared and the method of tracking the setforward point described by Captain Albert M. Jackson in the December, 1923 issue of the JOURNAL would be most applicable. The observers would only have to make a prediction for the time of flight, plus a small dead time interval which, in the case of guns, would be very small.

So that the receivers in the plotting room do not interfere, they could cover different bands of wave lengths. All sets should be completely shielded by a metallic grounded shield. Identity of set and length of leads, and careful synchronizing of the condensers is necessary.

In order to obtain a straight line condenser of correct capacity, it was found necessary on experiment to cut the stators and thus make two condensers in series with a common rotor. (Shown in diagram.)

By practice with a dead time interval similar to that used in antiaircraft, frequent sets of data could be sent to the guns. However, we might go a step farther—make the gun arm a resistance and its arc of azimuth a resistance and

with voltmeters at the guns, or data-out phones, which read in range and degrees of azimuth instead of volts, we could get a continuous line of data to set on the guns. The guns would be trained on the target at all instants and could be fired as soon and as often as loaded. Resistance circuits on the range and deflection boards would automatically throw correction into the circuit. All present boards could be used with the addition of german silver resistance elements, except the percentage corrector which would have to be built to give a correction, rather than the corrected range, in order automatically to get its correction on the range by means of a resistance circuit. It would be perhaps better to have such a system entirely in the plotting room and send the data to the guns by a mechanical follow-the-pointer system, for the concussion at the guns would probably throw such delicate instruments cut. If such a system were used, the prediction for a dead-time interval could be done away with.

I shall leave the reader to imagine the advantages pro and con of such a system. Of course, it is all theory, but all equipment, except the straight line condenser, is on hand and the system would be cheap to experiment with. Surely an arm-setter could be taught to distinguish a certain note and keep on it. A wireless expert would be needed in each battery, but our plotting room details could be cut.

In closing I wish to give due credit to Mr. F. H. Garrahan, Radio Station 8 A. O. L., who has given me valuable pointers on these circuits and has tested them out by experiment.

Annual Encampment, 1st Battalion, 514th C. A. C.

On August 15, 1926, the first Battalion of the 514th C. A. C. (Colonel Charles Elliot Warren), completed a most interesting and instructive two-weeks' training with the regulars at Fort Hancock, N. J. The Battalion was especially fortunate in being selected to take charge of the 315 Coast Artillery C. M. T. C. boys for the Second Corps Area, assisted by the officers of Fort Hancock. The organizing, processing, and initial training of the C. M. T. C. battalion was handled with remarkable smoothness and dispatch. Captain M. E. Kurtz, as battalion commander, was commended for the able manner in which he handled the organization of the battalion. After only three days' training, the boys were able to participate in ceremonies and a parade in New York in a very capable manner.

On August 6, his Excellency, Governor Harry E. Moore, of New Jersey, invited the Regiment to attend the ceremonies connected with Governor's Day at his summer capital, Seagirt, where the members attending greatly enjoyed an instructive demonstration of a regiment in attack, and a review by the New Jersey National Guard.

On Saturday, August 7, the members of the regiment were guests of the Seabright Lawn Tennis and Cricket Club, and cheered enthusiastically for their favorite, Helen Wills. After the tennis matches the officers were guests of the Casino Club of Atlantic Highlands at a very enjoyable dance.

Through the courtesy of Rear Admiral C. P. Plunkett, 3d Naval District, Commander of the Brooklyn Navy Yard, the U. S. destroyer *Fox*, Commander Kaufman, was placed at the disposal of the battalion, and a most enjoyable trip was made in it to New York City. After disembarking, the battalion was marched to the Polo Grounds, and paraded inside the grounds before their hosts and thousands of baseball fans. Manager McGraw shook hands with members of the Battalion, and thanked them for their fine drill.

The last days of the camp were filled with ceremonies and social functions. On August 13, the battalion gave a review to General Howard S. Borden and the regimental commander. Both officers expressed themselves as greatly impressed with the fine showing of the battalion. On the evening of August 13, an elaborate regimental dinner was held at the Officers' Club, given in honor of Colonel Godwin Ordway and the officers stationed at Fort Hancock. Colonel Warren acted as toastmaster. Speeches were made by Colonel Ordway, Colonel W. R. Sample, representing the Corps Area commander, Colonel Seoane, Mr. Shannon Cormack, of the *New York Times*, and Major E. L. Dyer. After dinner the regiment gave a dance to the officers and ladies of the post, concluding the social events of the tour of duty in a most enjoyable manner. Music was furnished by an orchestra from the 7th Regiment band and the 514th C. A. C.

Colonel Charles Elliot Warren offered the following cups as prizes for the Camp:

(1) One for the battery having the best tents, equipment, and company area during the camp.
(2) One for the battery being most efficient in infantry drill.
(3) One for the battery excelling in athletics.
(4) One each for the member of the blue, white, red, and basic courses whose services and work have been considered the best in the respective courses.
(5) One for the most efficient enlisted man in the 514th.

Recall has sounded for the last formation with the colors for the 514th C. A. C. this year, but as the officers and men return to civil life the War Department can assure itself that there is one fine organization, whose motto is "They who pass, fly high," which will be eager and ready to take its place in the line in case of a great national emergency.

Instruction at West Point

The eleven hundred and fifty cadets of the Military Academy began their year's work on September 1. This work includes three main branches: the academic work, the military training, and the fall intramural athletics.

Military training and intramural athletics alternate daily. Military drills and instruction are taken up in accordance with a prearranged schedule which provides for progressive training for Cadets of each class. For the Cadets of the first class, for the period September 1 to December 23, military instruction provides for riding, infantry drill, hippology, military hygiene, and various professional lectures, including several on the air service. The second class takes up infantry drill and riding. The third class receives training in the infantry and coast artillery. The fourth class has instruction in infantry drill, field artillery drill, rifle marksmanship, and infantry weapons. Throughout this period, whenever practicable, military drills are held out of doors. Riding is held in the riding hall, as is the study of hippology. Both field artillery and coast artillery drills consist largely of calculating firing data.

