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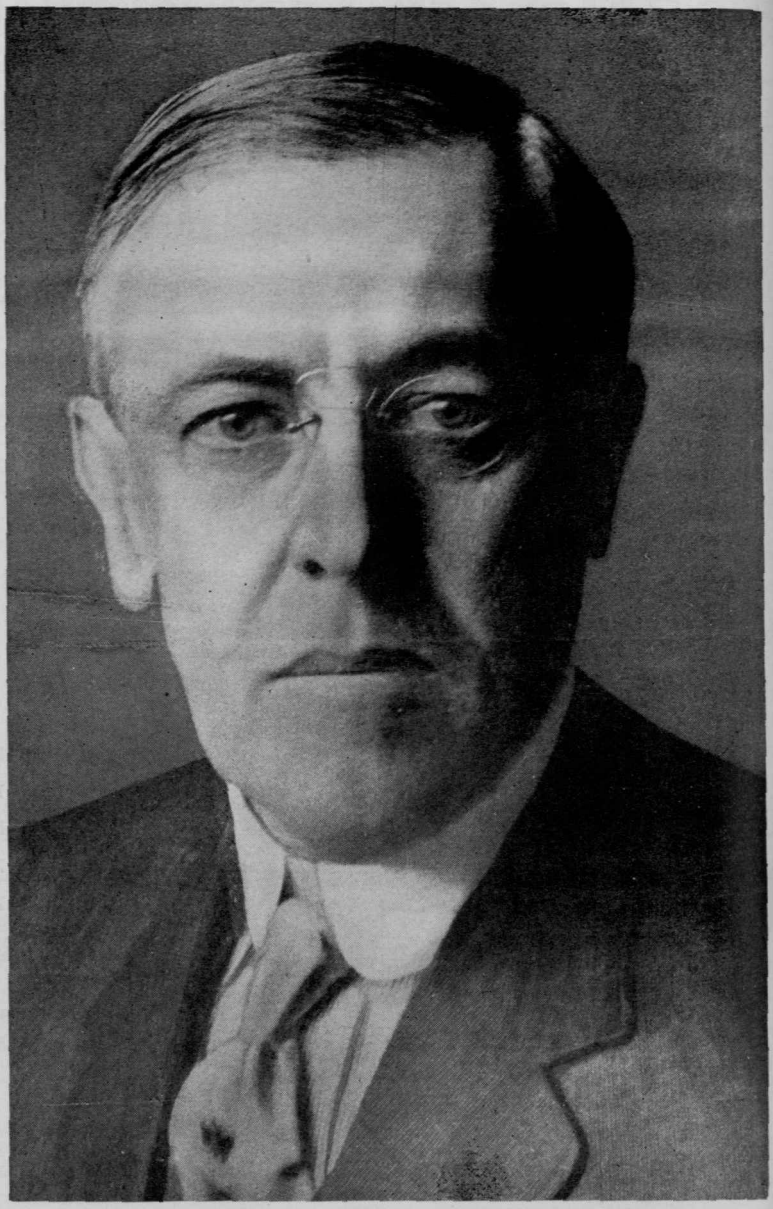


WOODROW WILSON

Commander-in-Chief, U. S. Army
March 4, 1913—March 4, 1921

The Coast Artillery Journal

Vol. 60 No. 2 FEBRUARY, 1924 Whole No. 210

Spotting for the Coast Artillery

By Brigadier General Johnson Hagood, U. S. A.

EDITOR'S NOTE: *General Hagood here expresses his views on the relative importance of adjustment of fire against moving targets. It will be considered by many that this article sounds a timely warning against the tendency to place too much weight on this phase of artillery training. This subject is considered of such paramount importance that the views of other officers thereon are solicited. Those of Colonel Henry J. Hatch, President of the Coast Artillery Board, will appear in the March Number of the* JOURNAL.

EIGHTY FIVE percent of the heavy artillery fire by the American forces in France (155-mm. G. P. F. and above) was conducted without the aid of observation, either aerial or terrestrial. If we had not had methods of fire independent of observation we might as well have dumped the bulk of our ammunition into the sea. The accuracy and effectiveness of eighty five percent of our fire depended upon a system that did not require us to know the effect of our fire—a system that on the other hand did require us to make, in advance, the most accurate mathematical and ballistic computations, the most precise adjustment of guns and instruments, to make the most careful calibration and registration of our pieces; and then to shoot, for effect, upon an invisible target, not knowing until days or perhaps weeks later whether the shots fell true or missed.

This was the old system in the Coast Artillery, when correction of fire for observed error was forbidden; when the Coast Artilleryman realized that his whole life might be spent in getting ready for a fifteen minute runby and that no one of those fifteen minutes could

be wasted in experiments and cogitation. The efficiency of a battery commander was then measured by the number of hits-per-minute and not by his ability to sling a lot of high sounding and meaningless phrases into a so called problem. Then Gunnery counted more than Glossary.

But today there is an ambition upon the part of many Coast Artillery officers, especially the progressive bloc, to discard the old fashioned and tedious methods of careful training, laborious computations, painstaking adjustments, etc., and to depend entirely upon correcting errors as they are observed during the shoot. Observation of fire, and especially observation of fire from the air, to them is the whole thing.

These officers might be described as Imitation Field Artillerymen; that is, they want to imitate the methods of the Field Artillery: some without having had any practical knowledge or experience in these methods; and some hoping against hope that a scheme will be devised by which the methods used by them to adjust upon a fixed land target can be used to adjust upon a moving water target.

The difference between the two problems presented is very slight; so slight that many do not see it, or slur over it. But boiled down it means this, that in the case of a fixed target the adjustment of fire by observed error requires the application of a simple equation with one unknown quantity; while in the case of a moving target, we have one equation with two or more unknown quantities. The former is solvable and the latter is unsolvable. The equations are.

$X = R + d$ for a fixed target.
$X = R + d + tr$ for a moving target.

in which

X=true range plus or minus probable error.
R=range at which gun is set.
d=mean observed deviation in range.
r=rate of change of range.
t=elapsed time.

r is a variable but if the target is moving upon a straight course it may under certain conditions be nearly constant.

They tell the story of a Professor at West Point who said he had no confidence in logarithms. And a famous surgeon in France said that the General Staff did not like to be hedged in by the multiplication table. General Weaver, whose name will go down in history as one of the great pioneers in the technique of modern Coast Defense, said that the Coast Artillery was divided into two camps:

those that believed in ballistics and those that believed in guesses. He described the latter by saying that first they guessed their error and then they guessed how to correct it.

Thanks to our friends up in the air, we no longer have to guess our error. All reports indicate that the airplane observations tally with the measured instrumental observations to a degree that is quite remarkable. This part of it is satisfactory. So satisfactory in fact that whenever the air observer puts the shot nearer to the target than the range rake observer, the battery commander feels confident that the latter is seasick or otherwise in error.

But the guessers still have the problem of how to correct the error after they get it. And it is their pleasure to stand upon the windy parapet of a 12-inch battery equipped like Alpine climbers and shout the cheering words, "Up Five Hundred" "Right—I should say Left-Ten." Profanity is a useful adjunct when the shots refuse to obey the order of command. One Battery Commander whom I know, when things did not go well, sought solace in his telescope through which he gazed intently at the target as it gracefully followed in the wake of the tug, on its way back to the starting point of the course.

The question as to whether "Spotting" or "Correction of Fire by Observed Error" is or is not a desirable thing for Coast Artillery was fought out once between General Arthur Murray—on one side, and the father of modern naval gunnery—Admiral Sims—on the other. Theodore Roosevelt decided between them and sided with General Murray in the negative. Subsequent to that, a careful analysis was made by Captain (afterwards General) P. P. Bishop, in the Chief's office. He considered all target practice reports for a period of four years and his analysis showed very clearly that those who corrected for Observation of Fire did not get as good results as those who did not. In other words, the old time painstaking careful Battery Commander who made sure he was right and then went ahead, had it all over the man who faltered along, feeling his way as he went. This however was in the days of two guesses.

My own observation since the war confirms Bishop's conclusions. This experience of course is very limited compared to that at his disposal. But still in the past five years I have had under my immediate command four regiments of Coast Artillery; four regiments of Field Artillery; seven active Coast Defense Commands; the Lee Hall Balloon School; and two squadrons of airplanes in the Philippines; also the voluntary assistance of Navy hydroplanes and blimps; and planes from Langley Field, Carlstrom Field and Benning. During this period we have had a great deal, and a very great variety, of firing with every caliber from mountain guns to 14-inch railroad,

and with pretty nearly every form of observation from the air and from the ground. Adjustment of fire by aerial or terrestrial observation has been just as essential to our Field Artillery practice as gunpowder. But I have yet to see a single instance where adjustment of fire by either aerial or terrestrial observation has been of any value to the Coast Artillery firing at moving water targets.

I think it can be summed up by saying; if the target is visible from the shore stations then aerial observation is of no necessity; if the target is not visible from the shore stations thán aerial observation is of no value.

For what purpose then is the Air Service valuable in connection with seacoast defense?

For scouting. This is of tremendous importance.

For driving away hostile planes.

For bombing hostile vessels. (I am strong for this.)

For locating and perhaps regulating the fire upon stationery targets in hidden anchorages.

As against this, let us see what practical difficulties the Coast Artillery would run up against in placing its dependence upon a system built around aerial observation.

First. At the outbreak of war there could be no airplanes available, and instead of being self contained and ready at the drop of the hat, as intended by Arthur Murray, the Coast Artillery would be burning the wires for help.

Second. The enemy fleet would bring combat planes and even if a few observation planes could be scraped together, the enemy would not permit them to fly over the fleet any more than they would permit a tug to go out and make range rake observations.

Third. The planes would be of no value at the time the enemy was most likely to make an attack, to wit, at night or in thick weather.

Fourth. Planes are not visible at long range and could not, as popularly supposed, fly over an invisible battleship, be tracked from the shore and thus used as a kind of floating aiming point. If the target is invisible from the shore it is either below the horizon or obscured by the opaqueness of the atmosphere, natural or artificial. In the first case the target would be in the neighborhood of twenty miles away and an airplane flying over it would be invisible. And in the second place the airplanes would necessarily be invisible except in the exceptional cases that would come under the case of scouting.

The advantages of an observation station on shore, in the matter of high power telescopes, steady platform, accurate instrumentation,

etc., seem to be forgotten and officers with no experience in the matter seem to think that if they go up in an airplane or in a balloon the limit of their vision is indefinitely extended. Experiments conducted by me with shore stations at Corregidor—up to 630 feet—and with balloons at Fort Eustis up to 900 feet—prove very conclusively that the target is best seen silhouetted on the skyline. If we go up high enough to have the target presented against a background of water we lose out on visibility. It follows from this that for picking up and tracking a target we get the best results from a shore station about 150 feet above sea level. Such a station would give us a battleship not quite hulldown at a range of twenty miles.

Theoretical discussion is best illustrated by example. Let me mention two from the many that might be cited. First a case of observation from the air, and then one of observation from the shore.

First case. Captain A was a good average officer of the prewar type. He had gone through the war as an artillery regimental commander in France—had commanded a brigade in action—and came out with the grade of Lieut. Colonel. He was a Coast Defense Commander and from many years experience with Coast Artillery troops splendidly equipped for this duty. But his war experience had made him forget the lessons of his youth and he had become an Imitation Field Artilleryman. When I came to supervise his practice, he was full of confidence. He has established liaison with a nearby flying field and through his personal effort had built up a wonderful system for local aerial observation. All difficulties of communication between air and shore had been overcome. He had flown himself in the preliminary preparations, and had evolved many improvised methods to handle every contingency.

During the preliminary inspection of his fire control stations, plotting rooms, etc., it was very evident that there had been great neglect. But he cared little for that. Give him five shots to get his bracket and he would knock the target out of the water. Things did not look quite right at the battery either. But the men were all recruits and you could not expect much.

What was the result? He struggled through one miserable day and then we had to stop the shoot. No one was more astounded at the failure than he. He wanted to begin again the next day and was sure it would be all right. But he was required to take two weeks and then be blundered out with rating "Inferior." It was not the worst practice I have ever seen, because I saw one other as bad—since the war, never before. His whole command fell down on him and nothing that he could get from the airplanes was of any use.

Second Case. Same type of Coast Defense Commander, but more true to form. He had worked out everything in advance as it should be. He had every man trained and on his toes, and every instrument in tune. But in accordance with the post war Coast Artillery procedure he had painted the lily by adding a triple system of observation from terrestrial stations—two horizontal base lines and a lighthouse. We happened to have a large extra quantity of ammunition to expend and he fired day in and day out for several weeks. He put up a fine practice—rated "Superior." But a careful analysis showed that in actual hits—exclusive of the time element—*he would have done better had he made no correction for observation of fire*: hits-per-minute of course would have been much higher. And more obvious still was the fact that all this observation and adjustment was wholly impracticable under war conditions. There is no place for it in the Standard Systems of Fire Control.

When we come right down to it Coast Artillery fire is like a Counter Preparation or a Barrage. It must be worked out in advance and then let fly. There is no time to adjust fire after it starts. We cannot scrap over instruments of precision, for range finding, tracking, and ballistic adjustment, just because two or three shots do not fall where we expect them.

We must not turn back the pages of progress. But we should move forward on solid ground. The future of the Coast Artillery lies with its young men. Such captains and lieutenants as Ingalls, Whistler, Lewis, Lundeen, Weaver, Pratt, Crozier, and Dunn brought us out of black powder and muzzle loading guns thirty years ago. There are young men in the army today or yet too young to enter, who will bring us out of our present difficulties and give us range finders that will reach beyond the limits of vision. But they will do this by careful, painstaking and scientific development; not with a divining rod.

The mission of the Coast Artillery was not changed by the war and what it needs most today is to heed the advice of our late President and get back to normalcy.

END

Experimental Investigation of the Effect of Wind Upon the Motion of a Projectile

By Second Lieutenant Philip Schwartz, O. D.

EVER since rifled guns have allowed the long range and accurate firing of modern days, artillerymen who desire to fire their guns efficiently have discussed the effect of wind upon the motion of a projectile. The first article in the earliest number of the JOURNAL OF THE U. S. ARTILLERY consisted of a paper on this topic by General J. W. Ruckman, then 1st Lieut., 1st Artillery. The next number also contained a discussion on the same subject by Colonel G. N. Whistler, at that time 1st Lieut., 5th Artillery. Later, arguments advanced by such men as Professor Greenhill, Colonel Hamilton, and others, kept the topic alive. The use of wind aloft measurements during the past war, caused the question to be revived, and articles on the ballistic wind have appeared recently in the JOURNAL. All of these have treated the effect of wind on range and deflection as one which could be computed from theoretical reasoning, none of the writers being able to prove definitely that the particular theory expounded was correct or even approximately so. However, it may be remarked that the basis for all of these discussions was the same as that laid down in 1860 by Didion—the relative wind—this being the basis which is still used.

Since 1917, with the introduction of wind aloft measurements, a resultant or effective value of the wind velocity has been used instead of the surface wind value. Prior to the war Colonel Hamilton endeavored to take into consideration the variation of wind speed with altitude, by assuming a definite rate of increase of speed with altitude. However, as can be seen from a study of the figure, it is impossible to predict accurately what this variation will be at any moment. Hamilton's formula was therefore superseded as soon as a system of applying the measurements of wind aloft to the motion of projectiles was introduced. The figure illustrates the usual situation, where at the ground the variations in wind speed and direction are considerable, whereas at higher altitudes—1000 meters or more—the wind is uniform over large periods of time. The surface velocity is affected by the immediate local conditions, being a very poor guide to the velocity aloft, which may have the preponderating influence upon the projectile.

The Ordnance Department, with the moral support of the Coast Artillery Board, has recently carried out a test, the results of which should settle many of the existing doubts concerning the accuracy of the wind correction. This test was carried out and reported upon at Aberdeen Proving Ground by Proof Director J. G. Sbarbaro under the direction of the Commanding Officer. It consisted in firing two guns whose azimuth of fire differed by 180°, almost simultaneously and over about the same area. The gun firing with the wind had its range or deflection increased, and the one firing against the wind had a corresponding decrease. The difference in measured range and deflection between the two guns was then equal to twice the effect due to the weighted measured wind—assuming that the effect of a head wind was the same as that of a rear wind. Similarly, the same was assumed for a cross wind to the right and left. All other ballistic weather corrections, such as those due to density and elasticity of air, cancelled when the difference was taken. The errors due to non-equality in velocity and condition of bore were avoided as explained subsequently.

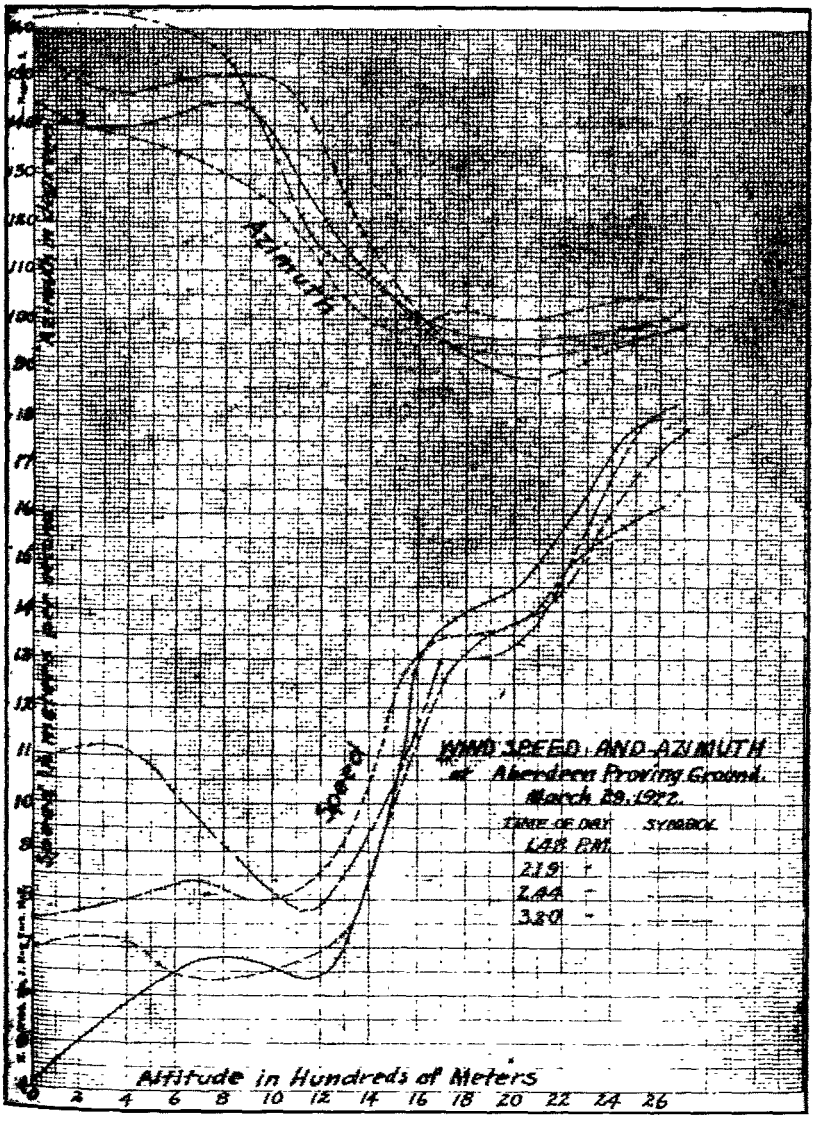
Two new French 75-mm. guns, Model 1897, were employed. The projectiles were Mark I H. E. shell of the type generally used during the past war, fitted with Mark V short non-delay fuzes. The powder charge was the same for all rounds and was sufficient to give an average muzzle velocity of 1745 f.s. The charges and projectiles were selected and prepared for both guns at the same time, the complete rounds being kept under similar conditions of temperature until fired. The elevation, 42° 30′, to give a range of about 8200 meters, was the same for all rounds. This elevation was chosen because it gave a fairly high maximum ordinate, 2500 meters, and a corresponding large wind correction.

The test was conducted in three stages, as follows:

1st stage: To measure the difference in ranging power between the two guns (call them A and B), they were placed side by side and fired, using the same azimuth. The resulting difference could be used to analyze the observed differences in range and deflection obtained in the main part of the firing. Before a satisfactory calibration value could be obtained, it was found necessary to fire on six days, thus determining a curve of the difference in range or calibration correction as a function of the number of rounds fired from the two guns.

2nd stage: When preliminary calibration firings had been completed, gun A was taken across the Chesapeake Bay, to a point about 14,000 meters away from the normal firing point and directly on the proposed line of fire from gun B. The important rounds of the test were then fired. Before firing on any day, it was first determined

whether the wind velocity could be measured up to the maximum ordinate of the trajectory; also, although the wind was rather large in magnitude, it was not very blustery or rapidly changing in speed



and direction. The ammunition was provided in advance and kept in the constant temperature magazine until required. When a suitable day appeared, the proof director, gun crew, and ammunition were ferried across the bay to the place where gun A was located. The firings were then started, the guns being discharged alternately and

at about minute intervals. Meteorological observations were recorded at least every half hour during the firing. It was necessary to fire on six days before the results were considered conclusive.

3rd stage: After the main part of the firing had been completed, gun A was returned to the normal firing point and calibration firings were once more made on three days.

The observed wind velocity values as obtained from the pilot balloon flights made by the meteorological section, some of which are shown in the curves of the figure, were then weighted in accordance with the exact weighting factor curve for this trajectory, and the exact ballistic range and cross winds computed. The ballistic wind values were also obtained using the Coast Artillery approximate weighting factor curve.

$(1-p) = .74(1-k)^{1/2} + .26\ (1-k)^2$, where p is the weighting factor and k the fractional part of the maximum ordinate. The exact ballistic values differed from the approximate values by only 1% in the case of range wind and 4% in the case of cross wind. From the practical point of view of artillery firing this difference may be considered negligible in any individual case, in view of the possible unknown variations in the wind measurement itself, due to differences in time or place between firing and meteorological observations.

There were 184 rounds fired in the main part of the test, the first group being fired on May 23, 1921, and the last group on April 24, 1922. About 325 rounds additional were fired in the two calibration tests. The difference in the mean range for each group of the main firings was obtained, then corrected for the difference in ranging power between the two guns as determined from the calibration tests, and the resultant divided by twice the computed exact ballistic range wind to get the range effect of a unit range wind. Similarly the mean observed deflection difference for each group was corrected for cant of the trunnions and the resultant divided by twice the computed exact ballistic cross wind, to get the deflection effect of a unit cross wind.

The final values showed that the observed range effect was 377 meters for a ten meter per second range wind, whereas the theoretical value was 401 meters, an error of 6%. The observed deflection effect was 31.0 mils for a ten meter per second cross wind whereas the theoretical value was 30.3 mils, a difference of 2%. When approximate weighting factors were used in computing the ballistic wind, the error was 7% in range effect and 6% in deflection effect.

On the basis of this test it is possible to draw the following conclusions:

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

(2) Errors in the application of the wind correction at the battery are due for the most part to the unavoidable approximations required for the successful use of artillery, and are not caused by faulty ballistic theory, except as affected by error in the fundamental retardation law. These approximations include (a) the effect of periodical instead of continuous receipt of the meteorological message, (b) the application of wind velocity values determined at one place to firings made at another place, and (c) the use of approximate weighting factors. These errors of approximation are probably no greater than the errors involved in applying a velocity or density correction when making ballistic corrections.

