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The Human Element in War

By MAJ. GEN. C. P. SUMMERALL

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EXTENSION OF REMARKS

OF

HON. JOHN Q. TILSON

OF CONNECTICUT

IN THE HOUSE OF REPRESENTATIVES

MR. TILSON. Mr. Speaker, on last Saturday, February 19, at the Army War College, Maj. Gen. Charles P. Summerall, Chief of Staff of the Army, delivered a notable address on the subject of "The Human Element in War." It is quite generally conceded that among all American Army leaders brought out and developed by the World War, none is better qualified to speak on this subject than is General Summerall. Along with great knowledge of the profession of arms, and unusual ability, he has as his most striking characteristic the possession to a very remarkable degree of those human qualities which must be possessed by every great leader of men in war or in peace. He possesses the faculty of being able to so impress himself upon others as to transfer to them much of his own personality, and thus to extend and multiply through others his own superior qualities of mind and heart.

I wish to give to the membership of the House and to others the privilege of reading what General Summerall had to say to the students of the Army War College and to a few privileged guests on the subject of the human element in leadership. Therefore, under the leave to extend my remarks in the Record, I include his address, as follows:

While the consideration of the human element is predominant in war, there is great necessity of comprehending it as an essential in the management of men in peace. Indeed, if one does not understand and practice the art of controlling the human element in peace, he cannot do so in the test of war. It is trite to say that the human element remains, as it has ever been, the determining factor in battle. Machines and arms may be multiplied and changed, but the man who uses them will determine the final issues of victory or defeat. The psychology of men is a definite quality. It cannot be changed. To be used it must be understood and taken as it is fixed by nature. It

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can be used to bring about results just as successfully in garrison as in campaign. Indeed, the qualities of discipline, morale, efficiency, loyalty, etc., are only evidences of the degree to which some leader has directed the psychology of his men. For example, today we are concerned by a high rate of desertions. Yet we find organizations where the same evil exists only slightly, if at all. Some posts have large numbers of men absent without leave, while others are proud of their good record. Most evidences of indiscipline are capable of being corrected or removed by methods that take advantage of the human element, for any given number of men are essentially the same in the human characteristics as any other like number of men. It is not so much the fault of those responsible as it is their lack of understanding and, in some cases, the aptitude to apply a few psychological principles. All of our schools should teach the theory and practice of dealing with men according to methods that are readily understood. While everyone would not be equally successful, there would be marked improvement in all standards, and the officer who lacked sufficient aptitude would subject himself to elimination.

While much has been written on psychology, the principles needed by the military leader are few; but they must be so thoroughly assimilated that they become a part of his life and personality. The following truths are stated as some of the more essential guides in directing the human element both in peace and in war:

MEN THINK AS THEIR LEADERS THINK

This is absolutely true in every echelon of military command. Thoughts are things, in that a man can not act or talk other than as he thinks. If an officer wishes to influence his men he must actually be what he desires them to become. A single disloyal remark or act will spread through the minds of his men. He not only will be unable to lead, but he will deprive them of the will or the power to follow. On the other hand, a resolute, loyal, unquestioning leader of any grade will inspire his men with his own indomitable spirit. Thus they will react upon each other and perfect confidence will make an invincible unit within its power, be it a squad or the largest command that one personality can permeate. The power of example thus becomes the measure of leadership.

ALL IMPULSES COME FROM THE TOP

From the very nature of command the minds of subordinates turn to the leader for direction. A military unit can be no stronger or more efficient than the leader. A subordinate may influence his echelon, but he will not affect other echelons or higher elements. Human nature is

jealous and proud. A leader naturally resents the effort of a subordinate to instruct or guide him and is thus not receptive of influence from below. From this it follows that if a command of any size is good or bad, one has only to fix the responsibility upon the leader.

The real leader will give his subordinates credit for all of their accomplishments, but he can no more escape a similar honor from them than he can escape blame for failure. The true leader not only initiates impulses for his subordinates but he adds force to impulses from above. With a chain of such leaders an order gathers momentum, and on reaching the point of execution it strikes with an irresistible force.

MEN FIGHT FOR THEIR LEADERS

The average mind is such that it does not analyze abstract causes or even the great principles over which wars are fought. Men are elemental and practical and cling to real things. They want to have leaders. They want to admire them and they want to follow them. After the classic assaults at Plevna General Skobelev II divided men into three categories: A small per cent have no sense of fear and are eager for combat. They will expose themselves recklessly and soon become casualties. Another very small per cent have not been endowed with enough courage to sustain them in danger, and they will soon disappear. The great majority of men in face of danger gladly surrender their wills to their leaders, and are easily controlled and guided. These are the men who properly commanded will win the battle. Danger, hardship, and tragedy develop a peculiar bond between men of all ranks, for basically human nature is the same. As one real leader has expressed it: "In the face of death all men are equal." Thus men come to have a perfect and almost childlike confidence in a successful leader. The man who in any unit shows sympathy, helpfulness, and comradeship for his men may be sure that they will fight for him. To secure this response a leader must be known to his men and must be seen by them at the point of danger as well as elsewhere. They must know not only his name and appearance but his record and they must have personal proof of his care.

MEN RESPOND TO APPROVAL RATHER THAN TO BLAME

Men do not fight for fear or for material reward. Courage and fortitude are spiritual and are not influenced by material considerations. A man fights for pride in himself and in his command. Pride is a basic element of human nature. There is no human being wholly devoid of self-respect. The soldier is especially sensitive by reason of his subordination, and when once his pride is aroused he becomes intensely solicitous and jealous of preserving it. In the same way he be-

comes loyal to his command and his comrades, and he would forfeit his life rather than act unworthily of them or incur the censure of those whom he respects. His sense of justice requires that his good performance be recognized, and where such recognition is withheld he experiences discouragement and depression. His richest reward is recognition by his leaders. This may vary from a simple word of approval to the highest decoration or citation according to his merits. On the contrary, censure or blame rouses the equally elemental quality of self-preservation. The man who humiliates his subordinates or who abuses his authority will forfeit their respect and arouse their antagonism or their hatred. Men want and admire firmness and positiveness, but command must be exercised so as to leave no personal sting. True discipline comes from pride and not from fear. Arbitrary and harsh measures may be easier to adopt, but they will multiply troubles out of all proportion to the gain.

The ways by which a leader's hold may be obtained on men are few and simple. He must live and conduct himself so as to be worthy of their respect. They are unerring in their perceptions, and they not only quickly discover but they abhor shams of every kind.

Men demand a reasonable degree of justice. They expect a leader to be fair and understanding. A single act of glaring injustice will injure his prestige and influence. Men must trust their leader in order to follow him.

It goes without saying that men demand the same courage and fortitude in the leader that they are expected to possess. A single evidence of timidity will end his usefulness. It is perhaps for this reason that officers have at times unduly exposed themselves and suffered unnecessary casualties.

Men are easily discouraged in the face of hardship and unreasonable tasks. With the loss of physical strength and with the exhaustion that is inseparable in campaign, the mind becomes correspondingly weakened. The leader must know how to assign missions possible of accomplishment under the conditions and to organize his resources so as to make success reasonably sure. Repeated failures can only result in a loss of confidence and in ultimate loss of morale.

Men are pleased by having their superiors know their names and something of their performances. While the limitations of higher commanders are soon reached, in the lower echelons a leader should make every effort to know his subordinates personally and make them realize his individual interest in them.