The fall intramural work consists of the following athletics: football, basketball, lacrosse, swimming, tennis, golf, fencing, polo, and gymnastics. For the Plebes, most of these athletics are a continuation of the summer work they have just completed. For the upper classmen they represent a continuation of previous work in this type of physical training. Intramural athletics, as a whole, form a very considerable part of the entire physical and athletic training of the Corps of Cadets. All Cadets get some instruction in each of the sports mentioned.

Regular Army officers (familiar with the sports concerned) are in charge, with from two to six Cadets of the upper classes as assistants. For these intramural athletics there are available three football fields, three basketball courts, two soccer fields, seven tennis courts, one quarter-mile track with a two hundred and twenty yard straightaway, a nine-hole golf course, a regulation fencing room in the gymnasium, and a riding hall for polo. For each sport Cadets wear the appropriate athletic uniform.

The third phase of Cadet training, which runs throughout the year, is the academic work. This is the hardest part of the Cadet's career at the Academy. For the first half of the year the first class (seniors) take up mechanical engineering, military art, ordnance and gunnery, government, law, tactics, and military hygiene. The second class, in their study of natural and experimental philosophy, take up chiefly during the first term general physics. They also study general chemistry and heat. They have laboratory periods in each of the foregoing. Spanish and drawing complete their academic work. The third class continue their mathematics, French, and English. In addition they take up history and drawing. The fourth class (Plebes) commence their academic work with mathematics, French, and English.

The academic day runs from 7:55 A. M. to 11:55 A. M. and from 1:00 P. M. to 3:00 P. M. Military exercises take place from 3:15 P. M. to 4:15 P. M. Intramural athletics run from 3:15 to 4:25 P. M. During September, parades are held daily, except Wednesday, at 4:35 P. M. Saturday review is held at 1:10 P. M. Sunday parade and formal guard mounting are held commencing at 4:45 P. M.

The Fifth Coast Artillery

The Coat of Arms of the 5th Coast Artillery was approved by the War Department on October 3, 1925, and its blazonry is:

Shield: Gules (red) a bend or (gold) charged with six cannon paleways in pairs sable (black), between in sinister chief a fish hook fessways, ring to dexter, barb to base, and in dexter base a Lorraine Cross, both of the second (gold).

Crest: On a wreath of the colors (gold and red) upon a cannon wheel or (gold) partly surrounded by two palm branches vert, the wheel grasped by two hands proper (in natural colors) issuant chevronways from base, a bronze cannon paleways smoking of the last (in natural colors).

Motto: Volens et Potens (Willing and Able).

The old 5th Regiment of Artillery was organized in 1861, as a horse artillery regiment; the other four regiments of artillery had only two light batteries in each organization. It was composed of ten batteries—then called companies—lettered from A to M; and two batteries, N and O, were added in 1899. Of these, eight are incorporated in the present 5th Coast Artillery. The units of the 5th Coast Artillery participated in sixty-four battles or skirmishes during the Civil War, of which only the following names are embroidered on streamers of the color of the campaign badge of the Civil War and carried on the staff of the regimental color: Peninsular, Manassas, Antietam, Fredericksburg, Chancellorsville, Gettysburg, Wilderness, Spottsylvania, Cold Harbor, Petersburg, Shenandoah, and Appomattox.

Battery C, 5th Artillery, now Battery C, 5th Coast Artillery, was a unit of the First Regular Brigade, Artillery Reserve; and Battery I, 5th Artillery, now Battery F, 5th Coast Artillery, was a unit of the Fifth Army Corps commanded by

General Sykes. Both participated in the Battle of Gettysburg, July 1 to 3, 1863. The Federal line of defense extended from Cemetery Hill to Round Top, the former resembled the hook and barb and the latter the ring. The line as a whole resembled a fish hook, which device is shown on the coat of arms and portrays this event. In the battle of New Market, May 15, 1864, in which Captain DuPont (later Senator DuPont), commanding Battery B, 5th Artillery, held a whole corps of Confederate troops in check so that General Sigel was able to retreat across the Shenandoah River in safety, he deployed his guns in pairs in echelon on the road, firing in sections, then retreating and taking up a new position, making the enemy believe that Sigel's whole artillery was in action (see *Field Artillery Journal*, November-December, 1922). This event is shown by the bend charged with the six cannons. The crest of the coat of arms symbolizes the gallant services of Battery C at Spottsylvania, May 10, 1864.

Theo. F. Rodenbough, in *The Army of the United States*, says: "Battery C-1 was engaged during the attack of the V Corps, May 10 and again in the afternoon. On May 12, it engaged the enemy during the attack of the VI Corps—one of the bloodiest fights of this campaign. When Hancock had forced the salient, called Bloody Angle, the key of Lee's position, and had reached the second line, he met stern resistance."

"After the capture of the Confederate works," relates Sergeant W. E. Lines, "we were in a position near the small pine trees so much spoken of, and fired a few lines of solid shot. While we were waiting, General Wright rode up to Lieut. Gilles and desired a section. Lieut. Metcalf came over to our section and gave the command and away we went up the hill past our infantry into position." "At this moment," writes an eye witness, "and while the open ground in rear of the Confederate works was crowded with their troops, a section of Battery C, 5th U. S. Artillery, under Lieut. Richard Metcalf, was brought into action and increased the carnage by opening at short range with double cannister. This staggered the apparently exultant enemy. In the maze of the moment these guns were run up by hand close to the famous angle and fired again and again, and they were only abandoned when all the drivers and cannoneers had fallen. In a few moments the two brass pieces of the 5th Artillery, cut and hacked by the bullets of both antagonists, lay unworked with their muzzles projecting over the enemy's works." This is the only recorded instance in the history of the war of a battery charging on breastworks. "Metcalf's double cannister cleared his front and undoubtedly contributed to the success gained. This battery was gallantly served throughout the day." (Hancock)

Battery A, 5th Coast Artillery, was Battery D, 57th Artillery, Coast Artillery Corps, during the World War and participated in the following: Toul Sector, May 16 to September 11, 1918; St. Mihiel Offensive, September 12 to 16, 1918; and Meuse-Argonne Offensive, September 26 to November 11, 1918. All of this service was in Lorraine, and the Lorraine Cross is taken from a charge on the collar of the supporter of the arms of St. Mihiel and symbolized the part that this battery performed in the World War. The shield is red for artillery. The motto "Volens et Potens" (*willing and able*) is taken from the Coast Defenses of Southern New York, where the 5th Coast Artillery was organized in 1924.