This test was conducted with a relatively small calibered gun compared with those employed by the Coast Artillery. However, the questions of expense and handling make it difficult to carry on a test as successfully as this one with a heavy immobile gun, especially with conditions of terrain as they exist at present at the Proving Ground. Even with the 75-mm. gun it required a period of two and a half years to complete the test satisfactorily. The original program contemplated firing with a 155-mm. gun after the firing with the 75-mm. gun had been completed, but this part was abandoned in view of the success with the 75 and the difficulties expected in handling the 155.

The formulæ now used by the Coast Artillery, and which this test has shown to be satisfactory are:

$$\Delta Rw_x = W_x \left(T + \frac{\sin \varphi}{V} \Delta R\varphi - \cos \varphi \ \Delta Rv \right) \tag{1}$$

$$\Delta Dw_y = W_y \left(T - \frac{R}{V \cos \varphi} \right) \tag{2}$$

$$(1-p) = .74\ (1-\kappa)^{1/2} + .26\ (1-\kappa)^2 \tag{3}$$

wherein

(1) ΔRw_x = Range effect of the ballistic range wind
W_x = Ballistic range wind
T = Time of flight
φ = Angle of departure
V = Muzzle velocity
$\Delta R\varphi$ = Change in range for a unit change in angle of departure
ΔR_v = Change in range for a unit change in muzzle velocity

(2) ΔDw_y = Deflection effect of the ballistic cross wind
W_y = Ballistic cross wind
R = Range

(3) p = Weighting factor
κ = Percent of maximum ordinate

The Conditions of Success in War

Illustrated by

Hannibal's Campaigns in Italy

By Lieut. Col. Walter Krueger, General Staff

WAR, says Clausewitz, "is a political act; a continuation of state policy by other means; an act of violence committed to force the opponent to comply with our will."

It follows that success or failure in war depends not upon the "act of violence" alone, but upon state policy as well, and that wars may be won or lost by the wisdom or ignorance of rulers and cabinets, councils and legislatures, as well as by the skill or incompetence of generals in the field. Back of these conditions of success, there lies the inexorable law of nature of the survival of the fittest, which does not necessarily mean the survival of the best, but the survival of the one best fitted continually to cope with conditions.

The principles of war are in themselves as simple and easily comprehended as they are difficult of application and execution. That they are immutable is a hackneyed phrase accepted as irrefutable, few people taking the pains to analyze the events of history sufficiently to arrive at this conclusion themselves by their own reflection. It is easy to acquire a familiarity with these principles, in fact too easy, for text-book writers have combed military history for examples to illustrate them, thereby saving us all the trouble involved in research and reflection.

But the superficial knowledge gained by this means, of the application of the principles of war, will not suffice—the campaigns themselves must be studied in order to get the true relation and bearing of events upon one another and upon the result, and conclusions must be drawn therefrom after profound reflection. And it is this reflection that is the all important thing. "Read and re-read the campaigns of Alexander, Hannibal, Gustavus Adolphus, Turenne, Eugéne and Frederick; take them for your models; that is the only way of becoming a great captain, to obtain the secrets of the art of war," said Napoleon—and he knew whereof he spoke.

With this end in view, this study is presented. It covers Hannibal's Campaigns in Italy, framed in an outline of the second Punic war as a whole, these campaigns being selected because they present such glaring contrasts and perhaps better than any others illustrate all the conditions upon which success depends and failure follows.

Twenty-two centuries ago, the Mediterranean world was practically divided between Rome and Carthage, the former first on land and master of the Italian Peninsula, the latter mistress of the sea and controlling an empire stretching along the north coast of Africa from the desert of Tripoli to beyond the Pillars of Hercules and including western Sicily, Sardinia, Corsica and the Balearic Isles. Rivalry between the two states was inevitable; the world was not large enough to contain them both; the issue between them, in the last analysis, a question of supremacy, could be settled in one way only—by war. A pretext was soon found and with it was kindled that long and bloody series of struggles known to history as the Punic wars.

The first of these lasted from 264 to 241 B.C. Its results were portentous, for it deprived Carthage of her possessions in Sicily, destroyed her sea power, annihilated her monopoly of Mediterranean trade and markets and reduced her to the rank of an inferior power.

During the peace that ensued, Rome consolidated her power in Italy by extending her frontiers to the Alps and by seizing the Island of Sardinia while Carthage was involved with a revolt of her mercenaries. When this was finally crushed by Hamilcar Barca after more than three years of civil war and Carthage demanded the restitution of the island, Rome threatened war and Carthage was forced to cede it to Rome as the price of peace. By this act of high-handed brigandage Rome had gained a province, but she had also kindled to her cost the undying hatred of Hamilcar Barca, which in the end brought down upon her the just and terrible retribution and vengeance at the hands of Hamilcar's great son, Hannibal.

But while Rome was consolidating her power, Carthage was not idle. The ignominious peace terms imposed upon her by victorious Rome, in particular her loss of territory and sea power, were an ever present reminder that Carthage existed merely by the grace of Rome. To all but the venal and cowardly peace party, the situation was intolerable and a war for revenge inevitable. Where formerly there had been many factions, there were now but two, the peace party and the war party. The peace party, which openly flirted with Rome, was led by Hanno; the opposition, or patriotic party, by Hamilcar Barca. The latter was convinced that it was useless for Carthage to attempt to regain her sea power, as any effort in that direction would immediately be crushed by the Romans. He believed that Carthage should concentrate all her efforts instead upon her army and this she could do only by acquiring territory which would offer at once a valuable recruiting ground and a base of operations for a descent upon Rome in the war of revenge upon which he had set his heart. The Spanish Peninsula not only fulfilled these conditions but offered

Carthage territorial indemnity for her losses and a rich field for augmenting her wealth. The last argument, he knew would suffice to win the support of the public and would serve as a cloak for his ambitious designs. He was well aware that so long as he augmented the revenues, he would have a free hand, and so it proved. His underlying scheme of using Spain as a recruiting ground and as a base for a descent upon Rome when the time was ripe, he kept a profound secret known only to himself and to the immediate members of his family.

As the Barcine faction, though not in office, in reality controlled the government and directed its policy, Hamilcar was appointed commander-in-chief by popular vote. This as a matter of fact made him dictator removable only by the popular assembly that had selected him. He immediately organized an army, and, without apprising anyone of his designs, marched along the coast—his fleet paralleling his course—to the Pillars of Hercules, and suddenly crossed over to Gades in Spain, 236 B.C. Before leaving, he had his young son, Hannibal, who was to accompany him, swear eternal enmity to Rome at the altar of the supreme God of his native city "and reared him and his younger sons, Hasdrubal and Mago—the 'lion's brood,' as he called them—in the camp as the inheritors of his projects, of his genius and of his hatred."* By dint of personal magnetism, blood, iron and diplomacy, he attracted, cowed and organized Spain—one end in view always—until in the flower of his manhood, 228 B.C., not as yet much over forty years old, he met his death on the field of battle just as his plans seemed to be reaching maturity. The elder Cato, notwithstanding his hatred of everything Carthaginian, on beholding the traçes of Hamilcar's work in Spain, a generation later, was compelled to exclaim that no king was worthy to be named by the side of Hamilcar Barca. Such was the father of Hannibal.

Hamilcar's work prospered in the hands of his successor, his son-in-law Hasdrubal, an astute statesman and successful soldier, who was elevated to his high office by the army, whose favor he had gained by his ability and personal popularity. By shrewd and far-sighted policy, he consolidated conquests already made, founded New

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*Mommsen, "History of Rome," Vol. II, p. 109.

Note: Silius Italicus places the scene of Hannibal's taking the oath in the sanctuary of Dido. This oath ran about as follows:

"So soon as age will permit, I will follow the Romans both at sea and on land. I will use fire and steel to arrest the destiny of Rome. Neither the Gods, nor the treaty which forbids us war—nothing shall stop me. I will triumph over the Alps as over the Tarpeian Rock. I swear it by the God Mars who protects me! I swear it, great Queen, by thy august manes!" Dodge. "Hannibal," p. 615.

Carthage, opened up mines, developed commerce, and, with the aid of young Hannibal and reinforcements from Carthage, extended the Carthaginian dominion practically to the Iberus.

Spain was invaluable to Carthage. From it she drew not only an immense revenue but conscripts and mercenaries, whom her able leaders developed into an infantry on a par with Rome's legions. Rome, blind to the strategic value of the new Carthaginian possession, was content to define the Iberus as the frontier beyond which Carthage must not go, and to secure herself a base of action by forming an alliance with and guaranteeing the neutrality of Saguntum and Emporiæ, no doubt in the fatuous belief that the inevitable, decisive struggle with Carthage would be fought when and where she chose. Hasdrubal was content to consolidate his conquests and even neglected the opportunity to attack Rome during her war with the Gauls. The time was not as yet ripe for this. When in 221 B.C., he fell by the hand of an assassin, the army chose Hamilcar's son, Hannibal, then but twenty-six years old, as his successor, their choice being later confirmed by the Carthaginian people.

Though young, Hannibal's life was already filled with a wide experience. His earliest recollections were of his father's heroic exploits in Sicily and in the Civil War. He was already a veteran of many campaigns, a splendid athlete, lithe of body, a superb horseman, an excellent swordsman, a fearless soldier, an intrepid leader, of robust constitution and iron will power, who could and did bear privation, loss of sleep, food and comfort as well as the meanest private soldier. Although reared in the camp, he was by no means untutored, and, having a fine mind, was possessed of as much culture as any Phoenician of his rank and station. He performed his first feats of arms under the eye of his father and was by his side when he fell in battle. Later on he commanded the cavalry under his brother-in-law, Hasdrubal, and distinguished himself alike by his dashing personal bravery as well as by his brilliant talents as a leader. Such was the man who was called upon to "execute the designs for which his father and brother-in-law had lived and died."*

Hannibal had scarcely assumed command when he decided that the time was ripe to commence the war of revenge against Rome, the oppressor of his native city. But the peace party in Carthage was too powerful to permit him to begin hostilities without at least some good pretext. He accordingly spent the next two years in consolidating his conquests and in preparation for his designs by perfecting the organization and training of his army and by replenish-

* Mommson, "History of Rome," Vol. II, p. 115.

ing his war chest. Then, using Rome's meddling in the party contests in Saguntum as a pretext by claiming that the latter's neutrality had been violated, he attacked the city, 219 B.C., and captured it after a terrible seige of eight months, thereby defying Rome, securing Spain and committing Carthage. The Roman embassy that was forthwith despatched to Carthage to demand the surrender of Hannibal met with a flat refusal and the die was cast—Rome declared war.*

In the period since the first Punic war, Rome had made rapid strides toward national unity. By colonization, by building roads and fortresses, but above all by a wise governmental policy that allowed them to share the profits as well as the glory of Rome, she had succeeded in attaching to herself the tribes conquered by her, by ties of self-interest as well as affection. Her strength rested upon the patriotism of her citizens and the loyalty of her colonies and allies. She was mistress of the sea; the organization, training and morale of her citizen army were good, but her cavalry poor. The weakest element of her military system lay in her constant change of commanders and in divided command. Her military leaders were brave soldiers, but no match for the great captain with whom they were now to cross swords.

Carthage had recovered somewhat from her defeat, yet she was inferior to Rome in all those elements essential to national greatness. Her empire was not knit together by ideas of loyalty and patriotism and the commercial spirit of acquisition and enjoyment vitiated what little military virtue resided in the people. Her government was vicious; corruption and vice were widespread and her soft burghers and untrustworthy subject races were alike unfit and unwilling to stake their all in defense of the empire. Carthage was accordingly obliged to wage war largely with mercenaries and with conscripts. Commanding genius came to her rescue, however, in the person of her great son, Hannibal, who, though not energetically supported by his country and obliged to fight traitors at home while facing the enemy, all but succeeded in bringing Rome to her knees and in changing the destiny of mankind.

The undertaking upon which Hannibal was about to embark was stupendous. In boldness of conception and brilliance of execution it stands unrivalled in the annals of history and required all those qualities of commanding genius with which nature had so richly endowed him. His plan reveals not only his power of broad and bold conception, but his foresight and sagacity, above all else, his firm belief in his mission, his faith in his ability, in his destiny, and in his star.

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* How and Leigh, "A History of Rome."

The basic idea of his plan was to anticipate a Roman descent on Spain and Africa by boldly seizing the initiative and striking Rome in Italy itself via the Alps. To accomplish this he intended first of all to provide for the defense of Africa and of his base, Spain, to secure his communications with them, and then to seize an advance base in Cisalpine Gaul, from which he could later shift his operations to central or southern Italy and perhaps reestablish direct communication with Africa.

One may well ask why Hannibal chose to invade Rome overland instead of by sea. There were several excellent reasons for this. Rome was undisputed mistress of the sea, whereas he had neither a fleet with which to challenge her supremacy successfully, nor any prospects of building one without having that project immediately nipped in the bud by Rome. Aside from this, for him to transport his army by sea would have been exceedingly difficult and involved entrusting all chances of success to that unstable element. Even if he succeeded in effecting a landing on Italian soil, his army would find itself among Rome's loyal adherents and would dash itself to pieces against the network of Roman fortresses before it could hope to gain elbow-room for effective operations.

The route he had chosen had been reconnoitered by his officers and brought him directly into the country of the Insubres and Boii tribes as yet smarting under defeat at the hands of Rome and desirous of throwing off her galling yoke. With these he had long been negotiating and they had promised to furnish him not only guides and supplies but levies that could be expected materially to augment his forces. It is probable, moreover, that he divined that the Romans, if they expected him to do anything at all, would expect him to do the obvious thing, move by sea, and it was a maxim with him always to do what the enemy least expected.

He hoped that Macedon, exasperated at Roman interference in the affairs of Greece, would actively support him and that his appearance in the north would cause the southern Italian allies of Rome to rise against her, Rome being thus assailed from all sides.

Hannibal had at his disposal about 90,000 infantry, 12,000 cavalry, 58 elephants and 50 quinqueremes, not all in commission, besides the elephants and war vessels in Carthage itself. Very few of his troops were mercenaries, most of them being Carthaginian subjects, Libyans and Iberians. In accordance with his plan, he disposed his forces as follows: 20,000 men, mostly Iberians, were to garrison Africa and to secure the communications with Spain; 15,000 men, mostly Africans, some elephants and the fleet, under his brother Hasdrubal, were to hold Spain; the portion of the fleet in Carthage

was to make naval demonstrations against the west coast of Italy and Lilybæum; and the remaining forces, under his personal command were destined for the invasion of Italy.

Having made all these arrangements, Hannibal started from New Carthage about the end of May, 218 B.C., with some 50,000 infantry, 9,000 cavalry and 37 elephants, crossed the Ebro in July and overran and subdued Catalonia, an operation that consumed some two months and cost him serious losses. Leaving behind a part of his force to garrison Catalonia and dismissing some 10,000 men to their homes to rid his army of undesirables and to produce a good impression in Spain, he crossed the Pyrenees in three columns. After reuniting his army at Illiberis, he pushed on by way of Elne, Perpignan, Narbonne, Beziers and Nimes to the Rhone, which he reached at Roquemaure about the latter part of September, 218 B.C.

The Romans, entirely unconscious of the thunder-bolt that was so soon to descend upon them from the north, leisurely put some 70,000 men in the field. The consul Sempronius with some 26,000 men and 160 quinqueremes was to invade Africa, the consul P. Cornelius Scipio with 24,000 men and 60 quinqueremes was to invade Spain, and the prætor Manlius with some 20,000 men was to garrison and defend Cisalpine Gaul. Long before either Sempronius or Scipio were ready to move, Hannibal was already far upon his way, while the small Carthaginian fleet was engaged in raiding Sicily and the Italian coast. Scipio's expedition was further delayed by an insurrection of the Gauls on the Po, which was no doubt fomented by Hannibal's agents. Scipio finally embarked his force at Genoa and sailed leisurely along the coast for Spain. Upon reaching Massilia, he was astounded to hear of the presence of the Carthaginian army on the Rhone. A cavalry reconnaissance that drove back a Numidian squadron that Hannibal had thrown out as a bait, confirming the unwelcome news. Scipio moved up the Rhone only to find that Hannibal had meanwhile crossed the river and was beyond reach of pursuit. It seems now for the first time to have dawned upon Scipio that Hannibal meant to invade Italy by way of the Alps. He returned to Massilia, sent the bulk of his army to Spain under his brother Gnæus Scipio and returned with the remainder to Cisalpine Gaul to cooperate with Manlius in facing Hannibal as he debouched from the Alps.

Upon reaching the Rhone, Hannibal, finding a hostile force of Gauls on the opposite bank intent on disputing his passage, sent a detachment to cross the river some 25 miles upstream with orders to turn their position, while he collected the means for ferrying the army across. When the prearranged smoke signal announced the ap-

proach of the turning force, Hannibal threw some troops across and the Gauls, attacked in front and flank broke and fled. Hannibal now crossed with the remainder of the army, the elephants being ferried across on huge, cleverly constructed rafts. In the short space of six days he managed to force the crossing of this wide and treacherous river almost under the very nose of a Roman army, of whose presence his Numidians had apprised him.

Hannibal now moved up the left bank of the Rhone to the so-called "Island," formed by the Rhone and Isere and inhabited by the Allobroges, who furnished him with food supplies and clothing. He then moved eastward and proceeded to cross the Alps. Whether he crossed by the Little St. Bernard, the Mont Cenis, the Mont Genévre or the Col de l'Argentiére, is still a matter of dispute. The route across the Little St. Bernard is the one most generally accepted. The crossing presented tremendous difficulties and consumed about fifteen days. Well-nigh insurmountable obstacles were overcome. Aside from the enormous difficulties of the terrain, cold, hunger, and hostile tribes all combined to assail the army, but all to no purpose, for nothing could daunt the indomitable spirit and shake the iron will-power and steadfastness of purpose of its great commander. It was his enthusiasm, personal example, magnetism and marvelous control over his men that enabled the army to make that wonderful yet terrible march.

In five months the army had covered a distance of some 1,100 miles, crossed large, swift and dangerous rivers and scaled the two loftiest mountain ranges of Europe. The bones of thousands of its members marked its path through the Alps; the remainder, some 23,000 infantry, 6,000 cavalry, and 37 elephants, utterly exhausted, but their leader as intrepid and undaunted as ever, had reached their goal and now stood on Italian soil early in November, 218 B.C. With this handful, trusting to Italy for recruits and supplies, but above all in himself, Hannibal now proposed to hurl himself upon the mighty power of Rome.

After giving his exhausted troops a rest of about two weeks, Hannibal turned against the Taurini, who were hostile to his allies the Insubres and had refused his offer of alliance. A few days sufficed to reduce their capital Augusta Taurinorum and to induce them and most of the other tribes of the Upper Po to join him.

Scipio, who had meanwhile returned to Italy, picking up the troops of Manlius, moved with about 20,000 men to the Po, and, after quelling the rebellion among the Gauls south of that river, crossed to its north bank near Placentia to menace the Insubres and to meet Hannibal's army or what was left of it upon its debouche from the Alps.

Hannibal, on returning to the Insubres from his expedition against the Taurini, heard with surprise that Scipio was on the Po and had already crossed that river. Crossing to the east bank of the Ticinus, he moved southward, his cavalry well in advance. Scipio, meanwhile, his cavalry well in front, moved directly toward him and thus was brought about the cavalry rencontre commonly called the battle of the Ticinus. In this battle, Scipio's cavalry, wholly outmatched by Hannibal's cavalry, was totally defeated and Scipio's army was forced to withdraw to Placentia on the south bank of the Po and to break its bridges behind it. Scipio was severely wounded and escaped only by the aid of his seventeen year old son, later so distinguished as Scipio Africanus, who was to defeat the great Carthaginian at Zama. Hannibal pursued as far as the Pa, but deemed it imprudent to cross in face of the enemy. Instead he crossed about two days' march farther upstream, seized the stronghold Clastidium guarding the defile of Stradella, which formed the gateway to northern Italy, camped below Placentia squarely on the road by which reinforcements must reach Scipio and tried to entice the latter to battle, but in vain.

As soon as news of Hannibal's presence in Italy was received in Rome, the consul Sempronius, who was still dallying in Sicily, was ordered to reinforce Scipio immediately. He moved his army partly by sea and partly by land to Ariminum. It seems as if Hannibal, who was between the two armies, should have defeated them in detail and prevented their junction, and this is perhaps what he intended. But in this he failed, very probably because in that day of intrenched camps it was difficult if not impossible to force an enemy to battle. At any rate, Sempronius managed to join Scipio. Napoleon compares Hannibal's situation to his own in 1796 and it is evident that the great Carthaginian was the teacher from whose maneuvers on the Po he drew his inspiration for some of his masterly strategic moves.

Meanwhile, Scipio, isolated in Placentia and alarmed by a defection among his Gauls, left a garrison in Placentia and withdrew into an intrenched camp on the left bank of the Trebia near the foothills of the Apennines, where he was joined by Sempronius. Hannibal followed and succeeded in luring the impetuous Sempronius to come into the open and to give battle. Hannibal had about 29,000 infantry, and 10,000 cavalry, Sempronius 36,000 infantry and 4,000 cavalry.

Placing 2,000 men under Mago in ambush on his left, Hannibal sent his Numidian cavalry before daybreak across the Trebia to attack the Roman camp and by retreating to entice the Romans into following. The scheme succeeded perfectly. Sempronius, in spite

of the objections of the wounded Scipio, ordered his men out and pushed them across the Trebia. It was now late in December, bitterly cold, and snowing. The Romans had not as yet breakfasted and were soaked, chilled and stiff from wading through the icy Trebia. The Carthaginians on the other hand had eaten heartily, had rubbed themselves with oil before their comfortable campfires and were in fine fettle. The Romans were already half beaten. The armies formed and the battle began. The Romans, their backs to the Trebia, fought bravely in spite of their condition, but their cavalry was soon dispersed by the Carthaginian cavalry, which then fell upon the flanks of the Roman infantry, while Mago's force struck their rear and the elephants demoralized the Roman auxiliaries. The whole Roman army was surrounded and a slaughter ensued that beggars description. Only ten thousand of the Roman center managed to cut their way through and to escape to Placentia, whither Scipio also was able to escape under cover of the succeeding night and a severe storm. The Roman army had been literally cut to pieces. Hannibal's loss had also been severe, but his brilliant success was ample compensation and left him master of the whole Po country, over which his cavalry now roamed at will.

Both armies now went into winter quarters, Hannibal in Liguria, Scipio at Ariminum, Sempronius at Luca. Hannibal had gained his first object, his base on the Po was secure, but in Spain the Romans had practically reconquered Catalonia.

Hannibal spent the winter in minor ventures and in strengthening his hold on the Po valley. But he had no intention of wasting his time defending that valley against Roman assaults. His doctrine of war involved waging a constant, unrelenting offensive, with the avowed object of breaking up the political solidarity of the Roman state, whose strength he fully appreciated. He was well aware that he could not bring Rome to her knees by standing still but must carry the war into territory loyal to Rome and defeat her armies wherever found. He accordingly decided to leave his secure base on the Po and to carry the war into central and southern Italy.

As a first step in carrying out this plan, Hannibal decided to move into Etruria as soon as spring opened. Two routes were open to him, the main route via Placentia and Ariminum and thence across the Apennines, the other across the mountains to Genoa and thence along the coast to the Arnus. The first was excellent but circuitous and its debouches through the mountains could easily be blocked by the Romans. The second was poor and little known to the Romans. Hannibal chose the latter in spite of its difficulty. His spy system was excellent and little passed either in Rome or in the headquarters

of the consular armies that was not promptly known to him. It is therefore probable that he knew that the two Roman consuls for the year 217 B.C., proposed to cover the two northern approaches to Rome on the two main roads, the consul Flaminius with 40,000 men being stationed at Arretium, the consul Servilius with 20,000 men at Ariminum. A move on his part by the main road would involve a direct attack, where all the advantage would be with the Romans, whereas a move by the western coast road would enable him to turn the Roman position. Aside from this, the last-named road was the shortest to his goal and he probably divined that the Romans would not expect him by any other than the usually travelled road, via Placentia and Ariminum.