Men read the expression in the face of their leaders and are unconsciously influenced by their appearance, manner, and tone of voice. Self-control becomes, therefore, a vital attribute of a leader. To be

calm, self-possessed, and self-confident is indispensable. A leader must not only believe that he is right, but he must be so sure of it that he will convince everyone else, by everything he says and does, that his plans and purposes are right. Thus he will make men sure of success even though the plans might not be the best that could be adopted.

Men are capable of understanding the tasks demanded of them and the purposes to be accomplished. They respond eagerly to the leader who will talk to them and explain their accomplishments, their situation, and the necessity for further effort. Thus they require a personal relationship toward the leader and a personal identification with his plans. Each man comes to feel an individual responsibility to perform his part even to the extent of feeling that success depends upon his own efforts. In this way the leader accomplishes not what men think they can do, but what he knows they can do. He dispels imaginary evils and obstacles and creates a state of mind and a method of thinking that add immeasurably to the fighting power of his command. Indeed, many difficulties are wholly imaginary. Defeat comes not so much from physical effects as from a state of mind which makes men reduce or cease their efforts. When properly identified with his troops, the personality of the leader remains in their minds, and in the stress of battle his influence encourages them and strengthens their resolution.

Within the limits of personal contact, men should be encouraged to go to their superiors with their difficulties and they should find help or be convinced of the reason why it can not be given. The strongest nature needs human sympathy at some time and a single act of consideration and help may change the entire career of a man for good.

These precepts may be somewhat commonplace and unscientific, but they embrace the essentials of human nature. The greatest responsibility one can have is to be entrusted with the lives and the sacrifice of men and even the fate of one's country in war. No labor is too exhaustive, no effort too great, and no detail too small for those who, as officers of the Army, have dedicated themselves to the motto "Duty, honor, and country."

Victory is not won by army or navy alone; it must be the work of the whole nation.—*Spenser Wilkinson, in Government and the War.*

Mechanical Fire Adjustment

By LIEUT. GEORGE A. PATRICK, C. A. C.

Second Prize (tie), Annual Essay Contest

A coast artillery battery command consists of a number of cannon of the same caliber and ballistic characteristics, commanded by a single individual, with the personnel and equipment necessary for their service. The strength of a battery depends upon the amount and character of the armament to which assigned or upon the nature of its duties. A captain and one or more lieutenants are assigned to each battery, together with the enlisted personnel necessary to man the guns and stations pertaining to it. Usually, however, not more than two lieutenants are assigned to any one battery—a first lieutenant who acts as range officer and a second lieutenant who acts as battery executive.

The general and specific duties of all battery officers are prescribed in training regulations and as it is not the purpose of this paper to discuss their duties in detail they will not be enumerated here. Suffice it to say that each one has enough duties of a supervisory nature to prohibit his being detailed to perform any one duty that will prevent his going wherever his presence is necessary in an emergency.

No specific person is charged with the important duty of making adjustment corrections as a result of observation of fire and the nearest approach to such a detail is contained in paragraph 12, Section IV, Training Regulations 435-220, which reads in part: "In practice or action, the battery commander is responsible for the accuracy of fire." It is a well known fact that the battery commander is responsible for everything in connection with his battery, although that does not mean that he does everything himself. It is thought that this sentence would more aptly read, "The battery commander is responsible for the accuracy of practice."

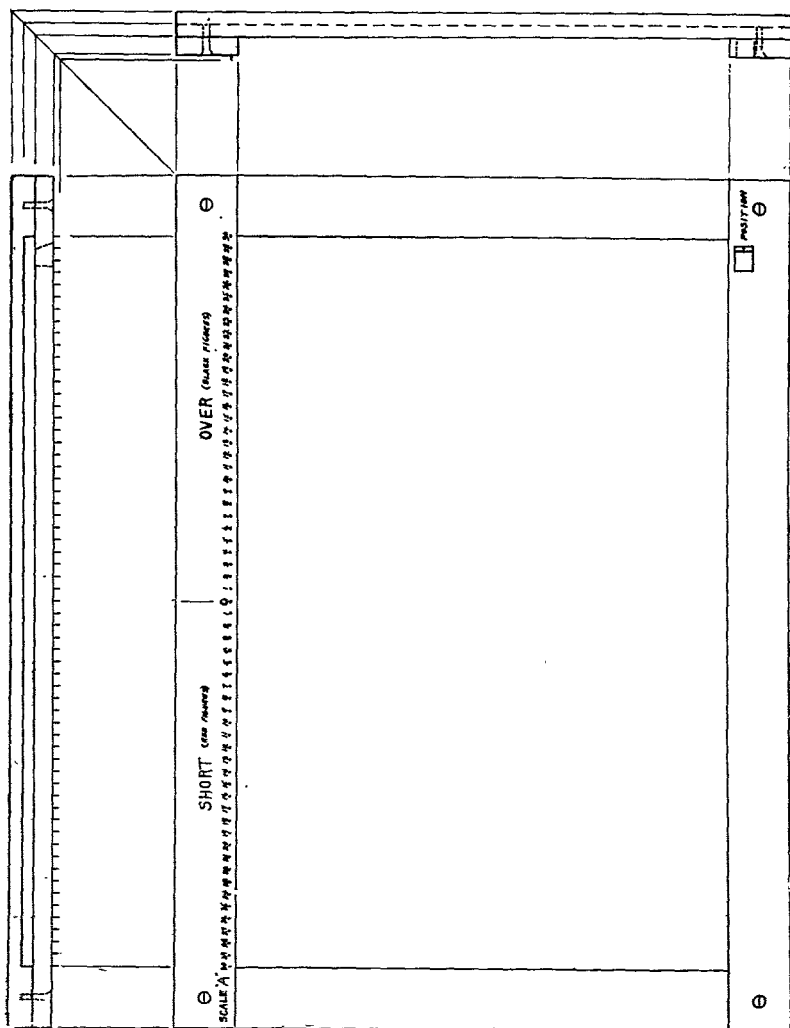
Accuracy of fire is determined by dispersion and is measured by the closeness of the grouping of the points of impact about their center of impact. The battery commander is enjoined to exercise every care in the training of personnel, the adjustment of fire control equipment, together with the guns and their carriages, and the preparation of ammunition prior to the practice or action. This will tend to increase the accuracy of fire, but when he has done all that he can there will still be more or less dispersion which is caused by conditions over which he has absolutely no control and for which he should not be held re-

responsible. On the other hand the accuracy of practice is measured by the distance of the center of impact from the center of the target. Assuming that all possible ballistic corrections have been carefully made and that observation of fire is possible, the only means available to increase the accuracy of practice, by bringing the center of impact nearer the center of the target and keeping it there, is to make arbitrary corrections by some method of adjustment. The battery commander has absolute control over this.

A prerequisite of accurate adjustment of fire is accurate observation of fire—in other words, accurate “spotting.” Under certain conditions this will be very difficult, if not altogether impossible. However, for the sake of argument, let us assume that both observation and spotting are good. Who, then, is to make the necessary adjustment corrections? The battery commander who is responsible for them? The range officer? The battery executive? Or a separate officer or enlisted man functioning as an integral part of the fire control system?