The designation of the different units since its organization are as follows:

Headquarters Battery was organized in 1861 as Battery M, 5th Artillery; designated 57th Company, Coast Artillery, in 1901; became 3d Company, Fort Winfield Scott, Calif., in 1916, and 3d Company, Coast Defenses of San Francisco, in 1917; again designated 57th Company, Coast Artillery Corps, in 1922; and became Headquarters Battery, 5th Coast Artillery, in 1924.

Battery A was organized in 1861 as Battery A, 5th Artillery; designated 49th Company, Coast Artillery, in 1901; changed to 3d Company, Fort Williams, Me., in 1916; became Battery G, 6th Provisional Regiment, Coast Artillery Corps, in 1917; Battery G, 51st Artillery, Coast Artillery Corps, in February, 1918; and Battery D, 57th Artillery, Coast Artillery Corps, in July, 1918. Disbanded at Camp Lewis, Wash., in 1921, and reconstituted and consolidated with Headquarters Company, Coast Defenses of Puget Sound (organized in 1921) and designated the 49th Company, Coast Artillery Corps in 1922. Became Battery A, 5th Coast Artillery, in 1924.

Battery B was organized in 1861 as Battery B, 5th Artillery; designated 50th Company, Coast Artillery, in 1901; changed to 1st Company, Fort Levett, Me., in 1916, and to 9th Company, Coast Defenses of Portland, in 1917; again designated 50th Company, Coast Artillery Corps, in 1922; and became Battery B, 15th Coast Artillery, in 1924.

Battery C was organized in 1861 as Battery C, 5th Artillery; designated 51st Company, Coast Artillery, in 1901; became 2d Company, Fort McKinley, Me., in 1916, and 12th Company, Coast Defenses of Portland, in 1917; Battery C, 54th Artillery, Coast Artillery Corps, in December, 1917; was disbanded at Camp Devens, Mass., in 1919; reconstituted and consolidated with the 4th Company, Coast Defenses of Portland (which was organized in 1918), and designated the 51st Company, Coast Artillery Corps, in 1922; and became Battery C, 5th Coast Artillery, in 1924.

Battery D was organized in 1861 as Battery L, 5th Artillery; designated 56th Company, Coast Artillery, in 1901; became 6th Company, Fort Hancock, N. J., in 1916, and 6th Company, Coast Defenses of Sandy Hook, in 1917; again designated 56th Company, Coast Artillery Corps, in 1922; and became Battery D, 5th Coast Artillery, in 1924.

Battery E was organized in 1861 as Battery H, 5th Artillery; designated 54th Company, Coast Artillery, in 1901; became 2d Company, Fort Wadsworth, N. Y., in 1916, and 6th Company, Coast Defenses of Southern New York, in 1917; again designated 54th Company, Coast Artillery Corps, in 1922; and became Battery E, 5th Coast Artillery, in 1924.

Battery F was organized in 1861 as Battery I, 5th Artillery; designated 55th Company, Coast Artillery, in 1901; became 2d Company, Fort DeRussey, H. T., in 1916, and 10th Company, Coast Defenses of Oahu, in 1917; 3d Company, Coast Defenses of Pearl Harbor, in 1921; again designated 55th Company, Coast Artillery Corps, in 1922; and in 1924 became Battery F, 5th Coast Artillery.

Battery G was organized in 1861 as Battery G, 5th Artillery; designated 53d Company, Coast Artillery, in 1901; became 1st Company, Fort Wadsworth, N. Y., in 1916, and 5th Company, Coast Defenses of Southern New York, in 1917; again designated 53d Company, Coast Artillery Corps, in 1922; and became Battery G, 5th Coast Artillery, in 1924.

The personnel of this organization wear the crest and motto in metal and enamel as a distinctive regimental badge on their uniform.

A New Priming Mixture

An important contribution towards the perfection and development of metallic ammunition became known when the Remington Arms Company requested patent rights on a formula for a priming mixture that eliminates rust, corrosion, and barrel pitting. Remington asserts that when cartridges containing this new priming mixture are used exclusively, it is not necessary to clean the inside of the rifle barrel. It makes an ordinary rifle barrel rust-proof and stainless. The use of cartridges primed with this mixture will prolong barrel life indefinitely, and the new priming mixture does not require the use of a special steel barrel.

The Remington laboratories have for several years been experimenting with the new mixture, and in the course of experimental work millions of .22-caliber cartridges have been fired to perfect it. Barrels through which thousands of .22-caliber cartridges containing the new priming mixture were fired show not the slightest signs of erosion, corrosion, rusting, or pitting. Similar barrels in which several thousand cartridges were fired with ordinary ammunition of every manufacture were badly eroded, corroded, rusted, and pitted.

Recently Remington invited a number of interested persons to witness some tests at the Bridgeport plant. These men were shown a number of rifle barrels. In some of these the new ammunition had been shot on December 10, 1924. In the others ordinary ammunition had been fired at that time. After being used the rifles were stood in a corner without being cleaned, and they were not touched again until they were brought out for inspection.