After some reconnaissance, Hannibal started early in the Spring (217 B.C.), crossed the mountains and descended to the valley of the Arnus, where his advance was all but checked by the flooded marshes along its banks. But nothing could stop the intrepid leader very long. Though the passage of the marshes entailed severe losses and cost him an eye, he gained his object and pushed on to Cortona, thus placing himself squarely across the communication of Flaminius, who was waiting at Arretium for the weather to settle so he could cover all the mountain passes against a possible descent of the Carthaginians. His surprise and chagrin must have been as great as Pope's when the latter found that the redoubtable Jackson was on his communications at Manassas. The game of strategy was as yet a closed book to the Romans; they knew how to fight, but maneuvering was an unknown art. But the loss of communications did not mean as much in that day as in this and Hannibal had still to prod his opponent into battle. To this end he systematically plundered and ravaged the country almost directly under the consul's very nose, and the latter, impetuous as he was, rushed with open eyes to his destruction. With the intuition that was one of his choicest gifts, Hannibal divined what sort of man his adversary was. He drew him on, having already picked out an excellent place for an ambush on the eastern shores of Lake Trasimenus, where the road from Cortona to Perusia skirted that lake, the hills coming down close to its shores and forming a narrow valley, the northern entrance to which has a defile and the southern exit a hill.

Hannibal camped behind the hill at the southern exit. During the night, he posted his heavy infantry on a hill astride the road in advance of his camp, his heavy cavalry on their right, but facing the road, and his archers and slingers well hidden along the heights overlooking the plain of the valley with orders to charge when the order for attack was given. His light cavalry he posted near the northern

entrance to the valley with orders to close it after all the Romans had entered the valley.

Flaminius on this same night camped on the Cortona-Perusia road north of the Lake and the next morning broke camp early and hastened forward to overtake Hannibal. A heavy mist hung over the lake and spread over the valley into which the Romans now passed unsuspecting to their doom. The Romans here as elsewhere—until they had learned their lesson—made no attempt to screen their movements, to reconnoitre, or to throw out covering detachments, something which Hannibal never neglected and at which he was a past master. When the head of the Roman column reached the hill at the southern exit, the column was assailed from all sides. The carnage was terrible. The Romans fell where they stood, or were drowned in the lake. A small body of 6,000 at the head of the column cut its way through only to fall into Maharbal's hands the next morning to swell the number of prisoners to 15,000. The army of Flaminius was annihilated, its commander among the slain, and although Hannibal made diligent search for his body to give it decent burial, he was unable to find it. Hannibal's loss amounted to but 1,500 men. The fury of the battle may be gauged by the fact that a disastrous earthquake passed unheeded by the combatants. To add to the disaster, 4,000 cavalry sent by Servilius to his colleague's assistance, were destroyed or captured by Maharbal a few days after the battle.

The road to Rome was now open to Hannibal and consternation reigned in that city, which was hastily put in a state of defense. In the absence of the remaining consul, Q. Fabius Maximus was elected pro-dictator with M. Minucius Rufus as Master of the Horse, the army of Servilius was recalled, raised to about 50,000 men by the addition of new legions and placed under the dictator's command. But Hannibal evinced no disposition to move against Rome and to waste his time in a weary siege for which he lacked every implement and resource. Probably nothing better illustrates his farsightedness and wisdom. Before he could successfully attempt to attack Rome itself, he had to wait for the disintegration of the Roman state, and as yet there was no sign of this. Besides, his army was badly in need of rest. So again he did what was least expected. He marched into Umbria, thence into Picenum, ravaging the country as he went and, on reaching the Adriatic, gave his troops the much needed rest. From here he sent despatches home with news of his successes. While his army was recuperating, he also rearmed his Libyan infantry with captured Roman weapons, reorganized it somewhat and introduced changes in its formations, though he did not adopt the manipular organization of the Romans. It is probable that he merely changed

his phalanx so as to give it a mobility and flexibility more nearly approximating that of the Roman line of cohorts, in place of the single-shock action for which it was originally designed. At length, when his army was sufficiently rested, he moved leisurely southward along the coast to the vicinity of Luceria in Apulia.

Fabius about the same time had moved to Aecæ, but cautiously kept to the hills, studiously avoided battle and contented himself with harrassing Hannibal's foraging parties. Much to Hannibal's disappointment, the Italian states remained loyal to Rome and, seeing no chance to entice Fabius into battle, he finally moved past Beneventum and Telesia into Campania, hoping thereby to incite the disaffected Campanians to revolt and also to lure Fabius into some indiscretion that would enable him to inflict a crushing blow upon him. Fabius followed cautiously. While Hannibal was ravaging the rich Falernian plain, Fabius quietly reinforced Casilinum, the northern outpost of Capua, which covered the only bridge over the unfordable Vulturnus, stationed Minucius with a strong force on the Appian way, posted 4,000 men to guard the only exit eastward from the plain, the mountain defile through which Hannibal had entered, and himself took position with the bulk of his army on the heights near Teanum, covering the Latin road. Hannibal was surrounded. But the wily Carthaginian was not so easily caught. Availing himself of a famous stratagem, he caused bundles of fagots to be tied to the horns of 2,000 oxen and, during the night, after lighting the bundles, his pioneers supported by light infantry, drove the maddened beasts up the slopes inclosing the defile through the hills east of the plain. The Roman detachment set to guard the defile, thinking the enemy was trying to scale the heights by torch light, scattered to various points to oppose him. As a consequence, Hannibal's light infantry found no difficulty in seizing the pass and, when morning dawned, Fabius found that his prey had escaped. Hannibal now marched through Samnium, gathering futher supplies against the coming winter and finally went into winter quarters near Geronium, on the edge of the plains of Apulia within easy reach of rich grain fields and hill pastures. Fabius followed and occupied a strong entrenched position nearby.

The Romans contented themselves with annoying Hannibal's foragers. Their exasperation at Fabius' tactics finally led to the appointment of Minucius as co-dictator and to a division of the Roman army. This gave Hannibal an opportunity to entrap the impetuous Minucius into a fight that but for the loyal and timely assistance rendered by Fabius would have been as disastrous to Rome as the battle on the Trebia. As it was, their loss was severe.

Thoroughly enraged by the Fabian policy of attrition, the people now demanded a more vigorous prosecution of the war. Aemilius Paulus and Terrentius Varro, the latter a Plebeian and the idol of the people, were chosen as consuls for the ensuing year (216 B.C.), and given eight strong legions, each of 5,000 infantry and 300 cavalry and a similar contingent of allies, in all about 80,000 infantry and 6,000 cavalry, with which to crush the 40,000 infantry and 10,000 cavalry of Hannibal. But again they were reckoning without their host. Remaining in Geronium until May, Hannibal tried to lure the consuls to battle by leaving his camp apparently deserted, but all in vain. The consuls were wary. But again adopting the same expedient, he decamped in earnest and moved swiftly southward and surprised and captured the Roman supply depot at Cannæ. This not only deprived the Roman army of its base of supplies but of the ripening grainfields of the area as well, and left the consuls no option but to retire or to fight a pitched battle on ground of their opponent's choosing.

The consuls decided to follow Hannibal and marched to Canusium early in June. But as they commanded the army on alternate days, the evils of divided command soon became manifest. Paulus desired to avoid battle, whereas Varro, elated by a minor success that Hannibal had allowed him to gain the day after the arrival of the Roman army on the Aufidus in order to whet his appetite, insisted on immediate battle. The Romans had established their main camp on the right bank of the Aufidus about three miles above Cannæ and a smaller camp on the opposite bank of the river, to protect their foragers. When Hannibal on the fifth day after the arrival of the Roman army moved out of his camp and offered battle, and Paulus, whose turn it was to command, refused, Varro's rage knew no bounds. When Hannibal later in the day sent his Numidians across the Aufidus to attack the smaller Roman camp, Varro determined to give battle as soon as the reigns were in his hands on the morrow. Early next morning he accordingly crossed to the left bank of the Aufidus and formed for battle; Hannibal followed suit.

In order to give his attack greater force, Varro discarded the regulation formation in three massed lines, 4,000 men abreast with a depth of 12 ranks, and formed his heavy infantry, about 55,000 men, in 36 ranks with a front of 1,600 men. His cavalry, about 6,000 men, was equally distributed on the flanks and his light infantry, about 8,000, covered the front. The remainder of his force, 2,600 heavy infantry and 7,400 light infantry, was left in the camps. The Roman army faced approximately east, its right resting on the Aufidus.

Hannibal posted 20,000 of his heavy infantry, Iberians and Gauls, in a thin line about 12 ranks deep in the center, the remainder of his heavy infantry, 12,000 Carthaginians in two columns, each 6,000 strong, in echelon in rear of the flanks, the bulk of his cavalry under Hasdrubal on the left flank and the light Numidian cavalry under Maharbal on the right flank, the light infantry, some 8,000 men, covering the front. The army faced approximately west, its left resting on the Aufidus.

The moment the two armies began to advance, Hasdrubal's cavalry hurled itself against the cavalry of the Roman right flank, quickly cut it down or dispersed it and then, moving clear around the Roman infantry, threw itself against the cavalry of the Roman left flank, which was engaged with the Numidian cavalry. Attacked both in front and rear, the Roman cavalry was completely annihilated. This done, Hasdrubal turned against the rear of the Roman infantry.

Meanwhile, the opposing infantry had approached each other, the Romans pressing back Hannibal's thin center of Iberians and Gauls at the first impact. But this easy progress came to a sudden stop when the Carthaginian flank echelons of heavy infantry came into action and in conjunction with their cavalry attacked the Romans in flank and rear. The Romans were soon facing in four directions. Crowded in a dense rectangular mass, a wonderful target for every Carthaginian weapon and unable to use their own, they fought as best they could and died where they stood. Hannibal was everywhere, encouraging, exhorting, condemning. The massacre lasted for hours until, tired of their bloody work, the Carthaginians finally took the remainder, some 3,000, prisoners. Some 50,000 Romans had perished. Aemilius Paulus was among the slain. Varro, however, escaped with a handful of cavalry and light infantry. The total number of captives including those taken in the Roman camps probably amounted to some 20,000. At most, only 15,000 Romans escaped on this terrible day. Hannibal himself had lost but 6,000 men, mostly Iberians and Gauls.

A perfect, annihilating battle had been fought, remarkable chiefly because, contrary to all theory, it had been won by an inferior over a superior force. "A concentric maneuver is improper for the weaker force," says Clausewitz; "it must not attempt an envelopment on both flanks, simultaneously," says Napoleon. Hannibal, however, violated both maxims and won, because he was opposed by a Varro and was clever enough to take advantage of the opportunity that Fortune had placed in his hands. Hannibal's tactics at the battle of Cannæ are superb, both in conception and execution, constituting a

masterpiece of which military history furnishes but few equal and no superior examples.

When the news of the disaster reached Rome, there was mourning in every house. The people were terror-stricken and in an agony of despair. To fill their cup to overflowing, two legions were cut to pieces by the Gauls. It was now that the senate, led by the aged Fabius, restored confidence and hope by its courage, tenacity of purpose, firmness and wisdom. Measures for defense were energetically pushed and the city put in condition to withstand a siege. That Varro, who had brought the tidings of his defeat in person, was now publicly thanked by the Senate for not despairing of the Republic, is eloquent testimony of the spirit of Rome and the greatness of its people.

Hannibal, meanwhile, made no attempt to follow up his victory by marching on Rome. Though urged by Maharbal to do so, he refused, for he knew full well how impossible it would be for him to capture that strongly fortified city with the means at his disposal. Probably nothing in his career more strongly shows his sagacity and clear vision. Ever consistent, he adhered to his plan of striking at Rome's military forces in the field with the object of undermining the political solidarity of the Roman state so as to bring Rome to her knees.

The fruits of his brilliant victory were not long in forthcoming. Most of southern Italy joined him and Capua, the second city in Italy, went over to his side; but the Latin states remained loyal to Rome. Hieronymus of Syracuse, who had just succeeded his grandfather on the throne, egged on by Hannibal's agents, repudiated the alliance with Rome and came to terms with Carthage. Sardinia, stirred up by Carthaginian emissaries, was in open revolt and Macedonia was ready to enter the war against Rome.

After plundering and destroying the two Roman camps near Cannæ, Hannibal meanwhile marched with the bulk of his army through Samnium into Campania, detaching Hanno to Lucania and Mago to Bruttium to consolidate those provinces. After an unsuccessful attempt to take Neapolis—from which he might have had easy communication by sea with Carthage—Hannibal established himself at Capua, where he remained during the winter 216-215 B.C.

In the meantime he had despatched Mago from Bruttium to Carthage with despatches and a bushel of gold rings taken from the Roman knights who fell at Cannæ. The tirade of Hanno, the leader of the peace party, upon the occasion of Mago's delivering these despatches to the Carthaginian senate—as related by Livy—gives eloquent testimony of the fact that Hannibal's worst enemies were

not in Italy but in Carthage and that to them Rome was largely indebted for her salvation. To quote: "This then," said he, "is what you say: 'I have slain the armies of the enemy, send me soldiers.' What else would you ask if you were conquered? 'I have captured two of the enemy's camps full of booty and provisions; supply me with corn and money.' What else would you ask if plundered or stripped of your own camp? Since, as you say," he continued, "the battle of Cannæ annihilated the Roman power and it is a fact that all Italy is in a state of revolt, in the first place, has any people of the Latin confederacy come over to us? In the next place, has any individual of the five and thirty tribes deserted to Hannibal?" When Mago had answered both these questions in the negative, he continued: "There remains then still too large a body of the enemy. But I should be glad to know what degree of spirit and hope that body possesses." Mago declaring that he did not know, "Nothing," said Hanno, "is easier to be known. Have the Romans sent any ambassadors to Hannibal to treat of peace? Have you, in short, ever heard that any mention has been made of peace at Rome?" On answering these questions also in the negative, "We have upon our hands," said he, "a war as entire as we had on the day on which Hannibal crossed over into Italy."*

The senate, it is true, voted that reinforcements be sent to Hannibal but these were mostly to come from Spain and were later (215 B.C.) intercepted by the successes of the two Scipios on the Ebro, almost all of those that were to go direct from Carthage being diverted to Spain. Hannibal was now practically master of southern Italy as far north as the Vulturnus, but his situation was a difficult one, for the Roman garrisons in southern Italy for the most part held out. Had he now received the reinforcements that his brilliant achievements gave him the right to expect and demand, it is very probable that he could have advanced to and captured Rome and that as a consequence his campaign would have been crowned with success in the end. But he was not a monarch like Alexander, Napoleon or Frederick, with all the resources of a strong empire at his command, nor did he have a great popular leader at home to represent him and his cause. As a consequence, the Hanno peace party had its way, and while it did not always succeed in frustrating the war effort entirely, it usually managed to hamper the energetic prosecution of the war and the sending of reinforcements to Hannibal, who was thus left to his own resources.

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*Dodge, "Hannibal," pp. 395-396. For Hanno's complete speech see Livy Book XXIII, XII.

So far Hannibal had been constantly on the strategic offensive, but the waning power of that offensive now made itself felt. His veterans were for the most part dead and the bulk of his troops consisted of mediocre material, being mostly Gauls and Italians. Besides, practically every town of any consequence was fortified and garrisoned. This network of fortresses hampered him, as he did not possess adequate siege materiel to reduce fortified points of any strength, and had to depend upon stratagem, surprise and assault. He often succeeded, but equally often failed. Bold and well-planned as his offensive had been, it was bound, sooner or later, to lead to ruin unless he continued to receive the means with which to deliver constant blows for the purpose of attaining his objective, the dislocation of the integrity of the Roman state to a point where Rome would sue for peace. This was something that the Carthaginian politicians did not grasp. Being animated purely by mercenary motives, war had to be lucrative and visibly so, to make them favor waging it with energy. That energetic support of her great leader was bound to lead Carthage to success—which was almost within his grasp even as it was—went beyond the narrow and selfish comprehension of the Carthaginian politicians and Hannibal was doomed to fail in the end in consequence. History presents no more striking example than the second Punic war of the utter folly and tragic consequences of waging war without one of the fundamental conditions of success, a strong, consistent and vigorous state policy.

From now on, Hannibal operated on the strategic defensive, partly due to the reasons already set forth, partly because of the increased skill of the Romans, who had now learned their lesson from him and were making herculean efforts to win.

The following spring, 215 B.C., the Romans put 140,000 men in the field, of whom 80,000 faced Hannibal in Campania, Fabius being at Cales, Gracchus at Liternum and Marcellus at Suessula. Besides, Brundisium and Tarentum were strongly garrisoned and two legions were in Apulia. Hannibal with 40,000 men had established himself on Mount Tifata, and while probably stronger than any one of the three opponents that immediately confronted him, he was not strong enough to attack them in their intrenched camps, and they, on their part, showed no disposition to allow themselves to be lured into an action in the open field. Hannibal accordingly played a waiting game, hoping for reinforcements from Carthage, for developments in Sicily, Sardinia and Macedon, and above all for the disintegration of the Roman confederacy.

The campaign dragged on, being marked by Hannibal's unsuccessful attacks on Cumæ and Nola, Hanno's defeat at Grumentum

and the capture by the Carthaginians of Locri and Croton. After a small reinforcement under Bomilcar had managed to join Hannibal from Carthage, he retired to Apulia for the winter.

The next year, 214 B.C., the Romans put 200,000 men in the field. Four armies, each over 20,000 strong and posted at Luceria, Venusia, Cales and Suessula, were to operate against Hannibal, who was reduced to a strictly defensive role, which, however, he carried out as brilliantly as he formerly had the offensive role. Moving swiftly from his winter quarters near Arpi in Apulia, he made unsuccessful attempts to seize Puteoli and Tarentum, but the surrender of Casilinum to Marcellus and the defeat of Hanno's Bruttian levies by Gracchus, forced him again to retire to Apulia for the winter. The Roman generals made no attempt to molest his movements, good evidence of the fact that, weak as he was, they dreaded to meet him in the open field. Although Carthage had scored successes in Sicily and Philip of Macedon now formed an offensive-defensive alliance with Hannibal which promised well, the advantage for the year rested on the whole with Rome. Hannibal's reinforcements had been frittered away, except the meagre force brought over by Bomilcar, his allies were inactive, in Spain the two Scipios held their ground, and he could look for no energetic support from home, where it was considered more important to reinforce Spain than to support the war in Italy.

During 213 B.C., although Rome put over 220,000 men in the field, the operations dragged. Hannibal, although confronted by four armies aggregating some 80,000 men, extricated himself cleverly and moved from his winter quarters at Salapia in Apulia to Tarentum. The Romans deemed it unwise to molest him seriously.

This inexplicable inaction of the Romans was followed the next year, 212 B.C., by still more blundering, although they had as large a force in the field as the previous year. Hannibal captured Tarentum, except its citadel, and Heraclea, Thurii and Metapontum fell into his hands. Marcellus, however, the best general Rome had, took Syracuse after an eight months' siege in which the famous mathematician Archimedes perished. The consuls now laid siege to Capua in the belief that the four armies aggregating more than 80,000 men, which immediately opposed Hannibal, would effectively prevent his coming to that city's aid. But they again reckoned without their host. Marching swiftly and eluding his opponents skillfully, he arrived in front of Capua unexpectedly and scattered the besieging force. But he could not maintain himself long in Campania and it was essential for him to protect the southern ports, which were vital to him. He was accordingly forced to return to Tarentum, destroyed two Roman

armies that barred his way, as he went, and wintered in Apulia to rest and recruit his army. As soon as he was gone, the Romans returned to the siege of Capua, which they prosecuted vigorously during the ensuing year, 211 B.C. The city was in imminent danger of falling into the enemy's hands. Apprised of this, Hannibal moved up by forced marches and made a violent but unsuccessful attack against the besieging force. After this failure to raise the siege, Hannibal did a desperate thing in view of the meagre force at his disposal. He left suddenly under cover of darkness and marched swiftly on Rome, whether with a view of surprising that city or of merely causing the Romans to raise the siege of Capua, is uncertain. At any rate, he failed in both, although he marched up to the very gates of Rome. Plundering and ravaging the fertile lands of the Latin allies of Rome, he retraced his steps and, after badly beating the consular legions that were following him, he retired hurriedly to Bruttium. Meanwhile, Capua fell and the captors wreaked upon it a terrible and bloody vengeance. Sicily also was practically reduced by the Romans and it looked as if Italy might soon see the last of Hannibal. But these Roman gains were offset by their losses in Spain, where the two Scipios had meantime been badly defeated and killed.

The fall of Capua caused Hannibal to change his plans. He clearly saw that he must give up some of his strongholds and must confine himself to a smaller part of southern Italy, one that he could hope to hold with the small force at his command. Reduced though he was to severe straits, no opponent dared to come within his reach. Though the campaign of 211 B.C. was favorable to the Romans, it is more brilliant in a military sense for Hannibal. He was if anything, greater in adversity than he had been when Fortune smiled upon him.

The next year, 210 B.C., Rome reduced her army somewhat, but still had some 200,000 men under arms. Hearing that the consul Fulvius with 22,000 men was threatening Herdonia, Hannibal, who was in Bruttium, swiftly marched with 30,000 men to its relief, surprised Fulvius and cut his army to pieces. After an indecisive encounter with Marcellus near Numistro, Hannibal withdrew for the winter to Tarentum and Marcellus to Venusia. In Spain, meantime, the younger Scipio (the later Africanus) had captured New Carthage and Hannibal's cause looked more hopeless than ever.

In the succeeding year, 209 B.C., while Marcellus engaged Hannibal's attention in Apulia and Fulvius in Samnium and Lucania, Fabius attacked Tarentum and, although heroically defended, it fell into his hands by an act of treachery. Hannibal, who had been unable to save Tarentum, now handled Marcellus so severely in a series of battles that he was glad to shut himself up in Venusia. The loss of

Tarentum was a grievous blow to Hannibal, but he did not despair. Though growing weaker and weaker, he was still a terror to the Romans.

When the spring of 208 B.C. opened, the consul Crispinus attacked Locri, Hannibal's base in Bruttium. Hurrying up from Metapontum, Hannibal not only forced Crispinus to raise the seige and to fall back upon Marcellus, but also annihilated near Petelia a Roman legion which was on its march from Tartentum to aid Crispinus. This done, Hannibal moved northward to face the combined consular armies at Venusia. It was near here that, while reconnoitering preparatory to engaging Hannibal's army, Marcellus and Crispinus fell into an ambush in which Crispinus was mortally wounded and Marcellus killed, Hannibal giving his body honorable burial. Though Rome had 21 legions under arms during the year, nothing had been accomplished. Hannibal was still master of southern Italy. If Rome was gradually wearing Hannibal down, she was slowly being ruined in the process. Scipio, it is true, had been successful in Spain, but Hasdrubal with 50,000 men and some elephants had managed to elude him and was rapidly marching toward Italy. Rome was now to face the last great crisis.