Battery commanders, as a rule, knowing that the responsibility for the adjustment rested on their shoulders, have felt that they could not properly designate an enlisted man, or even another officer, to determine the necessary corrections. However, making the adjustment themselves necessitated transmitting the deviations to the battery commander's station and then sending the corrections to the plotting room with consequent loss of time and liability of error. Then, too, this method required their undivided attention and precluded their giving their attention to the other innumerable details that they must supervise. Should communication with the group commander's station go out they must be free to assume the duties of the group commander or to fight their batteries independently as in battery commander's action. To do either of these would be to throw away the advantage gained by the adjustment corrections made up to that time, as they could not very well continue making the corrections and perform the additional duties imposed on them. It appeared, therefore, that the battery commander is not the proper person to make the adjustment.

The practice then developed of having the range officer make the corrections. This was an improvement, as he was in the plotting room where he could obtain the deviations directly from the spotting section, but again it required his undivided attention to apply the rules for adjustment correctly and consequently he could not give the proper supervision to the work of the range and spotting sections. It also precluded his leaving the plotting room, should his presence be required elsewhere, without interrupting the process of adjustment. Apparently the range officer is not the proper person to make the adjustment.



It is altogether out of the question for the battery executive or any of his assistants to make the adjustment on account of the noise and confusion at the guns, so it remains either to detail a separate officer or enlisted man to do it.

The former suggestion would be the better solution, but it would be a saving in more ways than one if the process of determining the corrections, according to the rules for adjustment, were simplified so as to eliminate the mathematics and thus allow an enlisted man, of the intelligence necessary to fill any of the important positions in the range section, to apply them. It was with this idea in mind that the board described below was devised.

It consists essentially of a base (Fig. 1), a chart (Fig. 2), and a number of double slides (Fig. 3). The slides are made up as individual units so that any number may be used at the discretion of the battery commander.

At the top of the base is a bar on which there are a number of pins and a scale "A." The pins are used for locking the first unit in any desired position below scale "A." The scale, which also appears on the inner slide of each unit, is used for setting off the deviation of impacts from the target. Each division represents either ten yards or one-tenth of one per cent. As indicated, overs are to the right and shorts are to the left of the center. (Note: All plus deviations and all up corrections are represented in black figures while all minus deviations and all down corrections are represented in red figures.) In the bar at the bottom of the base there is a window and an index for setting the position of the chart.

The chart is made up as shown in Figure 2, and needs no explanation.

As stated above, the individual units are double slides consisting of an inner and an outer slide. There is a scale "B" and a series of pins on the outer slide. The scale, on the upper part, is used for setting off the adjustment correction with which the particular shot is fired. It is marked "Down" to the right and "Up" to the left of the center. The pins are used for the same purpose as those on the bar described above, and are on the lower part of the slide. At the center of the upper edge there is mounted a hinged lock which is used to lock the slide to the pins on the unit above after moving it laterally to the desired position. In the normal position all units are locked in the position of zero deviation and all inner slides are set for zero correction.

Each inner slide has a window in the center and as noted above a scale "A" which is used for the same purpose as that on the bar.

The purpose of the board is to furnish the proper adjustment correction by determining the center of impact of the stripped deviations

UP (BLACK FIGURES)																										DOWN (RED FIGURES)																																										
27	25	23	21	24	26	28	25	22	21	20	17	18	17	16	15	14	13	12	11	10	9	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27												
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CHART-FIGURE 2.

of any desired number of shots or salvos mechanically. The board also permits the shot or salvo oldest in point of time to be eliminated and thus furnishes an adjustment correction which changes as the center of impact changes.

The operation of the board is very simple, and the only data required for its operation are the correction with which each shot is fired and the deviation of the shot.

A little study will show that the device adapts itself readily to making adjustments by any one of the three principal methods of adjustment used by heavy artillery, *i. e.*, the method of successive approximations, the trial shot method, or the salvo center of impact method. The board is operated slightly differently for the different methods, and it is only necessary for the battery commander to decide which method will be standard for his battery and to train the operator to work the board properly.

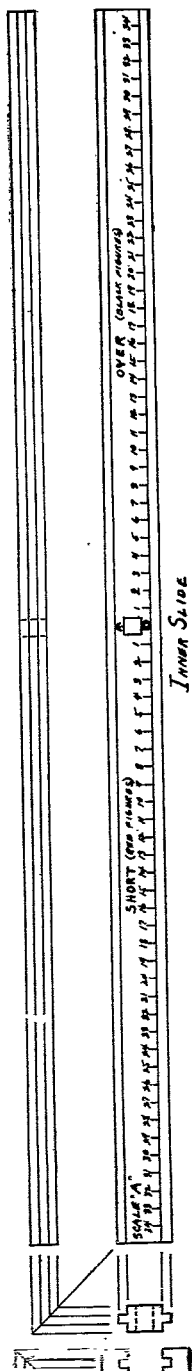
The following example demonstrates the operation of the board while making an adjustment by the method of successive approximations. Figure 4 shows this example worked out on the board. The following data are assumed.

<i>Shot No.</i>	<i>Deviation in %</i>	<i>Correction with which fired</i>	<i>Stripped deviation in %</i>	<i>Correction from fall of shot</i>	<i>Net Correction ordered for next shot</i>
1	+ 1.0	0	+ 1.0	Full — 1.0	— 1.0
2	— 1.6	— 1.0	— .6	$\frac{1}{2}$ + .8	— .2
3	— 1.2	— .2	— 1.0	$\frac{1}{3}$ + .4	+ .2
4	— .8	+ .2	<u>— 1.0</u>	$\frac{1}{4}$ + .2	+ .4

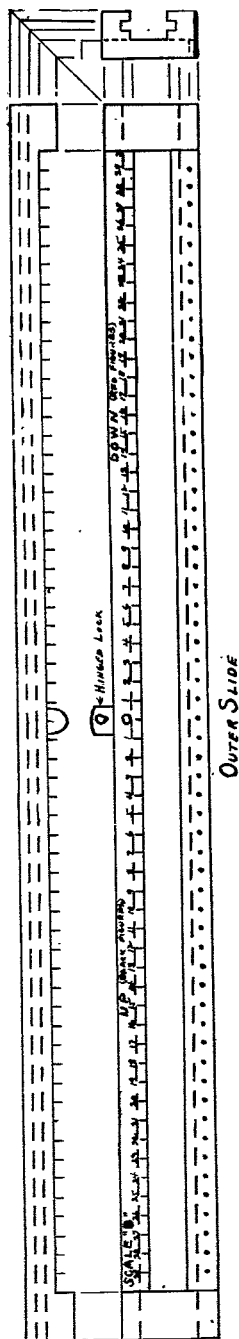
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(Note: In ordering corrections and setting deviations and corrections the decimal point is moved back one place and the use of the word "point" is omitted. One-tenth is called "one" and one-point-zero is called "ten," etc.)

At the start all slides are set at zero. The first shot is fired with zero correction and it is reported over 1.0. Unlock the first unit, move it to the right, and lock it at over 1.0 (note that all the slides below move with the first slide). Through the window in the inner slide of the first unit is seen a red 1.0 which indicates a correction of down 1.0. This correction is transmitted to the operator of the range percentage corrector and at the same time the inner slide of the second unit is set at down 1.0. The second shot being reported short 1.6 the second unit is unlocked, moved to short 1.6 on scale "A" of the unit above, and relocked. Through the window in the second unit is seen a red .2 which indicates a net correction of down .2 for the third shot. This method of operation is continued and after the fourth shot a correction of up .4



Inner Slide



Outer Slide

is read through the window in the fourth unit. This represents, but with opposite sign, the center of impact of the first four shots (stripped) and has exactly the same value as the correction obtained by applying the rule for the method of successive approximations.