When a dry cloth was run through the barrels, in which the new ammunition had been shot, to remove the powder residue, it came out clean. It was different with the barrels used in shooting ordinary ammunition. Some of the barrels were so dirty and rusty that they were beyond the cleaning stage. In an effort to rust the barrels after the new ammunition was shot through them they were subjected to severe tests in a specially prepared atmosphere, heavy with moisture. The moisture rusted the blue surface but the insides remained bright. The barrels in which the new priming mixture had been shot have been subjected to many other tests equally as hard as this one, and in no instance was any rust discovered on the inside of the barrel.

Camp of the 241st Coast Artillery (HD)

The 241st Coast Artillery, (HD), commanded by Colonel Benjamin B. Shedd, C. A. C., Mass., N. G., on August 21, completed its annual fifteen-day tour of duty at Fort H. G. Wright, N. Y. The record made by the organization should be an inspiration to other National Guard organizations. The attendance was unusually good. Out of a total strength of 851 enlisted men only twenty-five were absent as were two officers out of a strength of fifty-seven, which gives an aggregate attendance of 98%. Headquarters Battery and Batteries "A," "B," "C," "D," "G," "K," and "M" had 100% attendance. The morale was very high, the discipline excellent, and all duties were performed in an exceptionally satisfactory manner. The first week was rainy and foggy, so little sub-caliber firing could be done. Service firing started on Wednesday of the second week and was conducted as a Fort Command practice. Colonel Shedd had as his P. C. the regular Fort Command station on Prospect Hill and was connected with the three group commanders by the regular fire control telephones supplemented by field telephones, all installed by the specialists under the supervision of the Artillery Engineer. In all about

five and one-half miles of wire was laid and some twenty field phones installed. Monocord switchboards were installed in each Group Command as well as in the Fort Command. Two-way radio communication was established by radio phone with the tug and the planes used for spotting. Two group commands fired the first day and deviations were obtained by terrestrial spotting and airplane observation. All commands for firing came from the Fort Command to the Group Commanders who gave their orders to the batteries. At no time did an order fail to reach its destination promptly, as at no time was there a failure of any communications. The firing was of a highly satisfactory nature and done in excellent time. The tug was directed from the Fort Command. Practically all batteries obtained hits and some as high as five out of six shots, which was done by Battery "K" with 12-inch B. L. R. Hits per gun per minute in this case was .44. Battery "E," with 10-inch B. L. R. obtained .8 hits per gun per minute with four hits out of six shots. The Trial Fire method of adjustment was used by all batteries as being most suited for a battle problem of this nature, four trial shots being fired from each type of armament before the tug went on the course. Corrections were found from these shots and applied by each battery manning that type of armament. In most cases, after improvement fire ended no further corrections were found necessary.

The aid usually received from the regular garrison was kept at a minimum, which aided greatly in keeping the morale high. About all that was asked was that the stations and emplacements be opened where needed. During the past year the regular garrison made several changes in arrangement of fire control stations which were asked for. It is felt by all that the tour just ended has been one of the very best this regiment has ever had.

The Instructors on duty with this regiment are Lieut. Col. Charles C. Burt, C. A. C. (DOL), stationed at Fall River; Captain Edwin C. Mead, C. A. C. (DOL), stationed at Boston; and Captain Valentine P. Foster, C. A. C. (DOL), stationed at New Bedford. During the coming armory training period it is planed to assign two batteries to antiaircraft guns which will make this regiment a complete Harbor Defense unit in every respect.

Coast Artillerymen at Fort Leavenworth

The class at the Command and General Staff School. Fort Leavenworth, Kansas, for the academic year 1926-1927, includes one hundred and ninety-nine officers of the Army, three officers of the Marine Corps, and two officers of the Irish Free State Army. The Coast Artillery Corps is represented by twenty-three majors and five captains, whose names follow:

Majors Acheson, Herbert H.; Allen, Harvey C.; Atwood, Roy S.; Blood, Kenneth C.; Cox, Richard F.; Cramer, Raymond V.; Easterday, George W.; Garrett, Robert C.; Hall, Ruskin P.; Hawkins, Samuel F.; Herman, Paul H.; Hocker, Carl E.; Kimberly, Allen; Kimmel, Manning M.; Magruder, Lloyd B.; Miles, Sherman; O'Rear, John T. H.; Ruhlen, George, Jr.; Shedd, William E.; Terry, Thomas A.; Thomas-Stahle, Charles; Warren, Albert H.; Woodbury, Edward N.; Captains Bond, Oliver J., Jr.; French, Paul H.; Hinman, Dale D.; Phillips, Robert E.; Walbach, James de B.

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. R. S. ABERNETHY, *Colonel, Coast Artillery Corps, President Coast Artillery Board.*

Projects Initiated During the Month of August

Project No. 476, Combination Sponge and Rammer for 6-inch Gun, Model 1900.—To determine the desirability of adopting for service a combined sponge and rammer for use with the 6-inch gun.

Project No. 477, Communication Wire for Field Use.—Questionnaire received to be used in determining characteristics of field wire for mobile coast artillery. New type wire called "assault" wire suggested to replace outpost wire.

Project No. 478, Revision of T. R. 310-136.—Study of contemplated changes in Training Regulations relative to length of cable in use on Cadillac Power Unit for 60-inch Antiaircraft searchlights and proper procedure of occulting. Some units have been using six hundred feet instead of prescribed three hundred feet of cable and have been burning light occulted for extensive periods—both procedures evidently failing to produce harmful results expected.

Project No. 479, Antiaircraft Height Finder, 4-meter T-2.—Test of the 4-meter T-2 Stereoscopic Height Finder, comparing it with two-station altimeter in definition of target, ease and rapidity of picking up, following, and reading altitudes of target.

Project No. 480, Jack-o-Lite Lantern.—An electric lantern, the current being supplied by a magneto which is actuated by a spring motor. The motor spring is wound by a crank and one winding runs the light for about three minutes. The lantern is to be tested to determine its suitability for military use.