Passing the Alps swiftly, early in 207 B.C., and calling the Gallic tribes to arms, Hasdrubal threatened to bring the gigantic scheme of Hannibal to realization at the eleventh hour. Rome strained every energy to meet this danger. The consul Livius was to oppose Hasdrubal with six legions, about 60,000 men, in the north, while the consul Claudius Nero, with six legions, also about 60,000 men, contained Hannibal in the south, Capua being garrisoned by one legion and Rome itself by two, in addition to the forces in Spain, Sardinia and Sicily and the fleets. Fifteen legions with 150,000 men were thus under arms in Italy alone, 100,000 of which were available for the field to meet the divided Carthaginian force of not more than 80,000 men. Hasdrubal meanwhile, instead of moving promptly south to join Hannibal, wasted valuable time in a fruitless siege of Placentia. When he finally moved south with some 56,000 men and fifteen elephants, Livius fell back before him across the Metaurus to Sena. Hannibal, meanwhile, beating off Nero, who tried to impede him at Grumentum, advanced to Canusium in Apulia. Farther than this he did not deem it prudent to advance without more definite news of Hasdrubal as he would thereby jeopardize his base on the coast as well as his allies. Unfortunately, Hasdrubal's messengers bearing despatches asking Hannibal to meet him in Umbria and to march thence via Narnia on Rome, were captured by Nero. Leaving the bulk of his army in front of Hannibal, Nero now marched swiftly

northward with only 7,000 men—the infantry being carried on wagons—to join his colleague, whose camp he entered at night. A few days later, Hasdrubal was forced to accept battle and though he fought bravely and skilfully, his back to the Metaurus, he was totally defeated and himself died as befitted a gallant soldier and the son of the great Hamilcar. "With him fell the towering scheme of Hannibal." Nero now retraced his steps, carrying with him the head of Hasdrubal. This ghastly trophy of his victory, he flung into the Carthaginian lines, "repaying in this way his great antagonist, who scorned to war with the dead, for the honorable burial which he had given Paulus, Gracchus, and Marcellus."* Well might Hannibal exclaim, "Carthage, I see thy Fate." Hannibal now evacuated Metapontum, Lucania and Apulia entirely and retired to Bruttium.

"The dying embers of the war smouldered away in Bruttium. Forgetful of Hannibal, the Romans gave themselves up to the pursuits of peace."§ All that they had gained by skilful use of superior forces, interior lines and good communications with a centrally located base, they now flung away by stupid and blundering strategy. They made no attempt to concentrate their victorious armies and to throw them against Hannibal. Undefeated and undismayed, with splendid if useless obstinacy, he clung for four years to his untenable corner, to resign it at his own convenience and the call of duty. Never was his generalship and control of men through good and evil fortune more magnificent."§ Though nineteen legions were in the field (206-205 B.C.) and Hannibal was confined to Bruttium, Rome could not drive him from Italy. The fear of Hannibal, exhibited by even the best Roman generals, even now while he was at bay, is a splendid and eloquent tribute to his skill and prowess. Even Livy says: "The Romans did not provoke him while he remained quiet, such power did they consider that single general possessed, though everything else around him was falling into ruin."† His very name was equal to a great army.

Hannibal's brother Mago, meanwhile, 205 B.C., landed in Genoa with 20,000 men and, strengthened by Gallic and Ligurian levies, soon had an army of respectable dimensions. But he could neither risk attacking the strong Roman armies posted at Arretium and Ariminum, nor divert Scipio, who had returned from Spain in 206 B.C., after completing its conquest, from his project of invading Africa. In 204 B.C., Mago marched into Cisalpine Gaul, but the

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* Dodge, "Hannibal," p. 558.

§ How and Leigh, "A History of Rome," pp. 223-224.

† Dodge, "Hannibal," p. 563.

next year he was defeated in a bloody action near Milan. Nevertheless, he was able to effect his retreat to the sea without molestation and to embark for Carthage, but died of his wounds on the voyage.

Hannibal, meanwhile, still held on in Bruttium, though he had to evacuate Thurii and Scipio captured Locri. During the spring of 204 B.C., Scipio embarked at Lilybæum with 30,000 troops, sailed for Africa, landed near Utica and laid siege to that city. But its stubborn defense enabled the Carthaginians to come to its aid and forced him to raise the siege. He was now joined by Massinissa, an African prince and former vassal of Carthage, and in the following year, 203 B.C., defeated the raw Carthaginian levies in two battles. Carthage was terror-stricken and made desperate efforts at defense. Hannibal was recalled, embarked at Croton, without being seriously molested, reached Africa safely and disembarked at Leptis with 24,000 men toward the end of 203 B.C.

The next year, 202 B.C., Hannibal and Scipio met near Zama and fought the great battle that decided the fate of the West. Hannibal was defeated, though he came close to victory. His army was no match for that of his youthful antagonist, which had been augmented by levies of former Carthaginian vassal states, in particular by Massinissa's cavalry, which turned the tide of battle in favor of the Romans.

The peace terms were severe and required Carthage to deliver up all her warships and elephants; to undertake no war without the consent of Rome; to deliver up all Roman prisoners and deserters; to provide for the Roman army for three months; to pay an annual tribute of 200 talents (about $240,000) for fifty years; and to deliver 100 hostages to be chosen by Rome.

This peace sealed the fate of Carthage. Rome now relentlessly and consistently pursued her enemy to exhaustion, a policy that is natural when a single power overcomes another and is unrestrained by the influence of other states whose interests are that the defeated power shall not be absorbed by the victor. This principle is well illustrated by the action of the allies in 1814 and by that of the allies in 1918.

Hannibal, meanwhile, was chosen chief magistrate of Carthage and by his wise policy and reforms in the administration and finances was able to bring order out of chaos. What he was in council is well illustrated by his scathing rebuke to the driveller who shed tears that Carthage was compelled to pay tribute to Rome: "You should have wept," said he scornfully, "when our arms were taken from us, our ships burned and when we were forbidden to make war even in self-defense." But his exposure and reform of gross abuses in the public

service raised powerful enemies against him. The success of his administration had been remarkable, but envy and malice did their work. His own countrymen were unworthy of him, Rome could not tolerate him, and he was proscribed and driven into exile, 196 B.C.

"The protectorate of the Roman community now embraced all the states from the eastern to the western end of the Mediterranean. There nowhere existed a state that the Romans would have deemed it worth while to fear. But there still lived a man to whom Rome accorded this rare honor—the homeless Carthaginian."*

Hounded by Rome, Hannibal became a wanderer without a home and without a country and finally found a precarious refuge at the court of the king of Bithynia. But even here he was not safe—Rome could not be easy while her great enemy lived. When her minions finally came to take him, he died—it is said, by his own hand—in the 64th year of his age (183 B.C.).

The hard terms they had been forced to accept, left the Carthaginians no power to resist the injustice and aggression of Rome, which at length resulted in the last tragic act of the drama, the third Punic war (149-146 B.C.)—the siege, heroic defense and razing to the ground of their proud capital, Carthage, well named the London of Antiquity.

Hannibal was a master of the art of war and may rightly be called the Father of Strategy. It was he who taught the Romans that mere fighting was not all there was to war.

Nowhere in history will be found a better illustration of the principles of the objective and of the offensive than his descent upon Italy. In boldness and grandeur of conception, in forethought of planning and in brilliance of execution, it stands alone. Alexander, after all, pitted his power against inferior opponents; Napoleon, when he embarked upon his greatest venture, the invasion of Russia, towered above his antagonists and was undisputed master of the resources of three-fourths of Europe, and Frederick fought all Europe —England excepted—single-handed, it is true, but few of the armies of his enemies were a match for his and none of their leaders equal to his genius. Hannibal alone of all the great captains, with at best but half-hearted support from home, invaded the territory of the greatest then existing military power of the world, Rome, successfully maintained the unequal struggle against her for seventeen years, though finally abandoned and betrayed by his country, brought Rome to the verge of ruin and all but succeeded in changing the

* Mommson.

destiny of mankind. If he had had the good fortune to be the military leader of a people worth fighting for, he would undoubtedly have conquered Rome, and we would today have a Semitic instead of an Indo-Germanic civilization.

Hannibal stands unique in history in that his achievements and character have been preserved for posterity solely by the pen of his enemies. Scarcely anything that emanated directly from him has come down to us. Yet, in spite of villification and detraction his gigantic figure looms through the vista of the ages, as one of the most commanding that has appeared in history. He was unsurpassed as a general, illustrious as a statesman, a patriot, whose devoted loyalty to his country excites our wonder and demands our emulation.

He is best judged by his deeds. Mere victory was not sufficient for Hannibal; he desired annihilation. That is why he always attacked his opponent in flank and rear and invariably sought to cut off his retreat. His tactical handling of troops—especially of cavalry—was superb, his Cannæ a masterpiece of tactics. He thoroughly understood that the offensive alone leads to decisive success and that rapidity, activity and surprise are its vital elements. While his opponents constantly violated the principles of economy of forces, superiority and cooperation, he kept his forces in hand and invariably assured himself the superiority at the decisive point. No one has ever excelled him in utilizing expedients of secrecy, swiftness of movement, surprise, and stratagem to compensate for his numerical weakness, to increase the morale of his own troops and to depress that of the enemy's. Yet his movements were simplicity itself, in many cases startlingly obvious. "In war there is but one favorable moment," says Napoleon; "the great thing is to seize it." This rare gift Hannibal had in an extraordinary degree, being daring yet cautious, bold yet wary, and withal patient when it suited his ends. Keeping his own council, he was accurately informed of what happened in Rome as well as in the hostile armies and had a marvelous knack of sizing up his opponent.

He invariably divined how his adversary would probably estimate the situation; that with childlike simplicity a Roman would always expect him to do what a Roman would do under similar circumstances. In consequence he was able to set the calculations of his opponents at naught and to do what they least expected. Difficulties and danger could not daunt him—the words "it can't be done," were not in his vocabulary.

His organizing ability was astounding. For seventeen years he was able to form one army after another out of indifferent to mediocre

material, to imbue it with his own spirit, and to lead it to victory or to keep his enemies at arm's length.

His knowledge of human nature and the power he wielded over men were marvelous and are shown by his incomparable control over an army knit together neither by ties of race, religion nor love of country, an army which not even in the worst of times mutinied against him. His men followed him in victory and defeat, in fortune and adversity. He cared for their wants—his supply system being always excellent—shared their privations, and was himself the bravest of the brave, but it was, after all, his magnetism, his charm, his enthusiasm, his iron will power, steadfastness of purpose and greatness of soul, that produced the loyalty, esprit and high morale necessary for the brilliant execution of the designs of his creative genius.

"He was accused of perfidy, irreligion, cruelty and avarice. The charges are questionable, their source suspected. If the strength and tenacity of a great people, well supplied with ordinary ability, triumphed in the end over their own disaster and the character and genius of an extraordinary man, we cannot accept the calumnies with which the ungenerous victors—victors alike in the field of war and the pages of history—"* have sought to besmirch his fame. He was not as barbarous as his nation, his times and his opponents; "his avarice was only public, to support the charges of the war; yet Carthage thought him covetous and Rome cruel."* That he was capable of tender passion is attested by the fact that he loved and married a beautiful Spanish princess and relaxed from the hardships of war in the arms of a Salapian lady. Possessed of tremendous force of character compounded of iron will power, enthusiasm, simplicity, resourcefulness, patience, moral courage and steadfastness of purpose; endowed with common sense and extraordinary judgment; gifted with a marvelous understanding of men, superior organizing ability, intelligence and knowledge, robust health, coolness and imperturability in danger, dignity of bearing and great personal magnetism, he was a king among men. "Such was the man whose spirit, moving in all the complications of the times, the soul of all that happened in Spain, Italy, Africa and Macedon, gave to this prolonged death grapple, the well-earned title of the Hannibalic war."* It was to him no mere war of ambition or conquest but a holy, patriotic duty. Great as he was in victory, his real greatness of soul shone forth in adversity. He seemed superior to Fate itself. The success of his cause would have been a calamity for mankind; but this does not de-

*How and Leigh, "A History of Rome."

tract from his greatness nor diminish the admiration that it justly deserves.

It may well be that an all-wise Providence, which watches over the destinies of man, saw to it that Carthage did not possess the qualtities that would have made her deserve to win and so she could not and did not exert the energy required to transmit her institutions to posterity. The fury of Rome and centuries of time have rolled over her, devastating, annihilating. Where once the proud city stood with its palaces and towers, there is now nothing but a waste and a silence. But so long as history is written, the lustre of the fame and exploits of her great son, Hannibal, will live, an everlasting monument to his greatness.

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The Influence of Fast-Moving Tanks on the Encounter Battle

By Colonel J. F. C. Fuller, D.S.O.

EDITORS NOTE.—*The following paper is reprinted from* THE ROYAL ENGINEERS JOURNAL *for December,* 1923, *with due acknowledgment to that publication and to the author.*

Herein appears a stimulating and perhaps significant contribution to military thought in the idea of a possible discarding of our traditional arms of the service in favor of a regrouping of weapons and personnel to meet the conditions of future warfare. Colonel Fuller's suggestions are certainly revolutionary and may seem fantastic. Yet how inconceivable to Napoleon would have been our present-day divisional organization!

It is all too easy during a long period of peace to permit military ideas to become crystalized and stuttified. Colonel Fuller floods the field with the search-light of imagination. In the knowledge that few Coast Artillery officers have access to THE ROYAL ENGINEERS JOURNAL, *this paper is presented to our readers as a stimulus to imagination.*

PREFACE

MY object in this paper is not to prove that the tactics and training made use of in our army are valueless or that existing weapons are useless, but that we are today living in a transitional period in which changes are beginning to take form, changes which, I believe, must radically modify our military conceptions. No man can say with certainty what is going to happen, but we may say with some assurance that only by attempting to probe the future shall we be able to discover the probable nature of the changes which confront us. In this paper I have outlined in brief a few ideas, they are nothing more than ideas, but they may assist as a working base for further speculation and research. Though we must adhere to the doctrine laid down, it should be remembered that one day all our Manuals will have to be revised and, consequently, if we have not thought out beforehand the new directions that war is taking, when we are called upon to assist in this revision we shall fail in our duty as soldiers.

PART I

Argument.—In this paper I intend to deal with a speculative problem—the influence of a fast-moving tank on existing tactics

and organization. It is a problem which has not been studied, except by a very few, and it is an immense problem. In order to bring it within the scope of an article, I intend to limit my speculations to an encounter battle between two Continental nations—Red and Blue, each possessing 1 Cavalry Division, 6 Infantry Divisions and 7 Battalions of tanks. In the Red Army the Tank Battalions are an integral part of each Division, in the Blue they are Army Troops. The tanks with which these two armies are equipped, I will suppose, are proof against armour-piercing bullets, possess a maximum speed of 20 miles p.h., and weigh about 10 tons.

I will now lay down two postulates:

(i) The *arme blanche*, the bullet and wire are useless against tanks.

(ii) The tank is useless in thick woods, swamps and on the slopes of mountains.

Accepting these, and that two-thirds of the theatre of war is open agricultural country, I will consider some of the possible problems which may arise under the headings of Approach, Contact Deployment, Battle, Counter-attack and Pursuit.

Approach.—First, remember the nature of the tank organization of both sides; and secondly, imagine that war has been declared between the Red and Blue nations.

Red moves off in column of march. Its tanks, in most cases, have been distributed down to Brigades, for the Red C.-in-C. is a firm believer in close co-operation between tanks and infantry. Before the columns have gone very far there is a considerable amount of confusion. The tanks want to go eight miles p.h., the infantry will not go more than two. The tanks are turned off the roads into the fields, but their commanders find that delays occur and control is lost when they are confronted by streams, woods, thick fences, broken ground, etc., and so they look for spare roads on their flanks. They use these and poach on the communications of neighbouring Divisions. Much abuse follows and eventually they are withdrawn and placed behind their respective Divisions. A day or two later the Divisions cannot get their supplies up. The tanks are blamed—they block the roads. Besides, some Blue armoured cars have put the "wind up" one of the Advanced Guards and have shot a Brigade Commander whilst at breakfast, five miles behind the leading troops; so it is decided to put the tanks in front and the Red C.-in-C. issues orders that they are not to become engaged without infantry support.

Blue moves off in column of march, one central road is allotted to its seven Tank Battalions, the Divisions marching on parallel roads. When air reports inform the Blue Divisional Commander that the Red forces appear to have their tanks in front, they become jumpy and urge the Blue C.-in-C. to give them tanks. He refuses and, quoting Ludendorff, tells them that the infantry "must rely on their nerves." If attacked, they "must move to a flank." He will support them when he sees fit. He is a man obsessed by the idea of "the manœuvre mass."

Contact.—The Red Cavalry Division is operating well in front of its infantry and is supported by a Battalion of tanks. These machines enter the Blue villages, terrorize would-be *franc-tireurs*, then along come the cavalry. When the ground is broken and difficult, the tanks stick to the roads and the cavalry canter out on their flanks and the advance proceeds rapidly.

One day the Blue cavalry are sighted. The Red Commander does not know whether they are working with tanks or not; he is, however, suspicious. He calls up his tank Commander and they consort a plan.

"You see those two woods to your right and left," says the Cavalry General, "Well, get into them. I will go on with the bulk of my force and engage the Blue Cavalry; there will be no charges, but instead, directly we are in contact, I will fall back across the fields between the woods. Once the enemy is well between them, you will attack him at top speed. If possible, I will wheel round the woods and attack all I can in flank. Do not attempt to co-operate with me, but seize your opportunity and, when you do, hit hard."

The Blue Cavalry advance with caution, they have heard that tanks are about and are much relieved when the Red are met without them. The Red troopers fall back and the Blue push on. The Blue attempt several charges, but are beaten back by machine-gun fire. The Red fall back on the two woods and then further back still. As the Blue approach, 60 tanks move out at top speed—some 18 miles p.h., and the best part of a Blue Brigade is wiped out. The rest retire in panic and do not draw rein until they reach their infantry advanced guard, which the demoralize with the wildest of rumors.

That night the Blue outposts are most unsteady. Every sentry sees tanks. Wild firing takes place and the outpost reserves stand to arms throughout the night.

Deployment.—The Red Cavalry have mysteriously vanished. Except for a few isolated sections of troopers nothing can be seen of them. The Blue are still completely demoralized and their horses

useless. The advanced guards are in contact, both sides are deploying.

The Red C.-in-C., a man of methodical habits, is not going to rush the enemy. Under cover of his tanks he intends at first to deliver a frontal infantry attack with four divisions and turn the enemy's left with two. With these two divisions he would like to use more than two battalions of tanks. His Tank Battalions are, however, distributed; to withdraw one or more will create confusion and, further, will seriously affect the *moral* of the infantry who have learnt to rely on them. To withdraw individual companies is difficult. He must have some reserve force for his right flank, so he determines to withdraw one Division into reserve. He is very much annoyed at this change forced upon him through the difficulty of separating tanks from the other arms when close co-operation has become a recognized necessity.

The Blue Army is deploying rapidly, but the seven Tank Battalions on the central road are causing much confusion. The Blue C.-in-C. orders two of these battalions to join the Divisions on their right and left, and five to move to the right flank as an independent force. As the tank movements are to be kept secret, the machines must move out laterally well in rear of the infantry and under cover of darkness. As they cross the various roads, the artillery and transport columns are delayed and as night deepens confusion increases as the tail ends of columns try and catch up with their heads after the tanks have passed by.

Battle.—The Red Army advances whilst the Blue is still deploying. The Blue troops are in a nervous state, particularly the infantry, and are seeking to take up anti-tank rather than attack positions. Their attitude is defensive. Several of their positions are in woods and on hilly ground. These clash with the positions the Blue gunners would like them to take up in order the better to support their attack. Co-operation is difficult to establish. The Blue infantry start digging in, though not a shot has as yet been fired.

The Red forces continue their advance. In many cases the infantry have thrown away much of their equipment in order to keep up with their tanks; the number of stragglers is increasing.

The two battalions of Blue tanks which have been allotted to the Blue Divisions have been pushed out well ahead of their infantry and for the most part are out of sight. The two tank forces meet and long-range fire opens. The Red guns are pushed up at a gallop. The Red tanks which have been ordered to keep close touch with their infantry, want to push on, but cannot; a good many get hit.

Besides, the Red tanks are scattered on a wide front and are unable to concentrate against the Blue.

As the Blue tanks advance, the Red infantry opposite them break and stream to the rear. The Red gunners stand to their pieces and knock out several of the Blue tanks, but not many, as their speed makes them difficult targets.

The Red tanks move forward at the request of their infantry and soon lose touch. Then, as one Tank Battalion tops a rise, they see thousands of Blue infantry streaming away in the distance. All Red tanks are now moving rapidly forward, with every gun firing. The ground is littered with infantry equipment; Blue infantry are seen in all directions. Hundreds are caught up and shot down. The Blue gun positions are approached, some Red tanks are knocked out, but in a few minutes the tanks are on the guns, and the gunners, where they can, join the fugitives.

The Red tanks, pursuing the Blue infantry, have lost all formation.

The Red infantry, on the flanks of the penetration effected by the two battalions of Blue tanks, have fallen back and are seeking refuge in woods and villages and behind streams. With great difficulty the Red C.-in-C. collects some 60 or 70 machines and orders them to follow up the Blue machines which are manœuvring to avoid the Corps and Army Artillery. He is successful; a number of Blue tanks are shot down and the remainder, in attempting to withdraw, come up against a small river and, being unable to cross it, surrender.

In rear of the Red Army there is terrible confusion. Bad news has travelled swiftly and several of the supply columns are in panic.

Counter Attack.—The Blue C.-in-C. hears of the total rout of his infantry. Scarcely a company remains intact, for his reserves have joined in the *sauve qui peut.*

Simultaneously, he hears that his communications have been attacked by hundreds of tanks—fear magnifies numbers. This attack has been carried out by the Red Cavalry Division and its battalion of tanks. The night before, they moved 25 miles to the left flank of the Blue Army and then inwards. The whole of the rear system of the Blue Army is in confusion.

The only force the Blue C.-in-C. has intact is five battalions of tanks. These are well out on his right flank, preparatory to attacking the left flank of the Red Army. He withdraws them to a river slightly in rear, a stream which runs at right angles to his original line of advance. He does so because by air he has learnt that great numbers of Red tanks are attempting to cross it. He wheels his five Battalions inwards and they sweep down the river.

The Red tanks are surprised and taken at a terrible disadvantage. Some try to cross the stream and are ditched, others try to withdraw and are shot down, a few get away.

The Red C.-in-C., hearing what has happened, recalls his Cavalry Division. The horses are dead-beat and some of the tanks are running short of petrol. That evening but a remnant of the force rejoins him. Simultaneously he learns that the greater part of his infantry are in flight. Rumour has it that they have been attacked by thousands of tanks and that Battalions are surrendering wholesale. As darkness falls, the roads are blocked by streams of fugitives. Panic is now in command; even familiar sounds, like the noise of a motor-cycle or the droning of an æroplane, sends mobs of men scattering across the fields in the dark. Except for the five battalions of tanks, under the Blue C.-in-C., there is not an organized body of troops on or near the battle-field.

Pursuit.—The Blue C.-in-C. orders a relentless pursuit. Then he counterorders it, for his supply services are in chaos and he cannot get up petrol for his machines. He cannot get rations for his men, he does not know where his men are, he does not know where his rations are; all he knows is that most of his lorries are overturned in the ditches and that their drivers have disappeared.

The condition of the Red Army is still worse. Hungry men start marauding, marauders soon become brigands. The peasants take to arms in self-defence. The Red Government goes down with a crash and is replaced by a patriotic but revolutionary assembly.

The Blue C.-in-C. withdraws his five Tank Battalions; re-establishes his railheads and assembles the equivalent of some two Divisions of infantry. He begins to advance on the Red capital. He enters it only to find that, as a political centre, it has vanished, and that the people have taken up arms. Everywhere he is met by an intangible foe. Rails are torn up, bridges destroyed and water poisoned. His tanks are invulnerable, but with 300 machines he cannot control an entire nation. Directly the tankmen get out of their machines they are shot at. His small force of infantry can just keep open one line of railway and, except for this line and the capital, the country is unconquered.