Now suppose it is desired to eliminate the first shot from consideration and consider the second, third, and fourth shots with the fifth. Up .4 is set on the fifth unit. Assume that the fifth shot fell over .6. The stripped deviation of the fifth shot is plus .2 and the center of impact of the stripped deviations of the second, third, fourth, and fifth shots is short .6. Unlock the first unit, move it back to zero and lock it. Then move the chart downward until the index points to position 2. Through the window in the fifth unit is seen a black figure .6 which indicates a correction of up .6. Continuing in this manner we are able to keep a changing center of impact on the target.

If only eight slides are used the operator can transfer the data from the sixth, seventh, and eighth slides to the first, second, and third slides, move the chart back to the first position, and continue making the corrections without loss of time.

A criticism of the board might be that it does not furnish a permanent record for purposes of analysis after the shoot. This is true but it was not intended to furnish such a record and was devised to furnish accurate adjustment corrections during continuous fire without slowing up the fire for the purpose of making and applying these corrections. The operation of the board can be checked from the records kept after the practice in the same manner as any other device in the plotting room. If the battery commander desires he can use an impact board to give him a picture of the ballistic shoot, but he should not interfere with the adjustment unless he discovers that a large error has been made.

Inspection of the board will show that the setting of the lock of any unit opposite scale "A" of the unit above represents the actual deviation of the shot. The setting of the inner slide of any unit opposite scale "B" of the same unit represents the correction with which the shot was fired. The distance of the index on the inner slide of any unit from the zero on the inner slide of the unit above represents the stripped deviation of the shot.

It is believed that an enlisted man can be found in any organization who can operate this board satisfactorily. In this way fire adjustment can be made an integral part of the fire control system and come under the supervision of the range officer without interfering with his other duties.

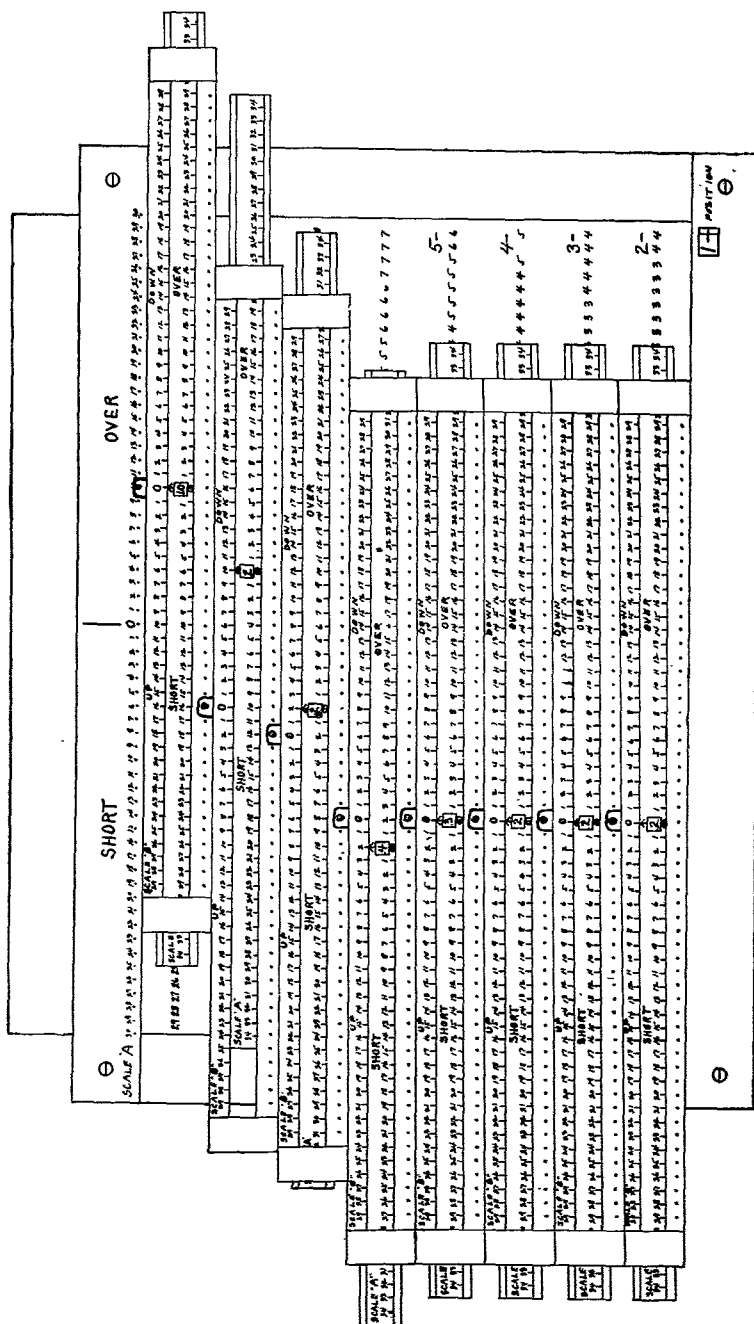


Figure 4.

In considering the use to which this board may be put, the question of applying calibration corrections or the separate adjustment of pieces has been considered and will be discussed briefly below. From our text on gunnery we learn that calibration corrections based on series of less than fifteen rounds per piece are not dependable and that corrections to individual pieces should be made only when it is certain that a calibration error exists. To be certain that a calibration error exists these fifteen rounds per piece should be fired under identical conditions, and it is extremely doubtful if this will ever occur in the case of major-caliber guns in time of peace. We are also told that it is not believed to be good practice to attempt to make a calibration correction during firing and that much better results may be obtained by a careful analysis of the firing, a calibration correction being made if the results of this deliberate analysis show one to be warranted. If it is found that the guns do not shoot together, a correction may be applied by slipping the range drum or by displacing the elevation index, thereby making a flat correction. If the correction is large, it causes a considerable range error when there is a great range variation. This could be remedied by applying a percentage correction, but since such a correction would entail stationing a man with a range percentage corrector or a range-range relation chart at the gun, it has been customary to make the flat correction. To make a calibration correction when laying by quadrant, an elevation-elevation chart would be required. In such a case, however, the correction is usually neglected.

An adjustment correction which is correct at one range or azimuth may not be even approximately so at widely varying ones. This happens because atmospheric conditions which affect the projectile at a certain range or azimuth do not have the same effect at other ranges and azimuths. Fire control apparatus provides the means for constantly applying corrections due to the changing conditions of atmosphere, wind, and azimuth; but these corrections, even when rapidly and accurately applied, can never be exact, and the conditions under which a series of shots are fired, though closely approximated for a short time, are not identical conditions.

From the foregoing it appears that even a deliberate analysis might fail to disclose a calibration error, and even if a calibration error is known to exist it is not considered good practice to station a man at the guns to make the necessary corrections. The very inaccurate method of applying a flat correction to guns laying by range drum is resorted to and no attempt is made to correct for known calibration errors of guns or mortars laying by quadrant.