Project No. 481, Coast Artillery Target Practice Reports.—A study was made at the direction of the Chief of Coast Artillery of a new method of rating harbor defense and antiaircraft artillery, and of the substitution of graphs for the present analysis forms.

Project No. 482, Balloon Barrage Protection for Antiaircraft Searchlights.—Three barrage balloons of large type are to be tested as to suitability for use in protective work. Large type balloons are for protection of permanent establishments; smaller ones would be used for mobile units but principles involved in test would apply to either.

Project No. 483, Deflection Computer, T-1.—This device, manufactured at Frankford Arsenal, has been received for test. The function of the device is the determination of the angular travel during the time of flight for Case II firing.

Project No. 484, Comments on Report of Test of Lubricants (for Internal Combustion Engines).—Recommendations were requested by the Ordnance De-

partment to add to the present specifications for lubricating oils, for all motor vehicles, in order to prevent refiners from submitting oils that pass required tests but are unsatisfactory to the using services.

Completed Projects

Project No. 414, Adjustment of Antiaircraft Fire

I—HISTORY OF THE PROJECT.

1. Instructions given at antiaircraft schools during the World War were that adjustment during fire was not practicable and not permissible. This doctrine, it is understood, was consistently maintained in the French service. *Gunnery and Position Finding for Antiaircraft Artillery*, in general use as a text in our antiaircraft service today, states on page 110:

> In antiaircraft fire, spotting and corrections based on observed deviations are not practicable under service conditions. In the first place, it will not be possible always to identify the bursts of a particular battery when two or more batteries (eight or twelve guns) are firing on the same target. Furthermore, even should a single battery be engaging a target, when it is recalled that a four gun battery should fire an average of one shot a second, the difficulty of spotting many of the bursts or identifying bursts with the gun from which they were fired becomes apparent.
>
> It is not practicable to fire single shots for purposes of spotting. The targets engaged by antiaircraft artillery are subjected to fire generally for so short a space of time that the entire power of all batteries within range should be devoted to destructive fire. Furthermore, rectilinear flight is the basis of the present predicting system and such flight, generally, will hold until the bursts begin falling close to the target. Therefore, the first bursts occurring while rectilinear flight still holds true should be the most effective. These facts entail that *fire must be carefully prepared by means of trial shots*, even should adjustment from spotting be feasible.
>
> The inability to spot should not prevent analysis of fire. A careful analysis of a series of shots always must be made. If a constant deviation has occurred in a series it generally can be traced to personnel or materiel errors which may be corrected by instruction of personnel or adjustment of materiel. Only rarely will an arbitrary correction be warranted as a result of analysis. Such corrections must be made with great caution, since the application of an arbitrary correction based on an apparent deviation may actually double the error when the personnel or materiel cause for that error is eliminated and will be of no benefit during the continuance of that cause.

The following is quoted from a French publication, *Instructions for Antiaircraft Artillery Firing.*

> Par. 46. In the strict sense of the word, it is impossible to "adjust" fire against an airplane. The observations made at the moment of burst cannot be used, as in the case of earth fire, to determine aggregate corrections for direction, height of burst, and range.
>
> Par. 47. On the other hand, it is possible, though often difficult, to "interpret" the fire. Interpreting fire is trying to find the cause of the errors when they are systematically repeated; they may result from errors in the determination of elements of fire; altitude, air speed, etc., or from lack of adjustment of the measuring apparatus.
>
> Par. 180. . . . Under all conditions, the firing officer should guard against altering the elements measured by any corrections that would only disadjust the fire. He must not forget the errors observed may be due to multiple causes.

Par. 182. Even assuming that:
the lines of sight are well adjusted,
the drift corrected,
the errors of aim negligible,
the errors in direction and height may be due:

1. To the fact that the objective has changed its course or speed during the time of flight;
2. To an error in the angle of orientation;
3. To the dispersion of the fire;
4. To the corrector of the fuze setter;
5. To an error in the wind;
6. To an error in the altitude;
7. To an error in the speed;
8. To an error in the time of flight;
9. To errors due to an approximation of certain formulas giving the corrections.

Par. 196. Whether fire on earth or aerial fire is concerned, there are two means of determining the elements of fire:
By measurement,
By observation.
As measurements and observations are subject to error, one never obtains the exact value of the elements sought; one only succeeds in approximating it . . . the errors which observation give would be greater than those given by measurements. . . . The observers will only have to intervene to detect the gross errors or to urge the firing commander to verify the adjustment of such an instrument which is manifestly faulty, after the shot has been fired, with a view to subsequent fire.

II—Discussion.

3. The theory that adjustment of fire is not practicable or advisable has been widespread, nevertheless many battery commanders have used adjustment during fire or subsequent to one course for fire upon the next course. In 1924 the batteries of the 64th Coast Artillery used flank observation for correction of fire. In 1925 the 62d Coast Artillery and in 1926 the 61st Coast Artillery used flank observation to obtain range sensing for correction. Probably other organizations have done likewise. In 1924 the battery commanders of the 64th Coast Artillery based adjustments upon reports from one flank observer who was located at the secondary station of the altimetric base line. The observer used a Battery Commander's Ruler and read in mils the deviation between target and burst. This was read as the deviation along the trajectory, not its horizontal projection. A separate telephone line and headset was used to report this value read for every shot (one gun firing). The battery commander stood between the R. A. Corrector and the telephone operator who called the deviations. If a series of overs was reported, the battery commander observing the position of the target with relation to the secondary station, could estimate the value of the reported deviation when converted into fifths of fuze range. He would immediately say "Down One" or "Down Two" to the man reading fuze range on the R. A. Corrector, who could thereafter read one or two tenths less than was indicated on the fuze range cylinder. Some battery commanders applied the correction to the corrector of the bracket fuze setter. Some applied a flat altitude correction on the R. A. Corrector. The battery commander had to judge the effects of high and low, right or left deviations as seen from the battery upon the range sensings. If flank observers reported overs and shorts, and a constant lateral or vertical error was apparent at the battery, vertical or lateral deflection corrections were applied. In all cases reports from three or more shots were received before any correction was made, and the earliest shot fired with correction applied was probably the ninth or tenth of the series. The methods were crude and based on quick judgment of the

battery commander, which was liable to error. Nevertheless the results obtained in percentage of hits and rate of fire were remarkably high. The organization in the 64th Coast Artillery obtaining the greatest number of hits, was Battery "D," whose battery commander did not correct during the fire but who did apply for succeeding courses corrections as determined by observation on each course. The objection to this method is that it appears not to fit service but only target practice conditions.