At the opening of hostilities six Divisions of infantry might have won through. Now he wants at least twelve, possibly eighteen for police work alone, as well as hundreds of tanks and armoured cars. His country cannot supply them and, whilst its Government is scratching its head, President Wilson descends in a parachute from a giant battle plane, patches up peace terms and Red and Blue lands have lived discontentedly ever since.

Part II

Apology—I must now apologize for the behaviour of the opposing Commanders-in-Chief. In place of criticizing their tactics, let us examine their difficulties. Both had been brought up in a certain school of thought. Both had been educated on Training Manuals which they were not allowed to contravene. In the Red Manual the Commander had learnt: "To seize and hold a position with infantry remains the only known way of destroying the enemy"; consequently, when tanks were given him, he looked upon them as handmaids to the infantry attack. In the Blue Manual, the Commander had learnt that shock is the decisive factor, so he, consequently, acted as he did.

Now, in my opinion, the initial mistake committed was that both these Commanders could not divorce themselves from particular points of view. A hundred years ago there were three arms—infantry, cavalry and gunners. Today, we have a multiplicity of arms which are not infantry, cavalry or gunners. Why not, then, change our system of thinking and think in terms of close combat troops (the new infantry), protective troops (the new gunners), and pursuit troops (the new cavalry). Then examine each group, pull out the weeds and organize each so that each can co-operate within itself and later on, perhaps, all three groups can co-operate with each other. Do not let us bother about holding ground or conquering ground—let us organize movement; this is the crucial problem. I will now examine each phase of the above encounter battle.

Approach.—Throughout the approach we see one outstanding difficulty, the difficulty of co-ordinating movement. Though tanks are roadless vehicles, when they are not fighting, their normal position is on a road, just as the infantryman's is. Man is a roadless animal, but if he has to walk from Aldershot to London he goes by road and not across country. If he has to fight an enemy along the way, he will often get off the road, but whenever possible he will get back on it. In fact, he only gets off the road so that he may get along it the quicker. With tanks we must do just the same.

The tank wants to go at eight miles p.h. and boils over if we try and make it go at two; the infantryman wants to go at two miles p.h. and boils over if we push him along at eight. As we cannot increase the marching-power of infantry we must produce a tank which can move at any pace without injury to itself. There is no difficulty in doing this. Then, if necessary, each company of infantry can have its own platoon of tanks and there will be no need to place tanks in front or behind formations, or on separate roads. If armoured cars come along, they will be ready to meet them. Such tanks can protect

as long as they move at from two to three miles p.h. Have we solved the problem? No!

Contact.—Cavalry can move for very short distances at twenty miles p.h., or for fairly long ones at eight. Can these tanks and cavalry co-operate closely? No! Why? Because tanks are protected against bullets and cavalry are not. The Red Cavalry Commander seems to have realized this, for he did not turn himself into a worm with the tank as the hook. If, in place of Blue Cavalry, he had met Blue tanks, I imagine he would have done very much the same thing. He would have used his cavalry as eyes, not as fists, and, if pursued, he would have scattered so as to reduce the target. He would, therefore, before he advanced, have settled on his "bounds" forward and have selected various rallying points if he were forced to scatter. In fact, he would be ready to dematerialize his command at any moment and materialize it again, anyhow in groups, an hour later and well in rear or to a flank. "Dematerialization" is the opposite of charging.

As long as tanks cannot move quicker than horses, cavalry will remain a useful arm.

A point worth noting in this contact engagement is that if, in war, we can strike a crushing blow first, even if we only crush a small force of the enemy, we not only gain a physical victory over the force we have crushed but a moral victory over every man behind this force. The lesson here is that cavalry and tanks, when working together, must act with the greatest audacity and cunning. To avoid jealousies they should belong to one mobile arm—the pursuit troops. Pursuit does not necessarily mean waiting until an infantry battle has been fought. If we are mobile soldiers let us get the infantryman out of our heads and pursue whenever we can. Our object is not so much to "fix" the enemy, but to endow him with extreme mobility in the opposite direction to which he wishes to go. Why? Because by so doing we shall turn him into a demoralizing projectile. We must always remember that the enemy has nerves.

Deployment.—Granted that the tank can, without detriment, move at the same pace as the infantry, deployment with tanks is no more difficult than deployment without them, especially if each Battalion has a Company of tanks of its own. In other words, we have dismissed the idea of infantry and replaced it by that of close-combat troops.

But have we really solved the problem of deployment? No!

What is this problem? Rapidity of movement. The tanks can move at twenty miles p.h., that is, eight times the speed of infantry. Twelve miles of infantry take a whole day to deploy; twelve miles

of tanks will take two hours, perhaps less. What if the enemy detach an independent Brigade of tanks to attack us whilst we are deploying? Should we detach a Brigade also to attack the enemy's Brigade and so cover our deployment, because we consider it essential that our close-combat troops must not exceed two miles p.h.? Here, once again, we catch ourselves thinking in terms of infantry.

What if we have not got an independent Tank Brigade up our sleeve? Are we going to let ourselves be run over? Would not we detach every tank we could from our close-combat forces to frustrate such an ignominious end? What would the infantry forces say? Would they console themselves with the idea that they were the decisive arm, that they can hold and conquer ground? What would their *moral* be like when their tanks, not as a united body but as a host of separate companies, disappeared over the skyline? What if their tanks were defeated? What if their tanks pursued the enemy thirty miles and defeated them? Are they going to double thirty miles to hold this ground? Or must their tanks abandon the idea of defeating the enemy and replace it by, "We must not go more than five miles or else our infantry will never get here by this evening."

By enabling a tank to go two miles p.h. we may have solved some minor march problem. Why not, in place, mount the infantry in cross-country buses which can move with the tanks and at the same pace? Instead of marching twelve miles a day they will then move one hundred, and deployment will be proportionately rapid and, if enemy's tanks are met with, the buses can fall back twenty miles in a couple of hours and, if our tanks beat the enemy thirty miles ahead, the buses can cover the fifty miles in some five hours and their occupants can hold whatever ground they like as long as their tanks remain close at hand. If their tanks move away, they can hold the ground against infantry. But is it likely that the enemy will attack them with infantry when he can make certain of victory by attacking them with tanks. If he does so, then the infantry will get into their buses and bolt. Their power does not rest in holding ground but in ability to abandon ground, and abandon it at a speed equal to that of the tanks.

Battle.—I will now turn to the battle. Why was it such an appalling chaos? The main reasons were because the tanks were bullet-proof and could move at twenty miles the hour, whilst the infantry were not bullet-proof and could not move at more than four, when in flight. Had they been provided with cross-country buses, most could have saved their lives, but what use would they have been as close-combat troops? None, except in areas in which tanks could not move.

Either in buses or on foot, infantry offer no protection to the guns in rear against a tank attack. If overrun by tanks, their supporting gunners have to fire indiscriminately on friend and foe. If only the guns could be placed in front of the infantry, how much safer would the infantry be! This can only be done by putting the guns on tracks. For a moment I will examine this question of artillery.

In the recent war, tanks, which could move at four miles p.h., had to attack positions held by hundreds of guns. Many tanks were hit, but, in spite of all these hundreds of guns, every well-organized tank battle was a success—an overwhelming success. Today, we have only seventy-two guns in a Division, and, in spite of the fact that some of them possess split trails, are they going to be as successful against tanks moving at 20 miles p.h. as the German non-split trail 77's against Mark IV. and Mark V. tanks?

Had the guns of the Red and Blue artillery been mounted on cross-country tractors or in tanks they could have protected the Red and Blue infantry. Their object would not, however, have been to effect this protection, but to destroy the enemy's tanks and tractor-mounted guns. The field-gun motorized is, in fact, no longer a protective arm but a close-combat weapon.

Counter-attack.—The Blue counter-attack succeeded not only because the Blue C.-in-C. had an organized force of tanks in hand, but because this force was homogeneous; it did not include arms which it had to protect but which could not protect it. The Blue C.-in-C. made full use of ground, not as cover but to restrict the mobility of his enemy's machines. He waited until they were hung up by a river and then attacked. This may seem a small point, but it is a most important one. We have been trained to appreciate ground from the point of view of cover and of fire effect. In the future we must also appreciate it from that of tank mobility. All our war maps will have to be changed. They will have to be coloured showing where tanks can go, where they cannot go, and where it is difficult for them to go. What we shall require in the next war are maps on the lines of sea-charts.

Pursuit.—Why did the Blue pursuit peter out? Because the Blue Army's supply system had gone west. To a mechanical army, its lines of communication are more vital even than those of a non-mechanical. This can be partially overcome by oil and gas producer plants, but as long as tanks are driven by petrol, communications must be safeguarded or else fleets of "tramp" æroplanes must be created to convey fuel to them.

And now as to the last question. Why had President Wilson to parachute out of the heavens like a falling Lucifer? Because, though armies can be defeated by machines, nations cannot be, except at a stupendous cost. To keep a nation in order we want men. Men who move everywhere, who go into houses and who can disperse meetings without bloodshed. To control a nation we want "human touch"; to conquer a nation we must establish order. When a nation rises, God help us, and to prevent its rising we must organize success and not merely gain victories. To organize success we want men, and the quicker we can move these men about the less likely are the people to revolt.

Part III

Conclusions.—In my Apology I stated that a hundred years ago there were three definite arms—infantry, cavalry and artillery. In the 14th century there were archers, pikemen and knights. Wellington did not think in terms of archers, pikemen and knights, and he was right. Today, we have new arms and we also must cease thinking in terms of the old. We are not certain of these arms, let us try to group them in the three essential groups.

(i) *Close-Combat Troops.*—Tanks, motorized field and medium artillery and motorized infantry, the last for attacking regions unsuited to tank action and for outpost work.

(ii) *Protective Troops.*—Motorized heavy guns and infantry pioneers. The latter to be used mainly on the lines of communications to build and garrison anti-tank blockhouses and to lay mine fields. The duty of these pioneers is to hold ground and they should be equipped to do so.

(iii) *Pursuit Troops.*—Cavalry, as long as they are useful; fast, lightly-armoured tanks and scout tanks, also æroplanes.

Behind this army of conquest will advance an army of occupation and of administration. It will consist of men and it will hold the countries won by organizing tranquillity within their boundaries.

Now I will conclude this paper by saying that I entirely agree with the *F.S.R.* when it tells us that infantry is still the decisive arm. I agree, because if we went to war tomorrow we should not possess sufficient tanks to wage such a battle as I have described. As long as we have no tanks we must rely on infantry. If a great war broke out

tomorrow, I believe, because of the enormous number of machine-guns which now exist—five hundred to a Division in place of twenty-four as in 1914, the war would go static at once. Behind a wired machine-gun wall great tank forces would be created. How would they be organized, this is the question? Would we think of them in terms of infantry, cavalry and artillery? Of course we would, unless we had troubled ourselves to think out their values in other terms.

This, then, is the gist of my paper.

We must be loyal to the present, because we live in the present. Do not, however, let this prevent us being loyal to the future. To be disloyal to the future is to imagine that the present cannot change. It *will* change, and in terms of our ignorance or forethought.

ARMY AND NAVY

For several years we have been decreasing the personnel of the army and navy, and reducing their power to the danger point. Further reductions should not be made. The army is a guarantee of the security of our citizens at home; the navy is a guarantee of the security of our citizens abroad.

Both of these services should be strengthened rather than weakened. Additional planes are needed for the army, and additional submarines for the navy. The defenses of Panama must be perfected.

We want no more competitive armaments. We want no more war. But we want no weakness that invites imposition. A people who neglect their national defense are putting in jeopardy their national honor.—*President Coolidge in his message to Congress.*

EDITORIAL

The Future of Our Harbor Defenses

A MISCONCEPTION is gaining ground among laymen and even among some in the military service itself, that today our harbor defenses do not hold the same degree of importance they did formerly because of the development of the Air Service and its ability to protect our coasts from foreign invasion. The fact is brought forcibly to our attention in a short unsigned article that appeared recently in one of the service Journals. It might well go unanswered were it the only one of its kind that has recently appeared in print. Such, however, is not the case. Persons not acquainted with the present-day capabilities and limitations of our various arms might well conclude from some of the statements being published that the usefulness of harbor defenses is a thing of the past. As a matter of fact, their importance never was greater than it is today. The article is as follows:

> "The bombing tests recently held off Cape Hatteras when $6,000,000 worth of Naval craft, represented by the old battleships *New Jersey* and *Virginia* were sunk at sea in compliance with the mandate of the "Conference on the Limitation of Armament," gave rise to discussion as to whether or not the end of the capital ship is in sight. Competent observers, however, were of the opinion that the only thing proved beyond the ability of 2,000 pounds of T.N.T. to sink an old type ship when fairly placed, was to make it more difficult for war vessels to reach coasts adequately defended by aircraft and to emphasize the contention of sea-strategists that the proper place for war ships is at sea. There they must meet the enemy and there they must defeat him or be defeated.

> "The defense of our coasts is not to be maintained by powerful guns in fixed defenses firing against battleships. The only time such war craft will approach the coast is when they have air superiority, and with enemy air-superiority, the fixed coast defense guns are useless, and the age old axiom reappears that the foot soldier and his auxiliaries alone can prevent an enemy from landing or once landed defeat him; by improved methods, no doubt, but dependent in large measure on man-power and not machinery. Wars of the future, like wars of the past will depend in great measure on Infantry tactics."

The attention of the Coast Artilleryman is immediately centered on the following statements in the second paragraph: that the defense of our coast is not to be maintained by powerful guns in fixed defenses firing against battleships; that the only time battleships will approach the coast is when they have air superiority; that with enemy air superiority the fixed coast defense guns are useless; and that with enemy air superiority the foot soldier and his auxiliaries alone can prevent an enemy from landing, or once landed, defeat him.

If these be logical statements, the Coast Artilleryman may well wonder how long a time, or rather how short a time, it will be before our harbor defenses will all be scrapped and the funds now being expended for their maintenance, turned to more useful purposes. But are the statements logical? Will not harbor defenses of the future be an actual as well as a potential power that will continue to deny our harbors to an enemy?

History narrates the records of many nations that have prospered only to be conquered by a people better prepared for war. Most of the nations existing today have at one time or another been conquered. The changes impelled by the forces of nature render it unlikely that any nation can exist forever. A nation that is well defended either by its people or by nature may exist for hundreds of years. Under other conditions its life is likely to be very short. History records the examples. The United States has heretofore depended primarily on its isolation for protection. But whereas a hundred years ago it took months to cross our bordering oceans, and fifty years ago weeks, they can now be crossed in days. We are no longer able to depend upon isolation for protection. Moreover, fifty years ago this country was not the richest of all nations. Fifty years ago its conquest would not have afforded untold wealth and power to its conquerors.

It is conceivable that a nation with a lust for conquest, or a combination of such nations, should sometime undertake the subjuga-

tion of this country, and as a preliminary step defeat our fleet and gain absolute control of the sea. Because of its vast resources this country never could be starved into submission and our enemy of necessity must seek the final decision on land. He must seek land bases from which to conduct his invasion. Will he be satisfied with such a base along an open shore or will all his efforts be bent on seizing land adjacent to a land-locked harbor; such a place that his transports and supply ships can be run close into shore, or docked, and troops and supplies quickly unloaded? Most assuredly, unless it is adequately protected, he will seek the harbor. Without it his chances of success are too small.

Until the enemy gives some assurance of his place of attempted landing the logical course of our infantry, with its supporting arms, is to concentrate its main force at some distance inland, with smaller detachments still nearer the shore line, and there adopt a policy of watchful waiting, ready, when the enemy does make his landing effort, to rush to the threatened point and there defeat him before large forces can be disembarked. This the infantry could be reasonably certain of doing provided the enemy attempted his operations along the open shore. There the time necessarily consumed in landing large forces of men in small boats, the difficulty of unloading artillery and transportation, and the elements themselves, are all against him. His only good chance of success lies in carrying on his landing operations in a harbor where docking facilities are available and the debouching rivers so shape the shore line that natural protection is afforded the flanks of early landed troops.

The question arises as to whether an enemy will wait until he has secured air superiority before attempting to seek a decision on shore. Operating thousands of miles from his bases he surely would have great difficulty in maintaining air superiority along our entire coast line. But it is reasonable to suppose that just prior to his attack on a fortified harbor, he would be able to concentrate his air forces and gain temporary air superiority at the point selected for attack. It would therefore seem that harbor defenses, to justify their existence, must be able to function even with enemy air superiority.

If the enemy has air superiority, are our harbor defenses helpless? An extract of an editorial from one of the country's great daily newspapers is quoted below. This newspaper evidently believes that under such conditions our harbor defenses are helpless. Here it is.

> "The big guns of the Coast Artillery cannot keep enemy air forces from flying overhead and demolishing the coast forts and the big guns. Antiaircraft guns will not deter bombing

planes from doing their deadly work. The only known means of preventing the destruction by airplanes of the United States coast defenses, including the new 16-inch guns, is to provide a defensive air force that can out-fight any enemy air force."

Is this correct? Every Coast Artilleryman knows it is not. To counteract the bombing operations of an enemy, it is only necessary to keep his planes at a high altitude and to camouflage our gun positions. Our guns are no longer being grouped closely together. Instead they are scattered over a wide territory. Our new fortifications today are being constructed with this point in view. The effectiveness of our antiaircraft guns and their fire control equipment is improving by leaps and bounds. What is to prevent burying our mining casemates so deeply underground that even a direct hit can do no harm? At what will an enemy aim his bombs with our guns, casemates, and stations all camouflaged? Will not his aim be greatly impaired by the bursting shells from our antiaircraft guns? The chance of an enemy bombing fleet putting out of commission a modern harbor defense is absolutely nil. It would be of great professional value to the Coast Artillery Corps should the Air Service select an obsolete harbor defense battery, instead of a battleship, for its next target. True, the airmen would be operating under conditions that would not exist during war, for their planes would not be targets for the antiaircraft guns of the harbor fortifications, nor would the battery be camouflaged, but still such a test would give some idea of the number of planes necessary, bombs required, and time consumed, to destroy a single battery of a harbor fortification.

Assume the enemy does not have air superiority. Are harbor defenses essential under such conditions? Can the enemy undertake no offensive action? During fogs and storms and at night the efficiency of our Air Force will be greatly reduced. Such conditions on the contrary will not materially effect the enemy's navy. Under these conditions, were it not for our harbor defenses, with their powerful searchlights, sub-aqueous sound ranging systems, submarine mines, and quick firing guns, the enemy could strew our harbors with mines, block the channels, bombard our cities, or carry on landing attacks within the harbors themselves. These can all be prevented by harbors defenses properly equipped and adequately manned. They cannot be prevented by any other branch of the service.

It is interesting to consider what could happen should Congress be so far influenced by statements now appearing in print as to do away with harbor defenses and to use our forts only for garrisoning

infantry or other troops. What would happen? Entire dependence would have to be placed in the Infantry and the Air Service. The Infantry would have to wait until the enemy came ashore or at least approached within range before it could combat him. Remains then only the Air Service. Picture the enemy fleet with its immense flotilla of transports lying three or four hundred miles off the Virginia Capes, and in such a central locality that it is impossible to determine whether it will strike at Boston; Providence; New York; The Chesapeake, with such cities as Baltimore, Washington, and Norfolk; at Charleston; at Savannah; or even along the Florida Coast. The enemy has its choice, and it leaves a long coast line for this country to defend. Would not many points be threatened before the real strike was made? Destroyer flotillas would be everywhere—few cities would escape. Possibly some morning peaceful Charleston would awaken to the screech of death dealing shells pouring forth from a half dozen swiftly moving destroyers, and its dead and dying, and burning city, would bear mute testimony of its undefended harbor. But the principal blow would be struck at one of the more northern cities. One hour of bombardment and New York would be in flames, and amid a fleeing, panic stricken populace, the enemy transports would quickly unload their hundred of thousands of troops at the multitude of docks, and our principal city, the very heart of our country, would lie stricken in the hands of the enemy. Financial, commercial, and manufacturing industries would be paralyzed. There would remain only to be decided the ignominious terms of peace. A great nation would at last awaken to the undefended condition of its harbors only to find itself the slaves of a ruthless enemy.

There is no desire to belittle any branch of the service. Each is an essential cog in the military machine that must be maintained if this country is to live in safety. But who can deny that, if our people are to be saved from the terror, disaster, and tragedy of war, the enemy must be stopped at our shores and not allowed to devastate our country? Moreover, is there anyone qualified to speak, who is prepared to state that coast fortifications are not absolutely necessary if a positive defense of our harbors is to be maintained? There is none such. In time a peace loving people will realize that harbor fortifications are essential if safety from foreign aggression is to be assured. Who knows the number of times that a nation with criminal intent has looked longingly toward this country, only to turn away regretfully, discouraged by the adequately manned harbor defenses that were formerly maintained?

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."—

JOURNAL U. S. ARTILLERY, June, 1922.

Work of the Board for the Month of December, 1923

A. NEW PROJECTS INITIATED DURING THE MONTH OF DECEMBER, 1923

Project No. 190, Ammunition for Antiaircraft Guns.—

DISCUSSION:

1. While the present consideration of antiaircraft ammunition problems is largely affected by the availability of common shrapnel manufactured on war time contracts, it is believed to be not too soin to consider a permanent policy to be adopted for future ammunition manufacture.

2. SHRAPNEL.

a. On May 24, 1918, recommendations were made from the office of the Chief of Antiaircraft Service, A.E.F., that the use of shrapnel in antiaircraft fire be abolished. This recommendation has been repeated at intervals, and is believed to be the policy at present. Briefly, this recommendation was based on consideration of results obtained both in physical effect (planes destroyed), and in moral effect on hostile aviators. While the danger volume created by a shrapnel is greater than that produced by an explosive shell of equal caliber, the locus of points of burst from which the plane will be included in the shrapnel danger volume is a narrow cone extending only in front of the plane. On the other hand the detonation of an explosive shell any place within its danger radius of the plane probably will result in a hit. The chances are so greatly in favor of the latter that the unquestionable superiority of explosive shell is easily demonstrated by reasoning as well as by the actual results.

b. There is believed to be on hand a large quantity of 3-inch and 75-mm. antiaircraft shrapnel. This ammunition is being used as target practice ammunition and it is very satisfactory for the purpose. Upon depletion of this stock, however, there will be no ammunition available for target practice purposes unless the manufacture of shrapnel be continued, since explosive shell cannot be utilized for target practice purposes for two essential reasons:—First, present regulations require crews of guns to take cover when firing explosive shell, and second, the danger to airplane pilots incident to the use of explosive shell would prevent firing at towed aerial targets, which is essential to the proper training of an antiaircraft battery. Thus it becomes apparent that the manufacture of shrapnel as target practice ammunition must continue unless some special ammunition be devised.

3. TARGET PRACTICE AMMUNITION.

a. The principal objections to the manufacture of a special type ammunition for target practice purposes have been that of the expense and incon-

venience of adding another type of ammunition and the necessity for different ballistic graduations on the fire control instruments. In answer to the first objection it is recalled from the preceding paragraph that this ammunition would displace rather than augment the shrapnel and furthermore its manufacture (as suggested in subparagraph b ante), would probably be less expensive than that of shrapnel. In refutation of the second objection it is noted that the *same ballistic graduations now apply equally to shell and shrapnel* and it should be practicable, therefore, to design the target practice ammunition with the same ballistic properties as the explosive shell.

b. No explosive or destructive properties are needed in target practice ammunition, but the point of burst should be well marked. A smoke producing mixture only should be liberated at the point of "burst." This would give added safety to gun personnel, air personnel and to the ground or water area over which the firing occurs. It would appear from past experiences that an orange smoke is most visible against the average sky, but this is a point for future experimentation.