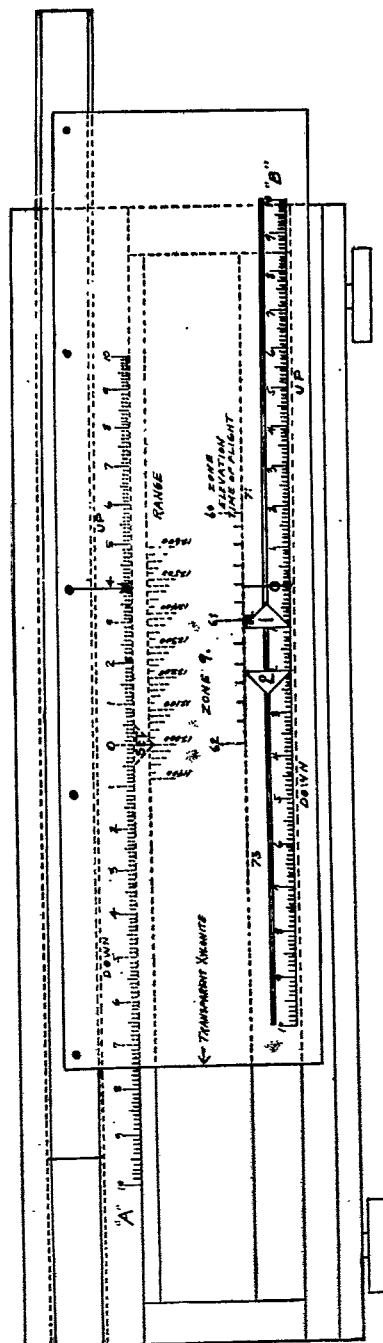


FIGURE 5

This is not believed to be good practice and the writer is fully in accord with the provisions of the following paragraph which is quoted from Training Regulations 435-280. "With calibrated pieces the adjustment of fire consists wholly of decreasing the deviation of the center of impact. When the pieces are not calibrated, *i. e.*, are not developing coincident centers of impact, each piece should be adjusted separately."

It is believed that the separate adjustment of two pieces or pits is practicable and should be done whenever possible, and the following method of accomplishing the desired result is suggested.

Use a separate mechanical adjustment board for each gun or pit that it is desired to adjust separately. The operator of each board adjusts the fire of one gun or pit, and only uses the deviations of the shots fired by his particular gun or mortar. He gives the necessary corrections to the operator of the range percentage corrector, naming the gun for which the correction is intended.

The usual range percentage corrector is modified as shown in Figure 5. A large plate of transparent xylonite is substituted for the ballistic pointer. On this plate are engraved an index, for setting off the ballistic correction, and a scale on which the adjustment corrections are set off. A slot is provided in it in which there are two pointers, marked 1 and 2, which represent the separate guns or pits. The operator sets the correction ordered for each gun on the pointer representing that gun, and reads the range or elevation separately for each piece preceding the data with the designation of the piece for which intended.

Figure 5 shows the following data set on the modified range percentage corrector: Range 12,000; ballistic correction, up 3.9%; adjustment correction for No. 1 gun or A pit, down 1.0%; adjustment correction for No. 2 gun or B pit, down 2.0%; data for No. 1 gun or A pit, Zone 9, Elevation 61-04; data for No. 2 gun or B pit, Zone 9, Elevation 61-24.

While the above described devices and methods are not suggested as a panacea for all adjustment and calibration ills and are in no way to be considered as a short cut and substitute for making the most careful and thorough preparation of materiel and the painstaking computation of all possible ballistic corrections prior to the practice or action, they are believed to be a step in the right direction toward making the fire control system self contained, of applying corrections for all known errors, and toward untying the hands of the officers so as to permit them to be free to go where their presence may be necessary, without interrupting or disrupting the whole system.

A Study of Artillery Fire Control with Special Reference to the Sixteen-inch Rifle

By LIEUT. WILLIAM D. HOHENTHAL, *12th Coast Artillery*

ARGUMENT

IT is assumed that, in the event of war, the coast line will be divided into sectors, depending upon geographical and strategical conditions and lines of communications. These sectors will be divided into subsectors. A sector is analogous to a corps front in a defensive situation in land warfare and a subsector to a division sector of the corps front.

Continuing the analogy, seacoast artillery, both fixed and mobile, may be likened to army or corps artillery. Because of its range and power, it will normally cover more than one subsector, hence should not in general be attached exclusively to one subsector. We do not normally attach corps artillery to a division, and similarly we will not usually attach seacoast artillery to a subsector, though an exception may occasionally be made in the case of the 155-mm. tractor-drawn guns. Seacoast artillery then, whether fixed or mobile, will usually be organized into groupments under sector control.

The defense of a sector is a defense by a tactical team of all arms, the seacoast artillery being not independent but an important member of the team. This applies to harbor defense as well as to beach defense. Troops of arms other than Coast Artillery should therefore be expected at times by sector commanders to furnish harbor defense artillery with data for firing and adjusting on both stationary and moving targets. These data, for maximum success, must be furnished to many batteries of different branches and calibers, simultaneously. The system which suggests itself, because of its simplicity and because it is known to all branches of the service and is used by all except the harbor defense artillery, is the system of rectangular coordinates. The future heavy artillery fire-control system should be based upon this, the common language known and understood by all branches of the service.

For the solution of the artillery problem of firing on moving targets, the terrestrial horizontal-base system (using depression range-finding instruments where possible) is the most accurate and dependable system now available. It is our present standard. It is limited in range by atmospheric visibility and by the possibility of being thrown out of action by fog or smoke screens. The use of balloon base lines, with captive balloons as base ends, has been tried and found practicable. Balloons have the advantage over terrestrial stations in being able

to see over most smoke screens, to observe at long ranges, to penetrate low-lying fogs, and to assist greatly in spotting. Balloons, however, are highly vulnerable, and the accuracy of their work is not as great as that of terrestrial stations. Considering the advantages and disadvantages of each, it is apparent that one or more balloon horizontal-base lines and a chain of terrestrial horizontal-base systems is probably the most efficient combination that is now available.

In this study I have been convinced that our present need is to develop in the service a sound method of application of both the present methods of observation and those which will be developed in the near future. Our fire-control system for heavy artillery should be able to utilize the position data obtained by any system of observation and should be primarily adapted to the most efficient system now in operation. It should be so flexible that the record of the track of a vessel can be shifted from one system to another and between units of any system instantly.

The basis of the present standard method of plotting observed data in seacoast firing is the "time-interval" system. At intervals of one minute, or of thirty seconds, readings from the observation posts are reduced graphically on the plotting board to terms of battery range and azimuth (to the target). It is obvious that there are compensating errors of personnel and apparatus and that fifty per cent of the plotted points do not lie on the actual track, but are, in average plotting, ten to thirty yards off. Based on at least three such plotted points, the plotter predicts the position of the target on the next time-interval bell, at which instant the battery will be fired. Then, in order to take into consideration the time of flight of the projectile, he must predict ahead another interval (approximately the same as the first interval) to obtain the setforward point at which the target and projectile are calculated to meet. The gun is laid on this point. In other words, based on the travel of the target assumed from its position at the beginning and end of a single minute (usually) the plotter predicts its position two minutes later. Experience shows that with a slow-moving target, of constant speed on a uniform course, quite accurate results will be obtained.