4. The 62d Coast Artillery in 1925 resorted to adjustment for succeeding courses from flank observation of each course. Range and altitude deviations were reported. No record is available to show how corrections were applied. The percentage of hits increased after adoption of correction as result of flank observation of previous courses.

5. Battery "E," 61st Coast Artillery, in 1926, used a flank observer for correction of fire. In his report (extract herewith) the battery commander states:

> (a) . . . with accurately fired trial shots there remains one essential cause for deviation beyond that chargeable to gun dispersion, and that cause is altitude. The probable error of a stereoscopic observer in reading altitude at the trial shot point is of the order of 35 yards—and 35 yards in altitude causes a range change greater than one division of the corrector.
>
> (b) It is considered that altitude is the prime cause of range deviations and that adjustment on range should be accomplished by altitude changes.
>
> (c) The stereoscopic telemeter can give a positive sensing of bursts when they fall within the field of the instrument, though the magnitude of the deviation cannot be determined.

6. It appears that adjustment of fire other than at target practice may become practicable if a means of sensing overs and shorts from the battery position is found. Effective observation from distant stations under service conditions can not but be very exceptional since it will require identification of both target and burst, which will not be possible with several targets present and several batteries firing.

7. But adjustment to be practicable in service must be accomplished simply and very quickly.

8. The following considerations may lead to a satisfactory solution of the problem:

a. Gun dispersion after careful preparation of fire will cause apparent deviations right or left, high or low, and short or over. These deviations should be small, and their presence alone indicated by an approximate equivalence of deviations in opposite signs.

b. Fuze dispersion has been regarded as the most important cause of ineffectiveness of antiaircraft fire. But careful study of the results obtained with the Scoville Mark III fuze does not justify this view. In fact, it is believed that with this fuze and the improved types now under development, fuze dispersion, after proper preparation, and after application of a percentage correction based on trial shots, may be considered exactly as gun dispersion.

c. Considering then that gun and fuze dispersion enter the adjustment of fire only as giving vertical, lateral, and longitudinal deviations equivalent in opposite senses, the important cause of large deviations or of excess in a single sense—*i. e.*, the error to be corrected for—remains to be sought. Assuming a high state of training with reasonably accurate use of instruments and laying of guns, there remains with present methods one source of material error: *Measurement of Altitude.*

d. Altitude is not used in laying the gun (except as it enters super-elevation), but only as an argument in determining range. Approximate adjustment in range can often be obtained by adjusting in altitude and such an adjustment can be made quickly and simply enough to be practicable in service. The effect of altitude corrections on other elements than range is so small as to be substantially negligible.

e. It should be possible then to secure an approximate adjustment by correcting altitude until the proper proportion of overs and shorts (if determinable) is obtained to bring the burst the correct distance short of the target.

9. Of great importance is the fact that the stereoscopic telemeter, in addition to functioning constantly as an altimeter, can give positive sensing of bursts as short or over when in the field of view of the instrument. Without flank observers it would be possible for an experienced range officer to estimate the magnitude of the range error by the amount of the lateral deviation, if he knows the range sensing. Regardless of amount of range error, he will want to correct if all shots are bursting short or over. He wants them short *and* over. Time permitting, he would change altitude until bursts appeared with opposite range sensing.

10. The practicability of adjustment during fire is more a tactical than technical question. Will the target remain in its rectilinear flight long enough to permit adjustment? Can the bursts of one battery be identified when several batteries are firing on the same target? Are not the two elements, surprise and concentration of fire, the factors most apt to bring hits? Adjustment during fire does not fit in with surprise and concentration.

11. Undue reliance upon adjustment is very apt to lead battery commanders to neglect preparation. This would be most unfortunate for it is with the first surprise bursts that most damage will be done in service firing, and the accuracy of these shots must depend upon painstaking preparation. This preparation includes calibration, trial shots, corrections for observed errors in previous firing and training in precision on the part of all personnel.

12. If a target under fire maintains such flight that fire can be continued, the battery commander, knowing the center of impact of his bursts to be off the target by a large amount, will and should use any and every means to improve his fire. It has been claimed that in the World War pilots sometimes ignored antiaircraft fire unless the bursts came dangerously close. Such policy, obviously, would permit adjustment. The range sense being known by means of flank observers or stereoscopic height finders, it is practicable by adjustment to improve the fire. To be successful in adjustment will require training. To give proper training, extensive experiments are necessary to determine the means by which adjustment can be obtained most quickly.

III—Conclusions.

13. The Coast Artillery Board is of the opinion that:

a. Preparation of fire is of the greatest importance.

b. By means of careful preparation, surprise, and concentration of fire, the most effective results will be obtained.

c. When by use of such means, the target is not deflected considerably from its course, adjustment to improve the fire is desirable.

d. Adjustment by change of altitude is a quick and practical method.

e. The measure of the efficacy of any method is primarily the speed of determining the correction desired and of applying same.

f. The use of the stereoscopic telemeter to determine range sensing, without interference with the observation and reading of altitudes to target, opens a hopeful prospect.

g. Further experiments in fire adjustment are desirable.

IV—RECOMMENDATIONS.

14. The Coast Artillery Board recommends:

a. That further tests be held to determine the efficiency of observation by stereoscopic telemeter and the efficiency of adjustment by altitude during fire.

b. That it be impressed upon antiaircraft artillery personnel that adjustment of fire cannot in the least replace careful preparation of fire.