4. EXPLOSIVE SHELL.

a. As discussed above, explosive shell should be used in all service firing and except for occasional experimental firings against material targets or to study the functioning of the ammunition, it would be fired only in time of war.

b. The efficacy of antiaircraft fire varies with the total danger volume that can be created in the air in a unit of time or, to consider that part of this factor controlled by the shell alone, with the effective danger radius of burst of the shell. The shell whose fragments fill the largest area is the most efficient. The target is fragile and no shattering or penetrating properties of the shell are necessary. The armored plane is armored only against attack from below and as now designed is equally vulnerable with unarmored planes to a burst above or at its altitude. From a tactical consideration, this type of plane generally will come within the defensive scope of the smaller arms, (Cal. 30 or 50 machine gun or 37-mm. gun). The volume made dangerous by the explosion of the shell, then, should be made as large as possible. It is believed that this volume can be increased by interior lamination of the shell to insure more even and greater fragmentation.

5. ILLUMINATING SHELL.

a. The value of illuminating shell against aircraft is questionable. The time of illumination is so small that continuous fire must be maintained for illumination. Furthermore, if the presence and position of an aerial target are sufficiently well determined to enable the illumination to be thrown over it, the time and power of the batteries would be better directed to its destruction rather than its illumination. To attempt to illuminate a plane within range would be a waste of vital time when other methods, namely, searchlight fire and fire by sound, are available to permit fire for destruction.

b. It is possible that the illuminating shell has a value for the illumination of terrestrial targets for either infantry or artillery and that such a secondary mission might be assigned properly to antiaircraft guns which would not be engaged normally in destructive ground fire. The Navy utilizes antiaircraft guns and illuminating shell in this manner. This particular question can be decided by test only.

6. INCENDIARY SHELL.

This type of ammunition has only one proper target—the lighter than air craft filled with hydrogen gas. The vulnerability of this type of air ships precludes, in general, its use within range of antiaircraft batteries. Furthermore, the probable future use of helium gas will render such targets non-inflammable. There remains only the observation balloon and these can be attacked by planes or destroyed or forced down by explosive shell. While incendiary shell would be more ideal for engaging this class of targets, it is believed the efficacy of explosive shell against it is sufficient to obviate the necessity for a separate class of ammunition.

7. CHEMICAL SHELLS.

a. The use of gas shells against aviators has been considered from time to time by various writers. At first glance the suggestion would appear practically valueless. The shell must burst immediately along the path of the aviator and the percentage of hits will be less accordingly, than with explosive shell. A light concentration would have no effect because of the dissipating effect on the gas cloud by the propeller. A heavy concentration would be dissipated by the propeller and if at all visible could be avoided by the aviator. The successful use of gas shells against aviators is too problematical to warrant deviation from the use of explosive shell.

b. Phosphorus shell might have a greater moral effect on an aviator than explosive shell. However, its destructive powers and range are considerably less. Its use does not appear warranted.

8. TRACER SHELL.

a. An antiaircraft tracer shell has been designed (Mark III). As now designed, that is, combined tracer and incendiary, its use comes within the scope of the discussion in paragraph 6 supra.

b. The use of a tracing composition in the base of all antiaircraft projectiles, however, probably will be of considerable value, if this can be effented without materially reducing the power of the shell. At any rate the value of tracers in antiaircraft gunnery should be investigated.

9. In summation it would seem that two types of ammunition and two types only are required for antiaircraft use, viz: explosive shell for all service conditions, and target practice shell for training conditions. In addition it may be that illuminating shell could be employed for the benefit of the infantry and artillery.

10. FUSES.

The desirability of a mechanical fuse has been sufficiently discussed in the past and is now the basis of future fuse design. The Mark II fuse, it is noted is not armed by rotation and can be fired, therefore, by striking the concussion plunger. To design the fuse to be armed by rotation is a safety measure which should be worth the added complication and expense involved. At least it should be considered seriously before the purchase of new fuses.

RECOMMENDATIONS:

1. The Board recommended that the following definite policy be adopted for the future manufacture of antiaircraft ammunition:

Ammunition for antiaircraft use to be of two types only, namely, explosive shell for service firing and target practice shell for training purposes.

12. That a target practice shell be designed as suggested in paragraph 3 *b* upra and that a number be sent to Fort Monroe for test. The test should include he determination of the best visible color so that the ammunition manufactured hould include various colors of bursts. White need not be included as the present hrapnel produces this color.

13. It was further recommended that the shells thus submitted for test be lesigned with a tracing composition in the base in order that recommendations on hat point may be made.

14. It was recommended that the Ordnance Department determine if it be possible to increase the destructive radius of the explosive shell as suggested in paragraph 4 *b*.

15. It was recommended that approximately 100 illuminating common steel shell, Mark V (A.A.) be shipped to Fort Monroe for a test to determine the efficacy of this shell in illuminating ground targets.

16. It was recommended that the question of designing antiaircraft fuses to be armed by rotation be considered in connection with future fuse design and manufacture.

B. Projects and Studies Completed During the Month of December, 1923

Project No. 79, Test of Modernized Sperry Searchlight Lamp.—The principal features of the New Sperry lamp that differentiate it from the old Sperry lamp which is standard for use by the Coast Artillery are as follows:

(1) A new thermostat and control system for the positive carbon having the lens mounted on the lamp column and a simplified thermostat mounted within the base of the lamp instead of being located on the projector.

(2) A new voltage regulator coil with compensating resistance having a flat temperature coefficient of resistance so that the old style arc length rheostat could be eliminated.

(3) Rigid cast, positive and negative electrode columns, designed to permit more accurate alignment of the electrodes.

(4) Worm type of feed in positive head, in place of star wheel feed.

(5) Insulated, cast metal, positive nose cap and tray light shield, eliminating the quartz bushing.

(6) A new type negative head with improved contact brushes so it is not necessary to use coated carbons, thus eliminating the trouble due to molten copper falling on the mirror.

Both lamps were tested by a photometer to determine horizontal and vertical widths of beams, point of greatest illumination, and proper setting of carbons to give greatest illumination.

The tests led to the conclusion that there is no appreciable difference in the illumination furnished by the old and new lamps. This is not due to the use of an exceptionally good old type lamp as three old type lamps were used.

It developed in all tests that the lamp tested later in the evening appeared slightly better than the one tested first and this fact is largely attributable to the improvement of atmospheric conditions with the time of night. There was less absorption and refraction of light in the last than in the first tests on the same night. During the test made on the night of October 8, 1923, the old lamp was run last and showed slightly better results than the new, the maximum intensities being respectively 104 and 90 foot candles. The width of beam was 10 degrees larger in the case of the new lamp. On the night of November 13, 1923, the new lamp was run last and appeared slightly better. Both lamps were tested on the same moving target and neither exhibited any marked superiority over the other.

Regarding mechanical features, the operation of the new lamp is more positively automatic than the old, no adjustment other than the initial one was necessary during the runs of March 26 to May 15, and October 8 to November 13. On the other hand the thermostat of the old type lamp must be set for each run, or at least its operation carefully checked, and it occasionally overfeeds. The new type lamp is free from these troubles.

The use of uncoated negative carbons is of no particular value for seacoast work, but is of considerable importance in antiaircraft work where the lamp is operated at high angles of elevation and molten copper from the copper coated carbons is likely to injure the mirror.

The new positive head with worm type feed is an improvement, but does not seem to make any material difference in the operation of the lamp insofar as steadiness in holding the positive carbon at the focal position is concerned. The elimination of the quartz bushing is an advantage as this bushing occasionally breaks in service, making it necessary to carry several spares.

The new arc voltage control coils function considerably better than those of the old lamp, which did not have a flat temperature correction thus requiring readjustment after the lamp has been run for a short time.

The omission of the occulter is justifiable. Tests on the old and new lamps showed that with the occulter the carbon glow was visible at a point 1000 yards away for 40 seconds, while the glow from the new lamp without occulter was visible for 75 seconds. The difference is not considered sufficient to justify the added mechanism to operate an occulter.

The rigidity of the column is of no great advantage in seacoast work, but even more rigid columns would be desirable for antiaircraft use.

While the new lamp is mechanically an improvement over the old type, the improvement is wholly mechanical and is not sufficient to warrant modification of lamps now in service for seacoast use.

It is believed that a lamp of the same general design as the new type lamp when placed in a light weight drum would be suitable for antiaircraft use.

No action toward modifying the lamps now in service was recommended.

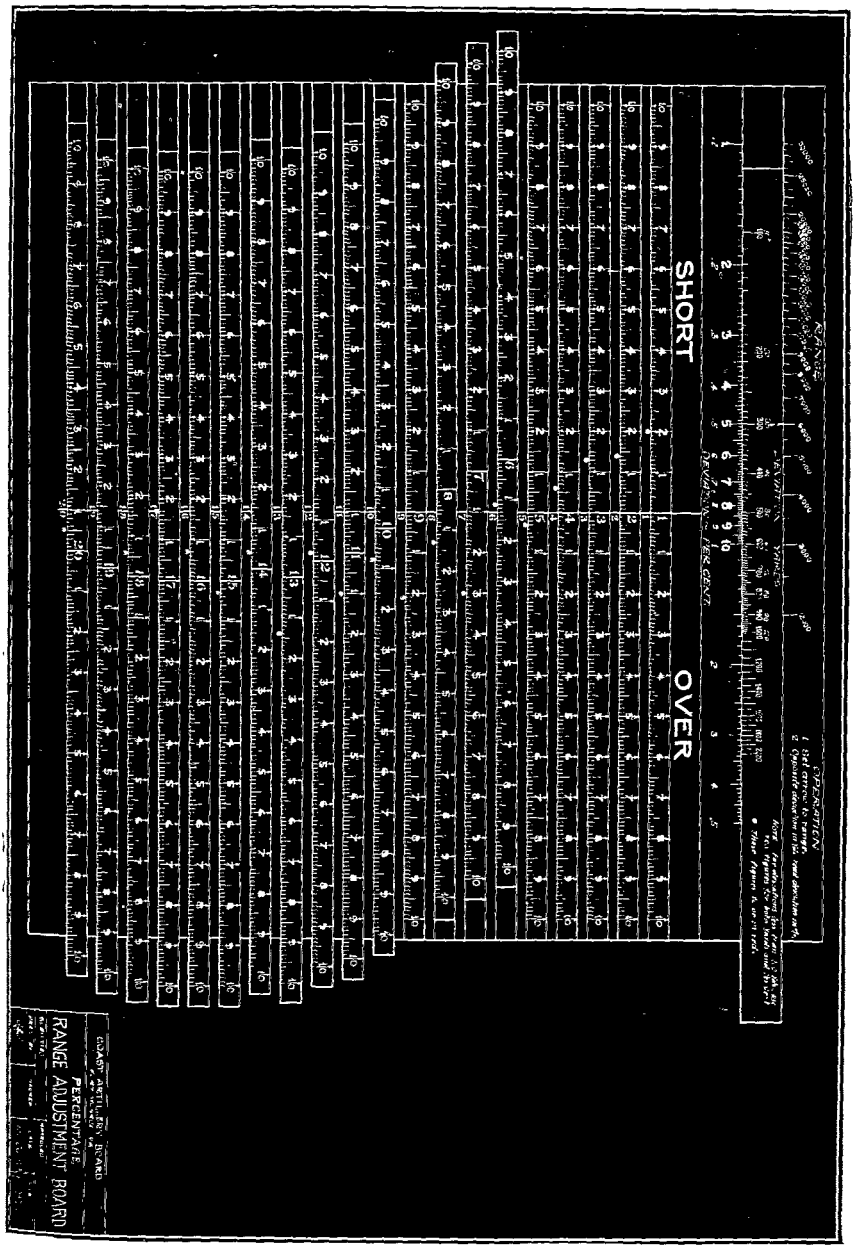
It was recommended that the new lamp be preferred in future purchase of searchlights.

It was recommended that the new lamp be retained at Fort Monroe in order that as much data thereon as possible might be obtained since this lamp will probably be the basis of future Sperry lamps, both seacoast and antiaircraft.

Project No. 122, Range Corrector for 155-mm. Guns, has been dropped as completed. A general idea of the design of this device may be secured from the Coast Artillery Board Notes in the July, 1923 issue of the Journal. A range corrector similar to the one described there has been made up in metal for the 8-inch Howitzer. This was reported on as Project No. 174, in the December, 1923 Journal.

Project No. 123, Percentage Range Elevation Device, has been dropped as completed. A description and discussion of this device is contained in the report on Projects 152 and 170 in the December, 1923 Journal.

Project No. 132, Range Adjustment Device.—1. PURPOSE. The device is designed to provide a means for determining quickly the approximate center of impact of any desired number previous shots, the deviations of which have been observed, and for exhibiting a record of both stripped deviations and of deviations from the expected range, as well as of the corrections applied as result of observation of fire.


SHORT
OVER
COAST ARTILLERY BOARD
RANGE ADJUSTMENT BOARD
PERCENTAGE

2. DESCRIPTION.

The device is constructed as indicated in Figure No. 1, except that the slides should be provided with some method of clamping them to prevent accidental displacement and consequent loss of the record. If the slide grooves were undercut, springs at the bottoms of the grooves should serve to hold the slides in place although a position clamp would be desirable also. In Figure No. 1, the device is shown with the slides set as they might be after 20 shots, (all of which have been spotted), from a gun or mortar, fired at such a rate and having such times of flight that the correction determined after the fall of any shot can be applied to the next shot but one.

3. OPERATION.

a. The device is not restricted to the conditions stated in the preceding paragraph. The operator of the board keeps the slides set to the last correction applied and plots such deviations as are observed with respect to that setting. Whenever the officer in charge desires to make a correction based on his inspection of the plot he moves the slide corresponding to the shot on which the correction will be applied to the desired position, that is, so that the normal of the slide is in the vertical line passing through the center of density of the more recent impacts. Whether he takes into consideration three of four, or more, of the last observed impacts is a matter of judgment, based on elapsed time, change in direction of fire, etc. If for any reason the correction actually applied differs from that determined in this manner the setting of the slide should be corrected to indicate the correction as actually made.

b. The device may be constructed or used either with or without the slide shown at the top of the board for converting observed deviations as determined in yards on a spotting board to deviations in percentage of range. In the first case the smallest deviations on the slides are taken as 1/10 of 1% and in the other case as 10 yards. If the conversion to percentage is omitted, corrections are determined in yards and called to the operator of the percentage corrector (described in report on Projects 152 and 170, Coast Artillery Board Notes, December, 1923 Journal), who moves his "read" pointer of the percentage corrector along the logarithmic tape in the direction and the amount corresponding to the change in the corrected range indicated by the correction ordered. The reading on the arbitrary correction scale then would indicate the total percentage correction which is applied as result of observation of fire. It would be somewhat more convenient, however, if the total correction from observation of fire be announced as a percentage correction, in which case he would keep his "read" pointer set to the reading on the arbitrary correction scale corresponding to the total correction due to observation of fire, as changed or adjusted from time to time. The main advantage of the conversion however, is one of accuracy. If, for example, five previous shots are to be considered in determining the correction to apply, an error of 30% or more in the magnitude of the resulting correction is possible with a fast moving target and slow rate of fire, due to basing corrections to be applied at one range on deviations which occurred at widely different ranges. This error is introduced in all methods of correcting fire at moving targets which apply a correction in yards based on deviation of previous shots determined in yards. While such errors are negligible for the rate of cnange of range usual in target practice against towed targets, they are large for targets capable of maneuvering at the speed of battleships or faster war vessels. The conversion of observed deviations

to deviations stated in percentages of the ranges at which shots were fired may be accomplished by the device at the top of the board without loss of time. If the sliding piece be set so that the arrow points to the range for which the piece is laid, the deviation in terms of percentage of the range may be read opposite the deviation as announced in yards.

c. In the example worked out on the board it is assumed that trial shots were fired at a range of 16,000 yards, the center of impact being 450 yards short of the target. This corresponds to a 2.8% correction which should be applied as an adjustment to the estimated velocity on the range correction board and appear in the setting of the ballistic correction pointer on the percentage corrector.

A rapidly moving target coming in at which shots or salvos are fired each minute as in mortar fire, is assumed. The range of the setforward points taken from the plotted course of a hypothetical target are as follows:

1.	16700	7.	13180	13.	10100	19.	7520
2.	16100	8.	12610	14.	9610	20.	7200
3.	15510	9.	12020	15.	9150		
4.	14930	10.	11530	16.	8710		
5.	14340	11.	11020	17.	8290		
6.	13750	12.	10530	18.	7900		

The first four shots are assumed to have the following deviations: –330,–210, –200,–90. The corresponding percentage deviations determined for the ranges at which fired from the device at the top of the board are:—2,–1.4,–1.3,–.6.

NOTE: If it be assumed that the velocity adjustments were based on three trial shots it may be accepted as good practice to apply no corrections until the returns from four shots have been received, providing no unusual delay has occurred.

As reports of these deviations are received they are marked by pins as indicated on Figure No. 1. Assuming that a correction based on the four deviations may be applied to the 6th round, slide six is moved so that its normal is at the mean of the four deviations. This operation is one of estimation, but the normal of the slide should not miss the arithmetical mean of the four deviations by more than one of the smallest divisions of the scale. Up one point 3 (1.3%) is ordered and applied on the percentage corrector. Shot five having been fired in the meantime without correction, its deviation is reported too late to affect the laying for No. 6. This deviation is over 30 yards, which is .3% of the range at which it is fired. If now the correction for shot No. 7 is based on the 5 shots which have been fired, the position of slide 7 is estimated and a correction "Up one point zero" is ordered, the indicated slight adjustment being made to the "read" pointer on the percentage corrector.

Any number of all of the previous shots may be considered in estimating a correction. In the example the 5 most recent shots only, are considered on the theory that the shots more remote in point of time are of less value as evidence of what may be expected of the next succeeding shots, than the more recent ones. Accordingly pin No. 1 is removed. It may be displaced by a pin of another color, or a mark may be made for record to indicate the deviation of the first shot, if desired. When the fall of No. 6 shot is reported, its deviation "150 over" or 1.1% is pinned at the point indicated to the right of the normal of No. 6 slide on the fixed rib below the slide as shown, and slide 8 is moved until its normal is on the vertical line passing through the center of impact of the previous 5 shots. "Up zero point 6" is ordered. In a similar manner the succeeding corrections are determined. The deviations and corrections are as follows:

Shot	*Yards*	*Percent*		*Shot*
7	over 400	3.0	Total cor. for	9, Zero correction.
8	over 150	1.3	" " "	10, Down zero point 4.
9	over 250	2.1	" " "	11, Down 1 point zero.
10	over 90	0.8	" " "	12, Down 1 point 2.
11	over 110	1.0	" " "	13, Down 1 point 6.
12	short 20	.2	" " "	14, Down 1 point 4.
13	over 140	1.4	" " "	15, Down 1 point 9.
14	short 40	0.4	" " "	16, Down 1 point 7.
15	over 30	0.3	" " "	17, Down 1 point 7.
16	short 60	0.7	" " "	18, Down 1 point 6.
17	short 140	1.7	" " "	19, Down 1 point 4.
18	short 50	0.6	" " "	20, Down 1 point zero.
19	short 150	2.0	" " "	21.
20	Hit	.	" " "	22.

d. Preferably the correction based on trial shots should be made as a velocity correction, if a range correction board be available. Subsequent corrections, if of considerable magnitude also may be applied as ballistic corrections. If no range correction board be available the mean deviation of the trial shots may be applied simply as a percentage correction since a percentage correction is very similar in effect to a velocity correction.

e. Whenever the correction from observation of fire is incorporated in the ballistic correction, the next succeeding deviations should be measured from the normal of the board until an additional correction from observation of fire is applied.

f. It is not necessary of course that a correction should be applied after every shot and it is not anticipated that in rapid fire all shots will be spotted; neither is it necessary to keep track of the serial number of rounds. So long as no correction is made the slides are set as shots are fired, to indicate the last correction made. (Note: It is not necessary that the number of slides set should correspond exactly with the number of shots fired). The deviation of the shots spotted are indicated by pins. Based on the plot of any number of recent shots a slide assumed to correspond to the shot next but one, or next but two, (or shot to which it is certain the correction can be applied), may be set to indicate the correction which will be applied to that shot. Until another correction is made, slides corresponding to subsequent shots are set to that same position. When no longer to be considered in future corrections, or for record, slides may be moved to the normal of the board.

CONCLUSIONS:

The Board is of the opinion this device is the most suitable of any thus far suggested for the purpose for which intended and that such a device is a desirable addition to the fire control apparatus of all batteries; that it permits an exercise of judgment in the number of previous shots which should be considered in determining a correction to apply to future shots, which is desirable; that the device may be used advantageously with any of the so-called "methods of adjustment of fire" and is particularly adapted to the method which appears most logical to the Coast Artillery Board, viz: A correction at any period based on the mean of the normal deviations of such number of previous shots or salvos as, after consideration of elapsed time and changing conditions, seem to indicate the most probable deviation of the next succeeding shots, if uncorrected.

RECOMMENDATIONS:

The Board recommended that a limited number of boards designed approximately as shown in the sketch with the addition of a suitable clamp for each slide be constructed by the Ordnance Department and issued to selected organizations manning different classes of armament for service test and report.

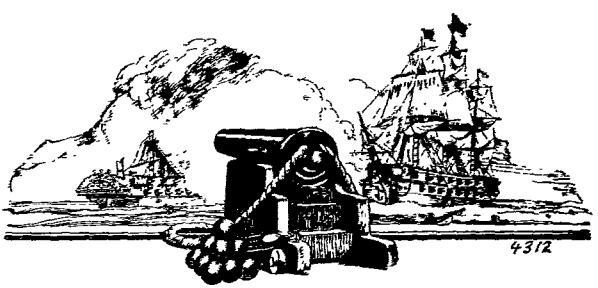
Project No. 157, Range Tables for 8-inch Seacoast Guns, M-1888, Mark I.—These tables are now in final form for reproduction.

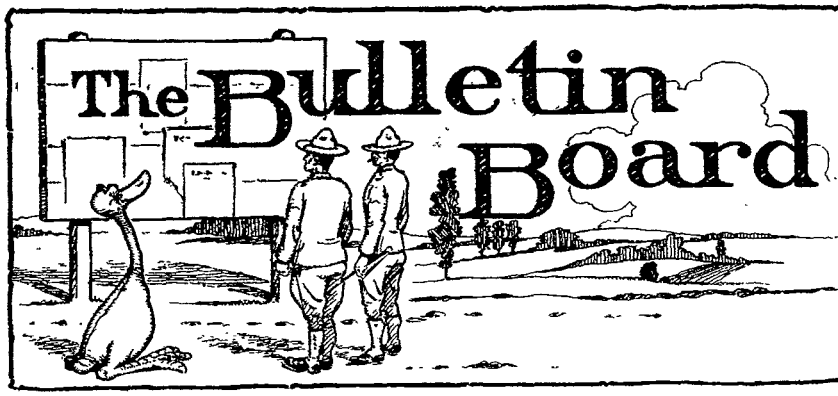
Project No. 162, Review of Training Regulations 435-Mine and Sub-Mine Target Practice.—The Board did not recommend any changes to be made in these regulations.

Project No. 164, Table of Asymptote Corrections as a Function of The Asymptote Angle.—This table has been prepared by the computing section and turned over to the Sound Ranging Company at Fort Eustis.

Project No. 178, Description and Sketch of the Cloke Plotting Board for Incorporation in Training Regulations 435-220.—Completed and forwarded.