With a war vessel moving at thirty knots per hour on a purposely sinuous course, the plotter is at a great disadvantage when using this system. A sudden change in either direction or speed, or the combination of both, may throw his projectile as much as a thousand yards off the course. Any one can easily test this statement in his own plotting room. A war vessel moving 35 knots per hour will travel 1150 yards per minute and is able to reduce speed down to 600 yards per minute in less than one minute. Its turning radius is equal approximately to its speed per minute. Using these data, the range officer can lay out

on his plotting board, for a test, a course that is reasonably sinuous. If he obtains from this plot, azimuths at the normal time interval for base-end readings and gives these azimuths to the plotting section in simulated drill, he will find that the most experienced plotter will have such practical difficulties that the only conclusion to be drawn is that our present methods of fire control fail to take advantage of the power of modern ordnance. The present time-interval system has probably been developed to its highest point of efficiency, but it is as inadequate for our problem as the old-time sailing vessel is for modern ocean commerce.

A PROPOSED SYSTEM

In this study I have confined myself to certain requirements which I believe are sound. To attain these requirements it has been necessary to evolve a system which differs from the present standard system rather radically and will therefore find much sincere opposition. This paper is published for the purpose of inviting criticism and suggestions of basic principles, rather than to advance the idea that the fire-control instruments described here should be adopted. I make no claim other than that the system has been evolved on sound principles. I have designed the instruments described here to illustrate *how* these principles might be carried out. I am sure that other and perhaps better methods of carrying out the same principles can be evolved.

The instruments illustrated in the drawings have not been constructed, and I am aware of the fact that a vast amount of experimental work is necessary to adjust any new device or method of operation to the rigid demands of the military service.

While I am certain that many of the operations can be made automatic through the use of electrical data transmission devices, the system is presented here in its simplest form, *i. e.*, hand operated, in order that the basic principles may be better understood. The requirements that I have attempted to meet are as follows:

a. The path of the target should be reproduced in the plotting room as a continuous line or band, without time-lag. In other words the plotter should have a continuous and instantaneous picture of the track of the target on his plotting board. This eliminates the time-interval system.

b. There should be no necessity of predicting for any factor but the time of flight of the projectile. Errors which occur during the time that the projectile is in the air can never be corrected for but errors occurring up to the point where the gun is fired should be within our control.

c. A simple and fairly accurate system of prediction should be provided for sinuous courses.

d. The unwieldy arms of the present standard system should be eliminated entirely.

e. The guns should be aimed and laid on a moving setforward point by a follow-the-pointer system or by continuous ranges and azimuths from the plotting room by telephone.

f. The system must provide for great flexibility in tactical control of the batteries using it.

A Situation

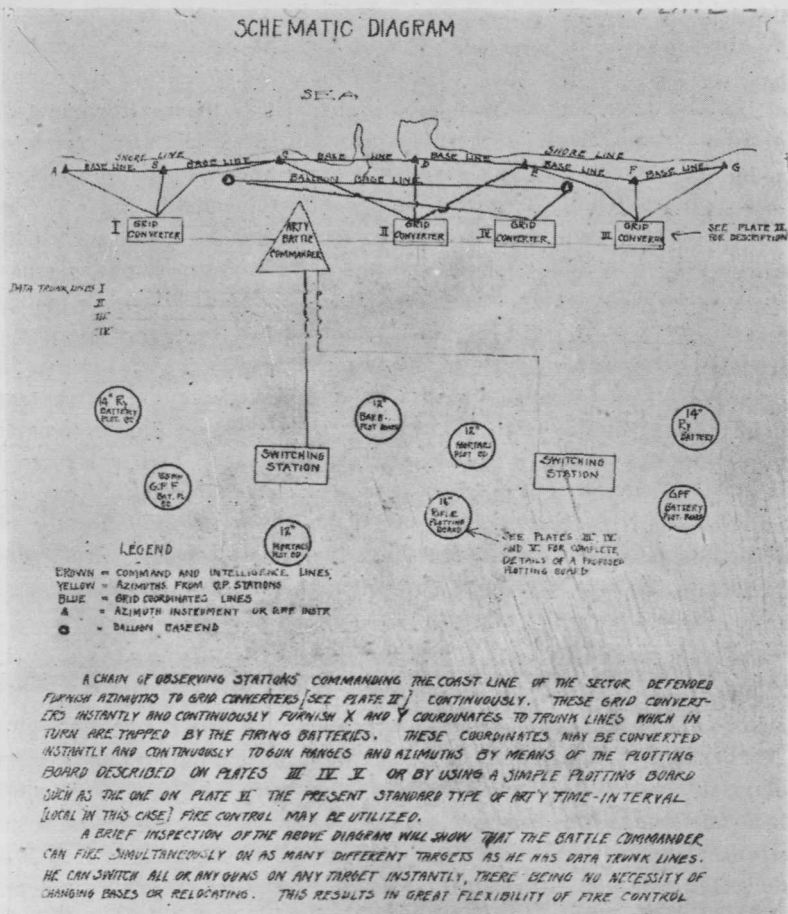
Before describing the proposed system let us assume for example that the organization of a defense of Boston harbor is under consideration. We are concerned with the areas north and south of Boston harbor included within the range of our 16-inch guns at Boston. The entire shore line will be organized for beach defense by infantry with supporting light artillery. Water-line defenses, consisting of a series of infantry company strong points, will be proposed, with large mobile reserves back of them. Searchlight batteries will be placed along the shore to illuminate the beaches and to locate targets at sea. Light artillery and large-caliber machine guns will be placed at points of vantage to operate against landings. Tractor artillery will be placed close to the beach to operate against transports, destroyers, and small craft. Seacoast mortars will be expected to cover channels to prevent a run-by. Sixteen-inch rifles, 12-inch barbette guns, and possibly a battery of large-caliber railway guns placed in the vicinity of Boston will attempt to keep the enemy's heavily armoured ships at extreme ranges and will form the nucleus of the artillery groupment.

The Proposed System Adapted to the Situation

In order to carry out the proposed system (Plate I) the artillery commander would locate a chain of terrestrial horizontal base and vertical base stations and at least one balloon horizontal-base system along the coast line defended by the 16-inch guns. All of these stations will be connected with the groupment commander's station with an intelligence line. He will install at each end of the balloon base-line and at every alternate terrestrial base-end station, a grid converter (Plate II), a device which converts observed azimuths of a hostile target continuously and instantly into X and Y coordinates. These X and Y coordinates are sent out from the grid-converter station on two or more trunk-lines in the same instantaneous and continuous manner. These trunk lines can be tapped by any battery firing on the target and used by them with either the present time-interval system or the new plotting board described in Plate III.

The groupment commander will put into operation a group or a system of these observation stations, indicating to them, over his intelli-

gence line, the trunk lines on which to send their data. He will at the same time advise batteries of the trunk line assigned to them. This will be equivalent to a target assignment. These data, being in terms of X and Y coordinates, can be utilized by any number of batteries without interference with one another. An independent organization of observ-



ers furnishes data for all artillery by this system, regardless of branch or position. The groupment commander directs observation, routes data, and calls for fire from batteries. In the organization of a large harbor defense, fewer men will be required by this system than would be required if every battery had its own fire-control system. Also great flexibility of the artillery defense system is insured.