V—ACTION OF THE CHIEF OF COAST ARTILLERY.

665.9/AR-3 1st Ind.

War Department, O. C. C. A., August 9, 1926. To the President, Coast Artillery Board, through the Commandant, Coast Artillery School, Fort Monroe, Va.

1. The conclusions and recommendations contained in Project 414 are approved.

* * * * *

b. Reference to Par. 6, the statement to the effect that observation from distant stations under service conditions is very exceptional seems well founded. However, it seems quite possible that under certain conditions, particularly those which obtain in rear areas and in portions of the front where aerial activities are comparatively quiet, it may be entirely practicable for the Battery Commander to receive sensings from a flank observer stationed at another battery.

* * * * *

3. *a.* It is desired that the Coast Artillery Board maintain this as an active project and that every advantage be taken of the opportunity presented by antiaircraft firings which members of the Board may witness.

ANTIAIRCRAFT TARGET PRACTICE REPORT

BATTERY "B," 61ST COAST ARTILLERY (AA), JUNE 23, 1926

Extract

* * * * *

Project No. 3.—Adjustment of Fire by Flank Observation.

22. When the range is known and then only may lateral deviations be correctly adjusted (see par. 39-*a*, *Gunnery and Position Finding for Antiaircraft Artillery*). The range deviation was known in this case. Following is a summary of the lateral results attained by the battery:

Date of practice	*Rounds fired*	*Total line shots*		*Total shots within 10 mils of target*	
		No.	%	No.	%
May 25, 1926, Day	46	6	13	17	37
June 2, 1926, Day	52	27	52	37	71
June 2, 1926, Night	31	14	45	17	55
June 3, 1926, Day	78	49	63	62	80

From this it will be noted that for the last three practices over half the shots were line shots and as high as 80% were hits in direction.

23. The flank observer began spotting with field glasses, but was forced to discontinue their use, due to lack of sufficient field and to conditions of visibility, in favor of the range rake. On several occasions he was unable to see the sleeve and was forced to spot on the plane. The situation was such that at the center of the field of fire one division of the corrector corresponded to 10 mils deflection in range. The original plan was that range deviations should be translated into a corrector change during the firing. This plan was abandoned for the following reasons:

(a) The lack of an airplane type headset for the range officer prevented his hearing the deviations during the firing.

(b) Considerations of safety limited the courses to such a brief extent that sufficient time for the application of a correction during firing was not available. This is very unfortunate, since the corrections should be applied during the flow of data on which the observations were made. A new course introduces new causes for error and deviation.

(c) It is not possible to alter the corrector without interrupting the firing.

(d) A further study and analysis showed that, with accurately fired trial shots, there remains one essential cause for deviation beyond that chargeable to gun dispersion, and that cause is altitude. The probable error of a stereoscopic observer in reading altitudes at the trial shot point is of the order of 35 yards. (This figure is estimated from a recollection of past instrumental tests.) And 35 yards in altitude causes a range change greater than one division of the corrector.

24. Throughout the entire practice the battery commander was too timid in applying range corrections. Furthermore, in making a "short" adjustment, he erred in making no change when bursts were reported 20 mils (two divisions) short or even 30 mils short. The realization of the logic and possibilities of altitude correction did not come until too late for a thorough application. In addition, it was a considerable time before the Battery Commander was convinced that the observer's reports were reliable.

25. Considerable of the adverse movement of the C. I. S. under theoretically correct changes (*e. g.*, June 2, Day) is believed due to the inaccuracy of C. I. determination because of bursts lost. The continued high elevation deviation, as in the practice of June 3, is traceable (1) to a decided and unexplained tendency of the guns to shoot higher in practice than in trial shots, (2) to the curve of the trajectory, and (3) to the fact that high bursts are not lost from the towing plane as easily as low bursts.

26. For the following discussion, data are used applicable to the firing of June 3, the average point fired at being on the 658 mil trajectory and having: angular height, 620; altitude, 1860; and time of flight, 5.8. One range probable error at this point is 25 yards while one division of the corrector is 43 yards along the trajectory. At the outset it becomes self-evident that it is not practicable to attempt adjusting ranges by range table probable errors where that value is smaller that the least usable unit. The probable error of altitude determination has been assumed to be 35 yards which, when translated into a range value (see page 333, C. A. JOURNAL for April, 1926) has become a distance of 65 yards along the trajectory, greater than the least usable unit and than the probable error. This probable error of altitude determination, it is believed, should be the basis of all antiaircraft range adjustment, prior preparation by trial shots being assumed. It is considered that altitude is the prime cause of range deviations and that adjustment in range should be accomplished by altitude changes. To that end the

following specific recommendations are offered, with particular reference to the further firings to be held at Aberdeen proving ground:

(a) Fire trial shots carefully and make a theoretical range adjustment on target, but, primarily, correct the trajectory to the proper elevation. It is not believed of value to adjust one division of the corrector short of the target (an adjustment that was made in each practice of this series) since altitude deviations are bound to cause range deviations greater than one division of the corrector. The question of intentional gun dispersion should be further investigated.

(b) Station a flank observer as nearly as practicable in prolongation with the expected course of the towing plane. This observer should be equipped with a range rake, and should read deviations in mils horizontal range since it is not practicable for him to establish the line of the trajectory and hence read deviations along the trajectory. His deviations should be those of the estimated center of impact as the bursts appear.

(c) The range officer must have in mind two essential quantities: the relation between mils and yards at the mid point of the course as spotted by the observer, and the altitude-horizontal range relation of the trajectory existing at the approximate point being fired at. Both of these values are approximations and are inaccurate, but any attempt to introduce precision methods will result in delays and errors that will defeat the attempted adjustment. An example of the method to be used follows:

Assume 1 mil range deviation = 3 yards horizontal range.