Project No. 189, Test of Coast Artillery Signals.—The signals were designed to be visible at a range of 25000 yards even though the airplane from which they could be dropped would be invisible. The signals were in the nature of smoke bombs. Six of them were dropped from an airship at a range of about 15,000 yards from shore observers. Half of the signals were equipped with parachutes. None of the bombs were seen by all observers—only a few of the observers could see any of them, and those but faintly. The signals even at that range and under conditions of fairly good visibility could not be seen by base end stations and it was impossible to determine even their approximate range from shore stations. The Board was of the opinion that the results obtained with the six smoke signals dropped at 15,000 yards did not warrant test at greater ranges or further test at any range. As constructed they were of no apparent value for use by the Coast Artillery.





"Our Aim in the Military Service"

Address delivered to the Students of the Noncommissioned Officers School, Fort De Russy, H. T., January 5, 1923.

By Major W. K. Wilson, C.A.C.

EDITORS NOTE: *From time to time it has been suggested that the* JOURNAL *publish material suitable for five minute talks by officers to their commands.—This article fulfills such a need. More articles by the same author will appear in the near future.*

If you were to step out upon the parade ground, and fire a shot into the air with a small-arms rifle without first taking aim, you might possibly hit a target on the other side of the parade ground, but the chances would be very much against you.

That is not the way to hit a target. First, you must learn to aim the rifle; this requires many hours of diligent application. After you have learned to aim the rifle you must learn to pull the trigger without disturbing your aim; this again requires many hours of diligent application before you are ready to fire the shot that will hit the bulls-eye.

Once in a while, a man will succeed without having a definite aim in life, but he is the exception and not the rule. Man does not usually succeed in that way. As a rule, success comes only to that man who takes a definite aim in life, and who in spite of hard work and discouragement, never allows that aim to be diverted.

A very successful inventor said to me not long ago that he believed our colleges and schools spent too much time in teaching a man to earn money, and too little time in teaching a man something about "the philosophy of life."

By "philosophy of life" he meant a man's answer to the following questions:

Why am I here? (Meaning in the world).
How long can I reasonably expect to stay?
What can I accomplish during my stay here?

In other words by "philosophy of life" he had in mind the necessity for a man to have a definite aim in life in order to succeed. I think he was probably right, and that we do spend too little time in discussing this very important subject.

As we look into the subject we are brought face to face with one very impressive fact, and that is that our lives are short, and that we cannot afford to waste too much of our time.

Another fact which is sure to impress us is that time once past is gone forever, and while we may look into the past and profit by our own experiences, and by the experiences of others, we cannot recall for future use one single minute of time.

Our military service is but one phase of our lives, but it is a very important phase. Some of us may have entered the military service for one reason and some for another, but no matter what our reason for entering the military service may have been, we can all aim at a successful military career no matter in what grade we may be serving. After all, *success in the military service cannot always be measured by promotion, but rather by the consciousness of duty well done, no matter what the duty or in what grade performed.*

We are posing as the defenders of our country. We are honored by being allowed to wear the uniform. Our country is honored by every good soldier, and is dishonored by every soldier whose conduct brings discredit to the uniform he wears.

Your very presence at this school indicates that you have had an aim. If you have aimed too low, in the past, aim higher. If you are not yet a sergeant, aim for the sergeant's chevrons. If you are already a sergeant, make yourself the best sergeant in your organization. If you are already the best sergeant, in your organization, make yourself the best sergeant in the Army. Convince yourself and your commanding officer that you are better than the other man, and do not let him get higher than you simply because he aims higher.

You men have already taken your places in the military service as leaders of men. Your responsibility does not end on the drill ground. The men under you look to you for inspiration. Let me urge you to inspire in them the desire to do their best. Teach them to AIM.

This is especially important with reference to the new men joining your organizations. A man's whole attitude toward the military service so often depends upon his experiences in his first few weeks. Seek out the new men. If they have no ambition to do well, inspire in them the ambition to succeed.

When you refer to a man as a man of weak character, you mean a man with no definite aim in life, who always follows the line of least resistance. When you refer to a man as a man of strong character you mean a man who has a definite aim in life and who cannot easily be shaken from that aim.

In the military service we have become accustomed to using "character" as the measuring rod with which we size up a man. On an honorable discharge a man may be rated with character "Good," character "Very Good" or best of all character "Excellent."

All honor to the enlisted man who after 30 years' faithful service in the United States Army can enter upon the retired list with the following words inscribed upon his discharges: Character "Excellent," Service, "Honest and Faithful."

1924 Class, Advanced Course, Coast Artillery School

On January 4, the 1924 Class, Advanced Course, Coast Artillery School—The Field Officers' Course—assembled at Fort Monroe for six month's intensive effort under the following instructors:

Major William S. Bowen, C.A.C., Director of the Department of Military Art.

Major Charles E. Wheatley, C.A.C.; Major H. K. Loughry, C.A.C.; Major Fred H. Smith, C.A.C.; Major Carl F. McKinney, Inf.

The class was welcomed by Brigadier General William R. Smith, the Commandant of the Coast Artillery School, in an address which outlined the purposes

of the Course, the regulations of the School, and expressed the Commandant's welcome to the officers composing the new class.

The 1924 Class consists of forty-one officers—thirty-nine majors and two captains, of the Coast Artillery Corps. The majors include:

Earl Biscoe	Edward L. Kelly
Paul D. Bunker	Philip S. Gage
Walter Singles	Willis Shippam
James S. Dusenbury	Francis P. Hardaway
Edward J. Cullen	Frederic A. Price
Lloyd P. Horsfall	Edward P. Noyes
Alexander G. Pendleton	William D. Frazer
Paul J. Horton	Austin G. Frick
Robert Arthur	Fred M. Green
Albert L. Loustalot	Oliver L. Spiller
Edward W. Putney	John L. Homer
Louis L. Pendleton	George R. Meyer
James H. Cunningham	Harold DeF. Burdick
Raymond H. Fenner	Octave DeCarre
Edgar H. Thompson	Claude M. Thiele
Willis C. Knight	Avery J. French
Edwin K. Smith	Alden G. Strong
Frank S. Clark	Otto G. Pitz
Eli E. Bennett	Stewart S. Giffin
	Eugene Villaret

The two captains assigned to this Class are:

John F. Kahle	Charles W. Bundy

The scope of instruction is but little different from that obtaining in previous years, the Courses and the approximate number of periods to be devoted to each being as follows:

Military Topography	17
Tactics of Other Arms	48
Combat Orders	21
Field Fortifications	14
Military History	14
Military Organization	13
Tactics and Technique of Artillery	61
Tactics and Technique of Antiaircraft Artillery, Machine Guns, and Searchlights	12
Seacoast Defense	12
Artillery Staff Duties	13

In addition to the subjects of instruction just outlined, the course includes instruction in equitation on two days of each week. This instruction is under the direction of Major Oliver L. Spiller, C.A.C., a graduate of the Mounted Service School, who has had charge of equitation instruction at the Coast Artillery School during the last five years.

The Class has effected an organization with the following officers:

President	Major Biscoe
Vice-President	Major Bunker
Secretary	Major F. M. Green
Treasurer	Major Cullen

No Haven for Crooks

Reprinted from The Fort Sill Guidon

The fact that the Army is not a haven for persons of suspicious character, or ever has been, is apparently unknown to some civil officials.

The Kansas City Journal recently published a front page story headed, "Jailed Negro Sees Haven in Army Life." The Chief of Police of Kansas City, Mo., is alleged to have more or less advised a negro, who was held as an undesirable character, to enlist in the Army.

Lt. Col. J. G. Pillow, executive officer at General Service Schools, Ft. Leavenworth, Kansas, saw the article and at once forwarded the following letter to the Chief of Police:

"October 18, 1923.

"The Chief of Police,
"Kansas City, Mo.
"Dear Sir:

"In the article herewith entitled 'Jailed Negro Sees Haven in Army Life,' which appeared on the front page of the Kansas City Journal of this date, you are reported to have said to one John A. Pruett, 18-year-old negro, a suspicious character held in the Kansas City jail charged with theft, that if he will join the Army you will exonerate him of the theft charge.

"If you have been correctly reported in this matter, please be advised that you have done the enlisted men of the Army a grave injustice. Your Army is not made up of thieves, thugs or suspicious characters, but of honorable men, clean, upright, wholesome, who are conscientiously striving to provide for their country and yours a system of national defense for the protection of you and your fellow men.

"It is sincerely hoped that you have been incorrectly reported in this matter. If so, it is earnestly requested that you bring that fact to the attention of the Kansas City Journal with request that your refutation be given the same degree of prominence and publicity as that accorded the original article.

"J. G. PILLOW,
"Lt. Col. Cavalry, D.O.L.
"Executive Officer."

An Enlisted Man's Opinion of the Coast Artillery Journal

Fort Wm. McKinley, P. I.
December 3, 1923.

The Editor,
Coast Artillery Journal,
Fort Monroe, Virginia.

Dear Sir:

I am inclosing $3.00 (money order) for which please continue my subscription to the JOURNAL for 1924. I find the COAST ARTILLERY JOURNAL indispensable for even an enlisted man who desires to keep abreast the times in artillery matters.

(Sgd) SGT. E. R. COLLINS,
Hq. Det. and Combat Train, 60th Arty. Bn.,
Fort Wm. McKinley, P. I.

Major G. A. Taylor, F. A., to Officers of Rhode Island National Guard

In the last issue of *The Tank* I expressed the hope that we would have a successful tour of duty at Fort Wright. My hopes have been more than realized. For the first time since the World War all companies, including those assigned to mortars, fired their full practice at moving targets. The demolition of the material target by the Woonsocket company is known to all.

The fact that we adjusted our fire by means of aerial observation is now known all over the country, owing to notices in the service papers. We should be particularly proud of this feature of our field training, because its importance has been recently emphasized by the Chief of Coast Artillery.

The results attained at camp could not have been accomplished without the co-operation of every officer and man, and I wish to express my commendation of the work done at the batteries, the cleanest of camps, and the finest of train discipline.

One never knows just how things are going to break at a camp, so much depends on the weather, but the elements were good to Rhode Island, and we did not have to push our projectiles through the fog.

Now that the armory drill season is on, we must not rest on our laurels or our oars, but buckle down to business again. I for one hope that every man will bring a new recruit to his armory, so that there may be no gaps in the ranks, and help teach them what he has learned. That is how we can make one component of the Army of the United States the success it deserves to be. May fortune smile on your banners and battery guidons during the coming year.

"Secretary Weeks Reports, Sir"

The Secretary of War submitted his annual report on the affairs of the Army. It was at once a report and a warning to Congress not to take another slice off the War Department's proposed allowance for next year—an allowance already pared by the Budget Bureau.

Mr. Weeks' chief recommendations:

Increase the maxium enlisted strength of the Regular Army from 125,000 to 150,000.

Increase the maximum enlisted strength of the Regular Army from 125,000 to 13,000.

His reasons and justification:

Our foreign garrisons are cut to a "dangerously low limit." The Regular Army at home is strained by the effort to furnish instruction to civilian training camps. "As a result the morale of the Regular Army . . . . . is below what we should demand of it."

"Since 1921 the total number of individuals under military training or in military organizations has decreased from 519,041 to 504,010."

The cost of maintaining our Army is about $2.34 per capita of the population.

The total cost of Army, Navy, and Marine Corps is only 14% of our total budget; the actual expenditures of the Army only 6%.

"In one year we spend six times as much for soda and confections as we spend for military purposes, for tobacco nearly four times, for perfumery, jewelry

and other items of adornment nearly five times, and for theatres, cabarets and similar amusements more than three times. Military preparations cost us, roughly, one-eighteenth of what we spend for luxuries, amusements and mild vices."

If every taxpayer "purchased each year for his own protection an Army automatic pistol the total expenditure would be more than the cost of the Army."

Estimating our national wealth as $400,000,000,000.00 we have only one soldier for each $2,500,000.00. The following nations maintain one soldier for the following amounts of their wealth:

Great Britain	$250,000.00
France	133,000.00
Italy	120,000.00
Japan	90,000.00

Considering our Army and Navy expenditures as "defense insurance," the premium rate is only $1.50 per $1,000.—*Army and Navy Journal.*

Alibi

And speaking of the deadly alibi, General White, in an address before one of the organizations recently, had this to say on the subject, which the Guardsman thinks well worth repeating:

"The greatest stumbling block in the way of a successful National Guard company can be set out in one word.

"That one word gives the cause of most of the failures in the world. It has wrecked more careers, more institutions and more enterprises than any other weakness known to frail human nature.

"Wherever you find a company on the ragged edge of failure you will find that same insidious word marching at the head of the column and scattered through its ranks.

"Whenever you find an officer or man whose performance of duty is indifferent or unsatisfactory you will find that word on his lips.

"If he lapses into that degree of utter worthlessness which makes it necessary for higher authority to put him out of the service, for the good of that service, he leaves with the fatal word on his lips and seeks to broadcast it to the world.

"But all the world knows the word and the man who applies it only advertises his own terrible weaknesses.

"The word will forever be the comforter of weak men and failures.

"If he is an indifferent company commander, who has not the support of his community, he seeks refuge in that word.

"If he is too lazy or conservative to ask for the cooperation of the press in support of his organization, the fatal word is his companion.

"If he leaves things to chance, rather than to plan, the word rallies to his rescue when disaster or censure overtakes him.

"We believe the word has killed more men than war and whiskey combined. At least killed their usefulness.

"And that word is *alibi.* I use it in its colloquial military sense of offering some graphic excuse for failure to make good.

"Kick it out of your vocabulary before it destroys you."

—*The Oregon Guardsman.*

PROFESSIONAL NOTES

The Battleship of the Future

Now that bombing battleships has become a pastime of our air service, the question of ship design grows vital. The recent commissioning of the gigantic superdreadnaught *Colorado,* one of our last two battleships for fourteen years, raises in the press anew the question of what the warships of the future will be. Powerful critics maintain that the day of the battleship has gone by. Yet strangely enough they note that the outstanding feature of last year's Washington Conference is that it evolved the definite decision that naval power shall be measured (till 1936 at least) in terms of capital ships. "The battleship still remains," Great Britain's First Sea Lord is reported to have said, "the ultimate basis of sea-power." One of England's foremost technical designers adds: "A remarkable fact of the present position is that, notwithstanding criticism leveled at the retention of battleships, the majority of the great Naval Powers have come to the conclusion that battleships must be retained as forming the great bulwark of protection." What, then, will the battleship of the future be like, and how is it affected by the Washington Conference.

It will be remembered that besides limiting the total tonnage of the Powers in capital ships, the Five-Power Treaty also fixed the maximum tonnage per ship at 35,000 tons (exclusive of fuel) and the maximum gun caliber at 16 inches. That this involves a sacrifice in one or more of the three principal factors of armament, speed, or protection, seems to be the opinion of the naval experts who were already planning a 57,000-ton battleship as the ideal post-Jutland type. In an article in "Brassey's Naval and Shipping Annual" on the "Washington Conference and Naval Design," Sir George Thurston, the distinguished naval architect, after declaring that "35,000 tons is not sufficient," gives as "paramount features" which must be kept in mind whether the design is the 35,000-ton "Conference" type or any other: High speed; Longest possible range for guns; Increased rapidity of fire; Improved adjustment of fire; Increased deck armor against airplane; Vitals well away from sides; Multiple watertight compartments; Central control for shifting balance of water in flooded compartment.

Now that the "ideal battleship" has for the next ten years been ruled out of court by the Washington Pact, he goes on to say, all that can be done at present is to arrive at some approximate idea of what we can do with the available opportunities in armament, propelling machinery, protection, distribution of weight, and types of battleships. The maximum caliber of the primary gun being fixed at 16 inches, and with "no immediate prospect of any appreciable reduction in the present weight of primary guns and mountings," notes the writer, the problem of armament involves mainly the number of 16-inch guns which can be carried on

the assigned displacement. The question of whether to mount two or three such guns in one turret, he dismisses as follows:

"There is an appreciable advantage to be gained in weight by adopting the triple mountings, for three triple-mounted barbettes can be fitted on the same weight as four twin-mounted barbettes, if total number of rounds for all guns remains constant. In view of a 12½ per cent. increase in broadside fire and a 50 per cent. increase in ahead fire in the fitting of triple-mounted primary guns in three barbettes, we may consider their adoption as inevitable."

Antiaircraft guns would, of course, be necessary, but with the remark that battleship torpedoes had not the remotest influence on any naval battle in the last war, we are told that: "The fitting of torpedo equipment to either battleships or battle-cruisers is an entirely useless and expensive luxury." The writer apparently is not as partial to electric drive as experts in the United States, but he thinks the question must, however, receive "very serious consideration" since it undoubtedly lends itself to a distribution of machinery further away from the sides of the ship and the point of underwater attack. As for armor, experience at the battle of Jutland has shown the necessity of a high percentage of protection. The maximum figure for the future battleship, says he, will probably be about 35 per cent., making the armor and protection of the 35,000-ton battleship approximately 12,250 tons. Any reduction for increased speed or gun-power must be arranged for by unequal distribution of thickness over magazines, machinery, etc. So he works out the distribution of weight thus in the 35,000-ton "Conference battleship":

1.	Armor and protection	12,250 tons
2.	Hull and fittings	12,600 "
3.	Equipment	1,000 "
4.	Armament and propelling machinery	9,150 "
		35,000 tons

Now the heart of this whole question lies in the way in which the 9,150 tons allocated to armament and propelling machinery, and the allowance for protection are divided up. Within the terms of the Washington Pact, as indicated above, the signatories have three choices indicated by Sir George Thurston. They may construct a battleship with:

(A) The greatest number of large caliber guns with maximum protection and moderate speed.

(B) High speed with adequate armor and a restricted number of guns.

(C) High speed with maximum gun-power and much reduced armor.

As far as appearance goes, types "A" and "C" would look much alike, but type "B," would probably be a very different affair.

It is well to note, he adds, the unlikelihood for the present of any battleship being constructed along lines so unprotected as those of type "C." Of the remaining two types, "A" and "B," it may be added that our own *Colorado,* just completed, approximates the first, where gun-power predominates and armor-plate is heavy, and the famous British *Hood* corresponds more nearly to the second, where high speed is the important factor, adequate protection is maintained, but gun-power is somewhat reduced.

But what about the airplane? In all this, how much attention is being paid to an agency which in the last few years has destroyed battleship after battleship, striking from thousands of feet up in the sky? The "experimental" battleship described herewith is the answer, maintains the naval architect we have been

quoting. For if the only adequate protection against airplanes is airplanes, this vessel carries its own swarm of protecting wasps. Astonishing though it may look, such a battleship may be constructed, we are told, within the 35,000-ton limit, with a speed exceeding 30 knots, the strongest possible deck and side armor-plate, and three 16-inch triple-mounted guns. It is, in other words, a combination airplane carrier and battleship, with a speed of 30 knots. As here planned, her upper deck forms two great platforms, one for the launching, and the larger for the landing of aircraft. The funnels and deck casings are gone, smoke and other products of combustion being conducted overboard through ducts swept by water from the circulating pumps. Funnels, of course, could be located on either side of the cleared deck space, if the other idea is considered too radical, but the funnel-free space is without the serious air disturbances which have hitherto made airplane landings dangerous. The lack of vibration from heat exhalation would also do away with the present main hindrance to accurate sighting of antiaircraft guns.

This "solitary and powerful unit," says the designer, might form part of a battle fleet, or go on emergency duty alone. She would carry within her the planes necessary for scouting, gun-spotting, or torpedo and bomb-dropping. Since in the naval battles of the future, "contact with the enemy will be made in the first place by aircraft or light cruiser squadrons," thinks another writer, this strange vessel might easily "prove the determining factor in a naval action where the issue hangs in the balance."—*The Literary Digest.*

French Coast Defenses

Coastal defense is being organized on practical footing all along our coasts. Long-range (sixty kilometers) 450-mm. guns defend the approaches to Toulon and are also to protect the Dover Straits, Brest, and Bizerta, in conjunction with 340 and 350-mm. batteries that are already installed. This artillery defense is being constituted on scientific lines. Range is of no use without adequate means of detection and of locating enemy ships, especially by night; and so lighting shells and bombs, as well as aerial searchlights, are being improved by constant experiments. Special shells with tremendous exploding and asphyxiating power are made to burst on striking the water, so that no projectile be lost that happened to fall near the target. Fire-director's tactics are used in launching salvos of four guns over an enemy; and it is believed no super-dreadnaught would survive the greeting of four projectiles of 1,500 kilos (18-inch caliber), or even of four of 600 kilos (13.4-inch caliber). Sighting appliances, so long neglected in the French Navy are the object of special studies. On the other hand, various camouflage devices are being prepared to prevent enemy seaplanes detecting our heavy coastal batteries, that are, besides, to be made proof from bombing.

Thus, enormous strides have been made since the war, when inferior Army guns, with a range of 9,000 meters, and so-called *obus-torpilles* Perruchot without much value were the only coast defense and all French harbors could have been bombarded with impunity from the high sea. Today the radius of action of long-range batteries *cotieres,* supported by guns on rails or trucks, have been so well calculated and provided for that bombardment by battleships and cruisers or landing on the French coast would prove operations extremely risky. The drawback of this comprehensive organization is its high cost in money and also in men. Ballistic experts are enthusiastic, but not so naval men, who by training are believers in the value of offense on the high sea. The latter remark that all that

brick and mortar or cemented armor policy, all that inert defense, is nothing but make-believe, would be powerless to ensure safe communications with French colonies, and is in reality a source of weakness, absorbing finances that could be and ought to be employed to better advantage. They consider that under-water and aerial flotillas, ever in progress in the matter of training, are the only defenses that count for the French coasts, and mostly because they are in reality mobile offensive forces possessing radius of action sufficient for work in narrow seas.—J. B. Gautreau, *Naval and Military Record,* 19 September, 1923.

Radio

STANDARD FREQUENCY RADIO TRANSMITTING STATIONS

If every radio transmitting station maintained exactly the wave frequency assigned to it, there would be available a standard frequency wave every time any station was in operation. However, at present this is the case with only certain stations, and because it is a matter of difficulty to maintain exactly the assigned frequency, and also because this is of great importance, the Bureau has been collecting some interesting data on the subject. As a result of these measurements it is possible to give out information from time to time on stations which maintain a sufficient accuracy to be useful as frequency standards. Several stations, which use special means for maintaining constant frequency, have very nearly attained the goal of remaining within two kilocycles of the assigned frequency, as recommended by the Second National Radio Conference.

At this time it is possible to give data on the following stations, the transmissions from which may be used in standardizing wavemeters and other apparatus, by the methods given in Bureau of Standards Letter Circular 92, "Radio Signals of Standard Frequency, and their Utilization." Data on other stations will be issued from time to time as the work progresses.

Station	*Owner*	*Location*	*Assigned Frequency kc*	*Period covered by measurements*	*Number of times measured*	*Greatest deviation*	*Average deviation*
WQL	R.C.A.	Coram Hill, L. I. New York	17.13	Aug. 24-Oct. 12	16	1.2%	0.3%
NSS	U.S.N.	Annapolis, Md.	17.48	" "	30	0.5%	0.2%
WQK	R.C.A.	Rocky Point, L. I. New York	18.21	" "	22	0.4%	0.2%
WGG	R.C.A.	Tuckerton, No. 1, N. J.	18.85	" "	36	0.4%	0.1%
WSO	R.C.A.	Marion, Mass.	25.80	Aug. 27-Oct. 12	36	0.6%	0.2%
WGY	G.E.	Schenectady, New York	790.	June to Oct.	34	0.5%	0.2%
KDKA	W.E.M.	E. Pittsburgh, Pa.	920.	" "	30	0.6%	0.3%

R.C.A. = Radio Corporation of America
U.S.N. = U. S. Navy
G.E. = General Electric Co.
W.E.M. = Westinghouse Electric & Mfg. Co.