An Important Mechanical Principle

Experiment proves that the motion of a slow-moving graduated limb or rack can be duplicated accurately and without lag by a similar graduated limb or rack at a distant point by sending over the telephone frequent readings from the index of the first device. In order to do this correctly, the second device must be moved by means of a small fly-wheel so geared that, for average speed, the operator or setter will have to turn the wheel approximately once every second. If the reader of the first device reads his index at every marked interval that he can distinguish accurately, in such a manner that the last syllable goes out as the index is opposite the mark, the second operator will quickly get the speed and swing, and synchronize his instrument with the first one. Small errors of the compensating type will occur of course, but the recording operator is just as liable to be a fraction ahead of the index mark as he is to be behind it. Several of these devices could be put in series, and, using separate operators and readers, no lag would be introduced. This is the principle upon which the continuous and instantaneous track of the target can be reproduced from the observers' data to an actual moving pencil track on the plotting boards of several batteries simultaneously. It is the principle used in the system proposed in this paper but need only apply where the apparatus is hand-operated. Successful electrical data-transmission devices have been constructed and could be applied to this fire-control system to do the same thing.

The System in General

If a plotting board based on the present standard types were built for the 16-inch battery, we would have a very clumsy affair, large and unwieldy and without flexibility. I propose a plotting board (Plates III, IV, and V) which will give accurate results on the smaller scale of 1:20,000, and since it has no station or gun arms (range and azimuth being determined by a system similar to the present vertical-base instrument), it is more flexible than the guns are; and although it produces a continuous track, no time is lost in plotting or prediction, the only prediction being for the time of flight of the projectile. A mechanical setforward point represents the point upon which the guns are kept constantly trained by this method.

Briefly the proposed system provides an organization and instruments whereby any number of batteries may obtain a continuous flow of X and Y coordinates simultaneously and without interference with one another. They may use these data either with a local time-interval system or by a new plotting board offered in this paper, a plotting board which plots a continuous track and furnishes a steady flow of

ranges to the guns. While this system was designed especially for the 16-inch battery, the fact that a 16-inch gun will always be surrounded by a large number of smaller guns has not been lost sight of. We could say that the 16-inch battery will be the nucleus of an artillery

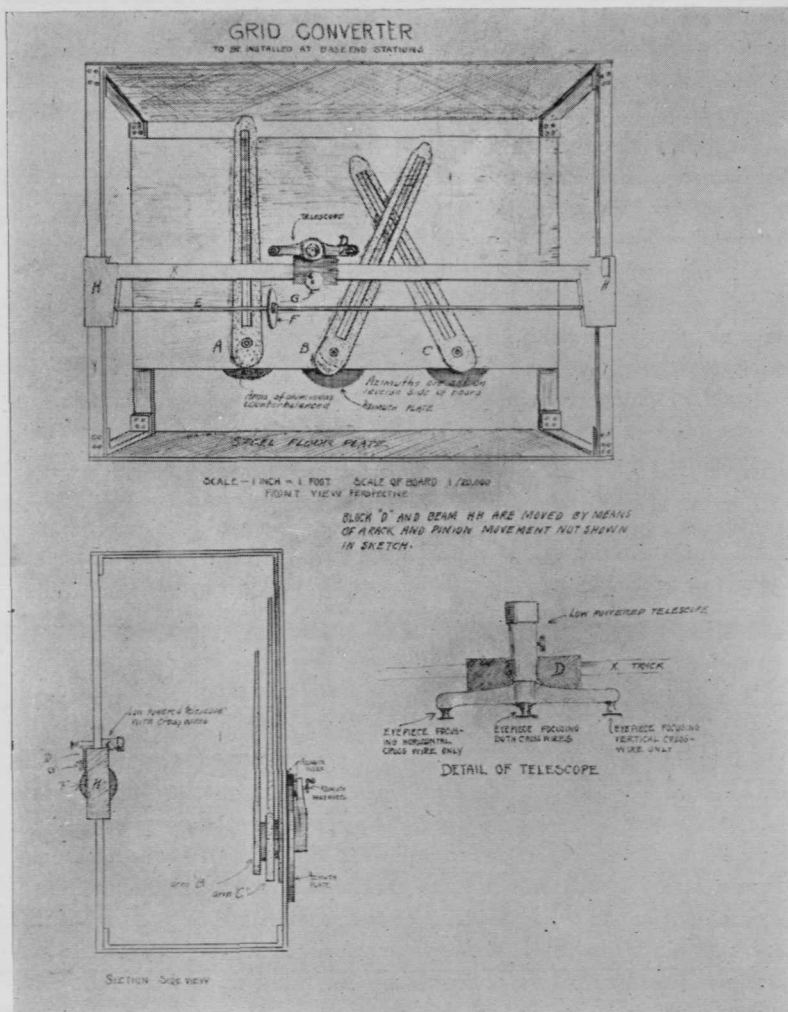


PLATE II

groupment in harbor defense. The system is designed to bring under flexible and efficient control the entire seacoast artillery of a harbor defense groupment. The five plates, showing rough sketches of the proposed fire-control instruments and their description, will present the system as far as it is intended by the present article.

APPENDIX I

DESCRIPTION OF THE GRID CONVERTER

(Plate II)

This instrument converts azimuths obtained at terrestrial base-end stations to rectangular coordinates. It is installed at alternate stations in a chain of observing stations along the seacoast. It consists of a vertical plotting board with three azimuth arms plugged in at their proper coordinates, the station at which the board is installed being the center one. These arms are made of aluminum and are flat. A slot two inches wide is cut in the center of each arm and a fine piece of piano wire is stretched in its center to represent the line of sight. Arms are counterbalanced and are separated from the plotting board by discs varying in thickness in order that there will be a clearance between all arms. This allows any pair of the three arms to be put in operation on a target with no change in the plotting board. Azimuth scales for the arms are placed on the *reverse* side of the board where azimuth setters continually set arms, when so directed, by means of small, geared wheels. It is obvious that the point on the plotting board perpendicular to both wires of any pair of arms represents the target and that the path of this point is the track of the target.

Parallel to and about two feet from the plotting board are two vertical machined bars, shown in Plate II as YY. A horizontal cross-bar X (also machined) is fitted on these bars in such a manner that it can be moved rigidly perpendicular to them by means of the rod E and the sliding handwheel F (gear and rack action). A block D, to which a low-powered telescope (with crosswires) is attached, is moved along the bar X by means of the handwheel G. In case of a permanent installation the bars X and Y may be graduated in coordinates and the same read by means of index boxes on the blocks D and H. However, in order that these instruments may be standardized and adapted quickly to any locality, it is suggested that the following be done: Attach flexible steel tapes (graduated in yards scale 1:20,000) to the blocks D and H by means of small drums and clamps, in such a manner (not shown in the sketch) that for any setting of the azimuth arms the tapes can be adjusted to read the correct rectangular coordinates. This not only permits the board to be adapted quickly to any area but also provides a means of adjustment.

The operator keeps the telescope crosswires continually on the intersection of the wires of the azimuth arms. A trained operator will be able to do this without difficulty, but it is believed that a double telescope such as described in the sketch will be advisable where the operator is not so well trained. In that case two operators are needed, one to operate the wheel F and one to operate the wheel G (vertical and lateral motions respectively). Readers at the X and Y index boxes continually send X and Y coordinates to all batteries firing on the target.

A modification in the arm (which is not shown on the sketch) will allow this grid converter to use the range and azimuth from a single DPF instrument. If the arm is graduated in yards range a simple sliding index box with an index wire perpendicular to and crossing the line of sight wire will allow one of the azimuth setters to set off ranges continually. A further modification of the board allowing a constant change in the position of the base-end plugs (including the azimuth plate) will adapt this board to the balloon base line.