At the selected point on the 658-mil trajectory, the firing tables show that 10 yards horizontal range change corresponds to 6 yards altitude change. At the appearance of the first group of bursts, the spotter reports "short 40." The range officer then makes the following mental calculation and correction: $40 \times 3 = 120$ yards short: $120 \times .6 = 70$ yards altitude. Thereafter, on a preponderance of shorts or overs, the range officer would increase or decrease his altitude by the least usable altitude value which is 25 yards on the present correction scale of the data computer.

(d) If the length of the course is too short for the application of a correction, the target should return over the course at the same altitude and the problem continue without the insertion of a new altitude from the altimeter.

27. The stereoscopic telemeter can give a position sensing of bursts when they fall within the field of the instrument, though the magnitude of the deviation cannot be determined. On such a course as that of June 3, with 80% of the bursts within the field of the instrument, fire could be adjusted by the observations of the stereoscopic observer. In every case the sensing of the stereoscopic observer was confirmed by the flank observer. In adjusting by stereoscopic spotting, a method of altitude probable errors (the altitude probable error being that of altitude determination as previously discussed) should be used. On sensings of "short" the altitude should be increased a probable error at a time until mixed shorts and overs occur. Hits will obtain on any course containing mixed overs and shorts, and it is believed that this should be the limit of refinement in adjustment sought. Any closer adjustment is an unattainable refinement with present materiel and methods. The foregoing method approximates the bracketing method only loosely, but there is no time for a closer adherence to that method of adjustment.

28. To the experienced artilleryman accustomed to precision adjustment, the foregoing methods will undoubtedly appear crude. It is suggested, in that connection, remembering the nature of the target and of the projectile, that hits per gun per minute should not be the criterion of adjustment of antiaircraft fire,

nor should percentage of hits. *The criterion of antiaircraft fire should be the length of time elapsing between the first round and the first group of hits.* The aim of the battery commander should be to produce mixed shorts and overs as quickly as possible or to pass the instantaneous center of impact through the target as quickly as possible. It is believed the two methods outlined above will bring hits most quickly and will increase the percentage of hits in addition. The battery commander is convinced that had he the confidence in the flank and stereoscopic observers that he now has and had all records been before him for study prior to the termination of the practices, he would have increased greatly the number of hits and the efficacy of the fire.

29. In summation:

(a) The primary function of trial shots is to put the trajectory on target. The range adjustment is not so vital because it is so greatly affected by a slight altitude error.

(b) Lateral adjustment is easily accomplished if the range sensings are known.

(c) Deviations in range are primarily caused by altitude errors and should be adjusted by altitude increments, the prior preparation by trial shots having been made.

(d) The battery commander should, by altitude changes, move the point of burst boldly, so that every course contains both shorts and overs, if the courses are of sufficient length.

(e) The primary aim of the battery should be a group of hits in a minimum of time after opening fire.

(f) The statements contained in Sec. XI, *Gunnery and Position Finding for Antiaircraft Artillery* should be amended to indicate that when a flank observer or stereoscopic observer is able to give range deviations or sensings, adjustment of range is possible and essential.

* * * * *

It was unpreparedness that cost America dear in the Argonne forest. If our men had been prepared it would have saved us 5000 men. It was just one of the lessons that prove how shallow and foolish pacifist talk was.—*Maj. Gen. Hunter, Liggett, U. S. A., Retired.*

BOOK REVIEWS

Description and Discussion of the Air Disturbance Around Bullets in Free Flight. By T. Harris, B. A., B. Sc., A. R. C. Sc. His Majesty's Stationary Office, London. Can be obtained in U. S. A. from British Library of Information, 8th Floor, 44 Whitehall St., New York. 1926. 6″x 9½″. 24 pp. Ill. 4 *s.*

This pamphlet gives the results of a study of a collection of photographs of bullets in free flight. From traces shown on the photographs—traces caused by refraction of light rays passing through the waves set up, the author makes a study of the nature of the waves set up in the air about the head, body, and base of the projectile. The paper is well illustrated by photographs and sketches and the subject matter is presented in clear and concise languages.—C. S. H.

Aircraft and Commerce in War. By J. M. Spaight. Longmans Green & Co., New York. 1926. 5½″x 8½″. 107 pp. $2.25.

At the outset it may be stated that the title of this work is misleading and of aircraft) against maritime commerce in war in its relation to international law.

In the first sentence of the preface it is stated that the book "is not written for the specialist." Much of it appears to have been written entirely for the credulous, as for example:

> It is only common sense to recognize that economic war, in the circumstances favorable to its being conducted and in which indeed its possibilities can alone be fully exploited, must tend to *overshadow the military encounter* [reviewer's italics] that is to say when it is waged by a strong naval power against a state which is at once highly industrialized and less powerful at sea.

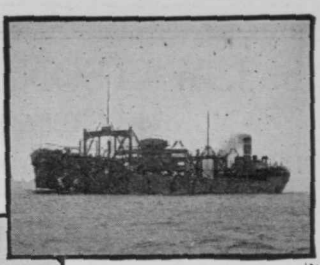
and further:

> Wellington's victories were only side issues in a war that was decided really by sea power.

But if the reader will wade through or ignore much obvious propaganda and some misstatement of fact he will find no little that is both interesting and valuable. What the writer is driving at seems to be that aircraft can be used to make naval war on commerce more effective, that in such war aircraft are to an extent comparable to submarines, that means of aerial war on commerce and of defense against such war must be developed, that present international law fails to meet the situation, and finally that the most effective means of conduct of combined naval and aerial war against commerce without disregard of international law will be by means of agreements or contracts with neutral importers, exporters and shipping companies by which freedom from delay for examination and search becomes the reward for nonshipment of materials that may be of economic value that the subject is in reality the conduct of naval warfare (with the assistance to the other belligerent.—R. S. A.

Below, at left: Interior of Bethlehem coal mine.

Below: Ore storage at Bethlehem Plant.



Above: S.S. Bethore, one of the Bethlehem - owned and operated fleet of ore-carrying vessels.

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