A METHOD OF MEASURING VERY SHORT RADIO WAVE LENGTHS AND THEIR USE IN FREQUENCY STANDARDIZATION

A paper by F. W. Dunmere and F. H. Engel, describing one method of establishing frequency standards employed by the Bureau has recently been published in the Proceedings of the Institute of Radio Engineers (p. 467; October, 1923). The method described is based on the direct linear measurement of the wave length of very short standing waves on a pair of parallel wires. The wave lengths measured were from 9 to 16 meters, the currents having frequencies from 33,000 to 19,000 kilocycles per second. The apparatus for generating these ultra-radio frequency currents is described, as well as the details of the method used in measuring the length of the waves which they produce on the parallel wires. A method is also described for calibrating a wavemeter at frequencies from 30,000 kilocycles to 352 kilocycles (10 to 850 meters). This method makes use of the harmonics in a second radio frequency generating set, one of which, when combined with the output from the ultra-radio frequency generating set, produces a beat note in a receiving set tuned to the ultra-radio frequency. The zero beat note method is used to obtain an exact setting.

DESCRIPTION OF A SERIES OF SINGLE-LAYER INDUCTANCE COILS SUITABLE FOR RADIO-FREQUENCY STANDARDS

The radio laboratory of the Bureau of Standards has prepared Letter Circular No. 103, "Description of a Series of Single-Layer Inductance Coils Suitable for Radio-Frequency Standards" which give specifications for the construction of a complete series of single-layer inductance coils suitable for radio-frequency standards. The series consists of seventeen coils having a constant ratio between the successive values of inductance, and the coils are designed to cover the inductance range from 8 to 5000 microhenries.

TESTS OF RADIO RECEIVING SETS (III)

The results of tests on radio receiving sets made by the Bureau of Standards are given in a series of letter circulars now being issued. The first of this series is Letter Circular No. 90, which gives results of tests on certain electron tube receiving sets. The second, Letter Circular No. 93, describes the results of tests on receiving sets using crystal detectors. The third paper of the series, Letter Circular No. 102, has just been issued and describes results of tests on a number of short-wave regenerative receiving sets. It is believed that the methods followed and the examples given in these reports will be of assistance to manufacturers in the development of methods of testing and describing and improving their products. The particular receiving sets are referred to by arbitrary reference numbers rather than by a statement of the manufacturers' names and type numbers.

These letter circulars have been issued in mimeographed form, but a limited number of copies are available for distribution to testing laboratories, manufacturers, and others who can show that they are directly concerned with the testing of receiving sets. Requests should be addressed to the Bureau of Standards, Washington, D. C.

SOURCES OF RADIO INFORMATION

A considerable number of inquiries received at the radio laboratory of the Bureau of Standards call for similar elementary information regarding radio publications, radio laws and regulations, station and operator's licenses, and

call books. In order to facilitate the handling of these inquiries, Circular No. 122 was prepared and recently revised. The new edition gives the more important radio periodicals, lists the important Government radio publications, and the radio books of general interest issued by various publishers, gives a brief summary statement regarding the radio laws and regulations of the United States and Canada, and gives a map showing the radio inspection districts. A copy of the second edition of Bureau of Standards Circular No. 122 may be purchased for 5 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

REGULATIONS FOR RADIO ANTENNAS

It is intended to include in the next edition of the National Electrical Safety Code some regulations for the construction of outdoor radio antennas. A subcommittee to deal with this subject held its first meeting at the Bureau of Standards on October 19 under the chairmanship of L. E. Whittemore of the Department of Commerce. Other members of the Committee are C. K. Ahearn, Superintendent of Fire Alarm, Waterbury, Conn.; H. J. Burton, Consumers Power Company, Jackson, Mich.; L. W. Chubb, Westinghouse Electric and Manufacturing Company; J. A. Cook, New York Edison Company; W. M. Craft, American Telephone and Telegraph Company; J. H. Davis, Baltimore and Ohio Railroad; and H. C. Wolf, Maryland Puplic Service Commission. Messrs. Guthrie, Doyle and Tesch of the Radio Corporation of America and Messrs. C. B. Jolliffe and M. G. Lloyd of the Bureau of Standards were also present at the meeting.

The Committee outlined proposals for the regulation of antenna construction and after further consideration these will be reported to the large Sectional Committee which is carrying out this revision of the Electrical Safety rules according to the procedure of the American Engineering Standards Committee.—*Technical News Bulletin No. 79 of the Department of Commerce.*

The Military-Political Situation in Great Britain

Translated by Col. Ruhlen, U. S. Army, Retired

The impression that Great Britain has reduced its military power too soon to the ante-war status is beginning to dawn but adequate measures to combat the spreading imperialistic measures of France are as yet only dimly perceptible.

The designation "expeditionary corps" is no longer heard, but that has no perceptible significance. That formation now comprises the 108,000 men in the home country. Aside from these there are: the Rhine army, 11,000 men; on the Mediterranean, 4,000 men; in Turkey, 5,000 men; included are: in India, 71,000 men; in Irak, 2,000 men; in China and other Asiatic possessions, 5,600 men; in Egypt, 13,000; in the West Indies, 2,000. The army in the Irish Free State consists of 50,000 made up of sparingly trained men. When the fighting forces of the Dominions, militia, colonial colored troops that have not been included in this enumeration, are considered, it is evident that Great Britain has endeavored to hold its standing as a world power, as far as regards land troops, with a minimum of forces, and has even thought to enlarge it, although its world political standing is based upon the impotence and rivalries of others rather than upon its own military power. History teaches that this has always been the case, hence it does not occasion much concern in England. In fact the army estimate for 1923-24 has been cut from 62.3 million pounds to 52 millions. If we would not assume that

there has been an unexplained and unaccounted for expenditure heretofore at various places, the saving can be effected only by circumscribing expenditures in the military establishment. A reduction of 10 million pounds can be accomplished only by a very judicious redistribution of the army units, reduction of personnel of staff and administrative bodies, etc.

The development of flying and air ship systems is an important question for the land defense. It is admitted by all parties in parliament and throughout the land, that Great Britain has been negligent and has been surpassed in that respect especially by France, to an extent causing anxiety and that a change is being demanded. The organization of the air service arm as well as the increase of the flying branch and its apparatus calls for attention. It has been a subject of discussion whether or not an organization of an air service force wholly independent of the army and navy may be expedient. To what an extent rivalries that are unavoidable wherever men are working together would be diminished, is an unsolved question. The question in regard to the extent to which expenditures on the fleet can be reduced because in future a part of those expenses would fall to the air forces, is intimately connected with the proposed organization. Up to the present government appears to incline to the view of standing by the independent air forces as an auxiliary to the army and navy. The budget for 1924 has already anticipated an increase of the air force because eighteen squadrons are to be added for 1925, thus reaching an establishment of fifty squadrons in round numbers. This year seven squadrons are to be made ready for service at home and three for the fleet. But these figures cannot possibly effect an equality with the French air fleet. It is therefore intended to bring about a further increase, namely: thirty-four squadrons of twelve flying craft each so that eighty-four squadrons in all will be available and the number of craft ready for flying service will be increased from five hundred and seventy-six to one thousand. General expressions given out in parliament and in the press, that these increases are not directed against France, but that Great Britain cannot possibly remain behind other powers, friendly or otherwise, are naturally unworthy of attention and are intended only for those simpletons who believe that, "after having eradicated" the accursed German militarism" we are on the way to a universal and everlasting peace.—*Militar Wochenblatt.*

Record Week's Traffic Through Canal

During the week from December 2d to the 8th, inclusive, there were 52 transits of the Canal from the Pacific to the Atlantic and 72 from the Atlantic to the Pacific, a total of 124 transits. In this number are included one United States government vessel from the Pacific to the Atlantic, and two small launches and 4 United States government vessels from the Atlantic to the Pacific, leaving 117 commercial transits for the week. This is a daily average of commercial transits of 16.71 and on all transits of 17.71 and is believed to be the largest week's business since the opening of the Canal.

The Panama Canal net tonnage for the week was 622,323 tons, tolls collected $571,665.45, and cargo carried 646,499 tons. Daily averages for the week were: Net tonnage, 88,903 tons, Panama Canal measurement; tolls, $81,666.49; cargo carried, 92,357 tons. At such a rate, traffic in a month of 31 days would amount to 518 commercial vessels, $2,531,661.19 in tolls, and 2,863,067 tons of cargo.—*The Panama Canal Record.*

BOOK REVIEWS

Les Chemins de Fer Francais et la Guerre. By Colonel Le Hénaff and Captain Henri Bornecque, with preface by General Gassouin. Librairie Chapelot. Paris, 1922 6½" x 10". Paper. 276 pp. 8 illustrations, 27 maps and plates, and one folder map.

A great number of books have been published since the Armistice, having for their subject the activities and uses of railways during the war. The authors have nearly always presented the subject from a purely technical point of view, and their works, founded principally upon statistics, have usually considered only a certain aspect or a limited section.

A study of the general position of the railways, with relation to the military organization of the transportation service itself, as well as with the requirements of the military command, and with the necessities of the armies and of the interior, could only be presented by officers familiar with the military and technical organization of the sections, who have lived in the surroundings of the High Command, either of the Armies or of the Interior.

No one has been better prepared to undertake such a task than either Colonel Le Hénaff or Captain Bornecque. Military commissioner of the Eastern Region at the beginning of the war, afterwards Director of Railways of the Armies at G. H. Q. for nearly three years, Colonel Le Hénaff had in this capacity the responsibility of preparing the transportation plans and supervising their execution in the Zone of the Armies during the most critical periods of the war.

Captain Bornecque, a professor of the Faculty, brought the cooperation of his critical judgment and acquired experience to the Fourth Bureau of the General Staff of the Army, where he had occasion to demonstrate his ability and knowledge in supervising, during the greater part of the war, the entire transportation service.

The present work is therefore the most complete study of the subject which has yet appeared, and is a truly historic document which may well be consulted by all those who are interested in the history of the Great War. The book, after a preliminary analysis of the organization of the military railway service and the modifications made therein during the war, is divided into three parts, one each of which is devoted to the French, British and American transportation services.

The study of the French service, which naturally occupies the major portion of the book, is subdivided into three periods. The first of these periods, called the War of Movement, covers activities from July 23 to the end of November, 1914. The second period, the War in the Trenches, comprises a detailed study of the railway transportation situation from immediately after the first Battle of the Marne to the beginning of the great Allied offensive in 1918. The third period,

the Resumption of the War of Movement, covers the movements during the Allied offensive, concluding with the period of demobilization and deconcentration. The second part, devoted to the British railway transportation service, is similarly divided into three periods. The first is the period of preparation and centralization, the second until the Battle of the Somme, and the third from the Somme to the end of the war.

The American service is considered somewhat differently. First, the general considerations affecting the American transportation service in France are taken up in some detail. Thereafter are considered the necessary preliminary measures taken, the selection and adaptation of ports, lines of communication, and the necessary construction. After a detailed study of the organization effected, the execution of the plan is reviewed, giving a comprehensive study of the problems met in maintaining transportation to and from the front.

Artillery Fire Control—Observed or Calculated. (*"Le Reglage Muet ou Calcule du Tir de l'Artillerie."*) By Gen. Challéat. Berger-Levrault Co. Paris, France. 1923. 5½" x 9". Paper. 52 pp. Price, 2 francs.

Gen. Challeat undertakes to compare mathematically the two principal methods of fire control for artillery fire; that which is adjusted by observation, and that which is carefully computed and fired without further adjustment.

Taking each class of fire as a separate problem, he deduces the following: 1. (a) Against a zone covered with personnel in the open, ammunition consumption for calculated fire is 50% greater than for observed fire. (b) Against protected personnel the ratio is even greater. However, this more costly method may be justified by the strategic aims of surprise, provided the duration of fire is short.

2. For counter-battery and against wire entanglements, observed fire is the only practicable method.

3. (a) Against communication trenches observed fire requires 60—100 shots, whereas computed fire requires 240—400 shots. (b) Against front line trenches observed fire requires 3—6 shots per linear meter, against 7—14 shots for computed fire. (c) Against machine gun nests, P.C.s and for destruction of houses computed fire is impracticable, except with enormous ammunition consumption of heavy shells.

These conclusions are drawn to establish the superiorty of unilateral and bilateral observation for artillery fire. The careful mathematical comparisons have been used by General Challeat as a challenge to that school of artillerymen who advocate the replacement of observed fire by a carefully computed problem and firing without observed adjustment.

Les Lecons Militaires de la Guerre. By Commandant Bte Bouvard. Masson et Cie. Paris. 1920. 5½" x 7¾". 320 pp. Price 9 francs.

This volume is one of a series by the same publishers dealing with the various phases of the utilization of the nation's resources for the prosecution of a war. The other volues take up suh subjects as industrial mobilization, food supply—civil and military, finance and credit, and foreign policies. In this volume, however, the author deals principally with the fighting forces, touching in a general way upon the relation of the productive forces of the nation to the armies in the field. The major portion of the book is devoted to a study of the coordination of all the arms and supply services in various tactical and strategical situations. The author does not go deeply into details but sketches the larger phases of warfare in its modern aspect of entire nations mobilized for military purposes.

The New Social Order. By H. F. Ward. The Macmillan Co. New York. 1922. 5¼" x 7¾". 384 pp. Price, $1.50.

Dr. Ward writes from the standpoint of the teacher of Christian ethics. He declares that the New Social Order is inevitable and so he presents principles and programs all of which have in common certain features, such as, limitation of income, and the extension of "state control over the economic process." Most important of all is the plan for the protection of wage-earners and their representation in the control of the industries. Although democracy fails to secure equality yet it is the ideal of humanity. The solution rests with the intellectuals of the middle class—the real leaders of society, and may be summed up in the words of the Golden Rule.

La Nostra Guerra. By General Ettore Vigano. Felice Le Monnier. Florence. 1920. 6½" r 9". 453 pp. 3 maps.

This book (in Italian) is a valuable contribution to the general history of the World War. The events covered extend from the beginning of the war in Italy to the disaster at the Piave. In dealing with these events the author rambles along more or less disconnectedly, his evident aim being to emphasize the errors made and persisted in by the Supreme Command and by General Capello, Commander of the second army, which resulted in the defeat at Caporetto and the subsequent disastrous retreat to the Piave.

The author devotes much space to the discussion of the causes having to do with the lowering of the morale of the army, among which are noted the drastic eliminations of officers in the higher grades, the frequent changes in organization commanders, promotion by selection, injustice in the designation for tours of trench duty and the propaganda of the pacifists.

Cadorna's plan of campaign is examined in minute detail and special emphasis is laid on his strategic error in failing to provide a solid general defensive base before undertaking a great offensive. This neglect the author considers as the military cause of the enormous disaster which followed the Battle of Caporetto.

Throughout the book the author neglects no occasion to account for the errors of the Italian leader by some defect of character. Thus, he is described as a great egotist, ever cultivating the applause of the populace, wording his communiqués so that even the most insignificant episode shall appear as a victory resulting from his clever strategy. In this way numerous minor episodes, entailing needless losses and presenting in the aggregate formidable totals, were constantly staged, the author states, simply to furnish data for bombastic communiqués in exaltation of the Supreme Command.

Of General Capello the author states that while he appeared efficient and capable as a division and corps commander, he seems to have lacked those qualities essential in a commander of larger units to whom must be entrusted important strategical missions.

General Porro, the assistant Chief of Staff, also comes in for a characerization by the author, who seems to think that this brilliant officer might have given a better account of himself had Cadorna permitted him to perform duties more in consonance with his office.

Three excellent maps enable the reader to follow the dispositions and movements of the armies with the greatest ease.

Some Problems in Current Economics. By M. C. Rorty. A. W. Shaw Co. Chicago. 1922. 5" x 7¾". 143 pp. Cloth. Illustrated with charts. Price, $1.25.

In "Some Problems in Current Economics" the author has confined his analysis to those social and industrial questions of growing significance in the development of the relations between business managements, labor and the public. The problems which he discusses are vital to the welfare of every executive and employee.

Specifically he indicates the need and probable line of development of cooperation between employers and the employees; the duties of management to employees, bondholders and stockholders and the public; the need of graduations in regulation and control of industry; where the real gains in the improvement of the conditions of the average man may be made and analyzes many other significant questions of the present day.

Through the five sections which make up the book, the author aims to present true pictures of opposing viewpoints, rather than to set up a series of arguments for any particular political or industrial theory. He outlines the origins and growth of our industrial system from its crude beginnings and discusses some of the problems of future social, and industrial development. With this background provided, he points out specifically the differences between the individualistic and social concepts of government, and suggests the form the ultimate compromise may take. He then applies balance sheet methods to a discussion of the business cycle and the round flow of income and expenditure in the economic organization, and deals with the statistical evidence upon which many statements in the book have been based. Finally, the author presents his conclusions and a constructive program for the future. Most of the discussion is in terms of dollars and cents, and exact figures rather than of theoretical generalizations.

The table of contents will suggest the scope of the book: Section 1—Industrial History; Section 2—Social and Industrial Organization; Section 3—Production and Distribution; Section 4—Some Pertinent Statistics; Section 5—Facing the Facts—A Recognition of New Conditions.

The Trend of History. By William Kay Wallace. The Macmillan Co. New York. 1922. 6" x 9". 372 pp. Price, $3.50.

Here is a treatment of history from an entirely new standpoint, the theory of history rather than the chronicling of events. There is a relation of the past to the present which the author traces for us by selecting out of all events those by which the present may be interpreted. He names religion, politics, economies as the "three regulative factors of human intercourse," tracing the influence of each upon the age of which it is characteristic and showing its result in our social phenomena of today.

No student of history and world affairs, should miss reading "The Trend of History" because of the freshness of its viewpoint, and because no other author has given us an equally clear interpretation of historical events with regard to present day problems.

On "Culture" and "A Liberal Education." By Jesse Lee Bennett. The Arnold Company. Baltimore. 1922. 5¼" x 7¾". 92 pp. Price, $1.00.

During journalistic experience of fifteen years, Mr. Bennett has received many letters from men and women of all ages and classes requesting lists of books which could help them to gain "culture" or "a liberal education." This book has been prepared to meet the demand evidenced by these letters. At the present

time the journals of the country are flooded with advertisements offering "culture" much as if it were a predigested breakfast food. In this work the author presents what culture *is not* as well as what it *really is,* and the result is very gratifying.

This little volume of 92 pages contains information that will prove priceless to an eager-minded person. It is a guide to what is best in life—lists of books covering a wide range of subjects, beginning with History, Science, and Philosophy, through Travel, Archæology, and Imaginative Literature together with Poetry and World Politics. Each list is supplemented by interesting comments.

Anyone desiring guidance through the confusing wilderness of books, the pointing out of paths and directions to the treasure house of culture may well approach this work with confidence.

Le Guerra Alla Fronte Italiana. By General Luigi Cadorna. Fratelli Treves. Milan. 1921. 6½" x 9½". 2 Volumes.

General Cadorna was Chief of Staff of the Italian army, from July 1914 to November, 1917. In his initial chapters he gives a most lucid picture of the difficulties encountered in attempting to make an efficient fighting machine of an army which had been for years forced by the government to maintain itself on war budgets more modest proportionately than even those of Switzerland.

After briefly sketching the military preparations made during the period of neutrality the author points out the deficiencies still existing at the opening of hostilities—shortage of officers, and particularly of artillery, engineers and staff; lack of heavy field guns, few heavy guns and little ammunition for either; trifling quantity of high explosives, few wire cutters and little engineer material; shortage of the regulation rifle

He next gives a brief outline of his plan of operations with the reasons for its adoption, cites his memoir to the armies, containing instructions intended to enable the commanders to study their problems under all possible hypotheses and gives the changes in those instructions necessitated by the changes in the system of mobilization and concentration, the lack of coordination with the Allied armies and the tactical difficulties of the theater of war.

The remainder of the two volumes is devoted to a most absorbing account of the military operations during 1915, 1916 and 1917 to the retreat on the line of the Piave. This narrative, being supported by documents, constitutes a reliable history of the events recorded. Whatever the merits of General Cadorna as a military leader, his ability to present the events of those stirring times in a manner to grip the heart of the reader is beyond question.

Considering the number of critics that have published books, pointing out the errors and weaknesses of General Cadorna in the conduct of the war in Italy, it is noteworthy that throughout this book there is a total absence of rancor or harshness towards any such, which, to the mind of the reviewer, is a strong mark of greatness of soul not possessed by many.

This book is a worthy contribution to the history of the World War and should stir the soul of even the layman.

Memoires du General Gallieni. By General Gallieni. Payot, Paris, France. 1920. 5¾" x 9". 269 pp. 7 maps. Paper.

In his Memoires on the Defense of Paris covering the period August 25 to September 11, 1914, General Gallieni tells of his appointment as Military Governor of Paris and Commandant of the Armies of Paris after having been retired for

age in April, 1914; his organizing his work into a civil and military department, placing civilians at the head of the civil department and taking the military defense of Paris against the Germans as his own personal work. He tells of studying the necessities of the situation; gives his report on the deficient condition of defense in which he found Paris with the Germans sweeping down upon it; of the steps taken to meet these deficiencies; of his conclusion that to defend Paris adequately it was necessary to meet the enemy outside of Paris and turn them back. His idea was to organize an army out of all the forces given to him for the defense of Paris and those that he might be able to obtain, and form an army which he could place out beyond Paris to attack the advancing First German Army of Von Kluck on its right flank and threaten its communication, the very thing that Von Kluck was doing to the French armies. With all the initiative and prompt action that has always characterized Gallieni, he set about to form this army from the forces he had under him that were available and to reinforce it as soon as possible by all the forces he could get. He placed General Manoury, whose ability he respected very highly, in command of this army, the Sixth French, and directed its actions himself. He paid numerous visits to the Headquarters of Marshal French and carried on much correspondence to obtain the cooperation of the English in his plan of operation. In the meantime the French government had withdrawn to Bordeaux leaving him in charge with instructions to resist the Germans to the utmost.

Marshal Joffre's orders called for the French to continue their retreat south of the Marne, but General Gallieni thought the opportunity at hand and ordered the Sixth French Army to attack, having arranged with the English for their cooperation. Gallieni agreed that above all the commander should try to preserve his forces, but in this instance he decided to go against Joffre's order for retirement and fight it out, because the loss of Paris he believed would be a mortal blow to the French, and, besides, he saw a good opportunity to play the Germans at their own game--take them in flank.

Gallieni's plan worked excellently and changed the overwhelming German invasion to a hasty retreat. At the height of this retreat, Marshal Jeffre wrote General Gallieni a very flowery letter praising him for the great work he had performed. In the same letter however he relieved General Gallieni from command of the 6th French Army and directed him in future to communicate with the government at Bordeaux only through him.

Gallieni states that Joffre, by this unexpected and uncalled for action, robbed him of all his initiative. He continues to give his side of the controversy between the Marshal and himself. He gives very good arguments against Jeffre's action, but in his subsequent letters to the Minister of War maintained the highest loyalty to his Marshal.

Gallieni in his work speaks in high terms of the calmness and willingness of the Paris population to work both day and night and make all sacrifices requested in those trying days. He tells of his requisitioning all the taxis in and about Paris to rush troops out to the French left flank to form and reinforce his 6th Army that was to turn the tide of battle. He states that it was no uncommon incident to see a soldier halt a taxi, have its passengers dismount in the center of the street, and drive rapidly away with the taxi to the camps without any disputes or grumblings from anyone.

In the back of the book are documents, copies of the various order and letters discussed by Gallieni in his Memoires, and seven maps showing the disposition of the forces on the various days.

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