By means of electrical transmission devices the operation of the arms may be made automatic. This, however, is a second step in the development of the system not considered in this paper except as a logical possibility.

APPENDIX II

DESCRIPTION OF THE MAIN PLOTTING BOARD
(Plate III)

This plotting board can be better described as a plotting floor. A fine mixture of concrete could be used. For a sixteen-inch battery, mounted on the seacoast and commanding a field of fire of 180 degrees on naval targets, a board 8'x16' is the proper size (scale 1:20,000). Two rails marked XX in the sketch are

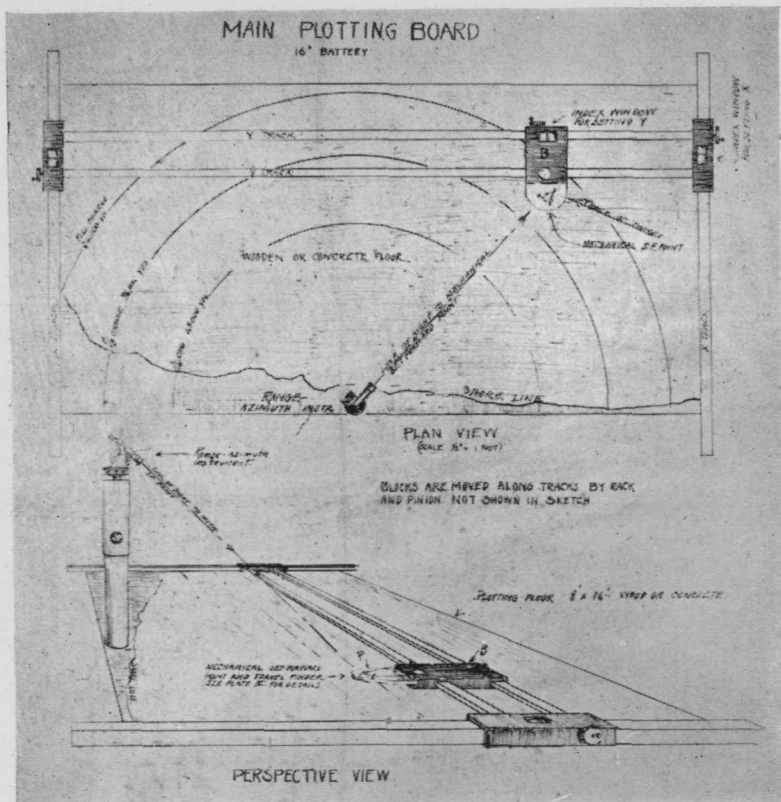


PLATE III

mounted parallel to one another as shown in the drawing. These tracks carry a double tracked beam YY which is fitted to them in such a manner that it can be moved rigidly perpendicular to them. This beam YY carries a sliding block B which holds the mechanical setforward point and travel finder (for full description of which see Plate V).

The index mark on block B and the index mark on the beam Y are continually set by small handwheels on the Y and X coordinates sent in from the grid con-

verter stations. A pencil on block B (marked p) indicates the exact track of the target, without lag, and a small wheel on the same block determines travel for any given time of flight. The plotter adjusts a mechanical setforward point (described on Plate V) on which the operator of the range-azimuth instrument keeps his cross-wires fixed. Drift and ballistic corrections are determined from charts and are set on the range-azimuth instrument and corrected ranges and azimuths are continually sent to the guns by telephone or a follow-the-pointer system such as is used in the Navy. The cost of this plotting board is estimated at approximately \$500.00 if constructed by a civilian firm.

The apparatus should be designed so that the variation in elevation of block B will not exceed 0.01 inch in moving over the floor. As the mechanical set-

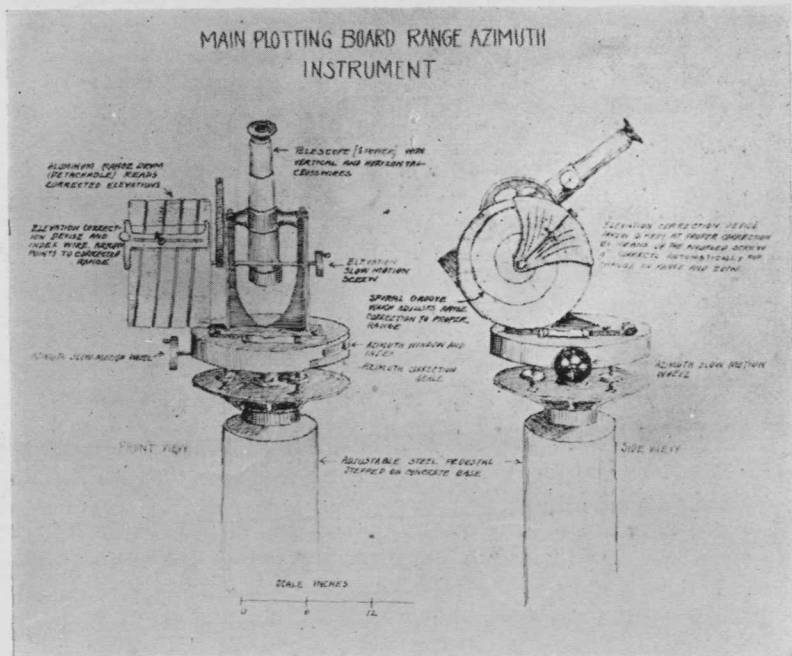


PLATE IV

forward point is entirely independent of the level of the floor, a maximum accuracy can be expected.

Such a board might be used for a group of guns, each installing a pedestal and range-azimuth instrument over its proper coordinates on the board and observing on the common mechanical setforward point.

By using two adjustable, flexible steel tapes graduated in yards for the scale of the board, on the X and Y rails, the board may be quickly adapted to any locality by adjusting these flexible tapes to read the local coordinates. This also provides a means of adjusting the board. (Steel tapes are not shown in the sketch.)

It is entirely possible to construct this board in such a manner that it can be dismantled and set up again quickly thus adapting itself to the heavy railroad artillery.

APPENDIX III

DESCRIPTION OF THE CENTRAL PLOTTING BOARD RANGE AND AZIMUTH INSTRUMENT

(Plate IV)

This instrument takes the place of the usual gun arm on the main plotting board. It is actually a vertical-base instrument of accuracy and power inferior to the standard type now used in harbor defense artillery. It is mounted on an adjustable pedestal over the point on the plotting board floor representing the gun position. Range and azimuth corrections are obtained by charts and are set on this instrument. The operator keeps his cross-wires fixed on the mechanical setforward point on the plotting floor. The readers continually read ranges and azimuths to the guns (or this may be done automatically by an electrical follow-the-pointer system such as is used in the Navy).

This instrument is designed to increase the flexibility of the plotting system to a degree where the guns may be fired as quickly as they are loaded. It eliminates the predicted point now used.

This instrument can be graduated to a standard scale, which allows it to be used with any 16-inch gun battery, or by simply replacing the aluminum drum it can be quickly adapted to any type of heavy artillery.

Its approximate cost is estimated at twice that of a light engineers' transit.

APPENDIX V

DESCRIPTION OF THE MECHANICAL SETFORWARD POINT

(Plate V)

The device shown in plan and elevation on Plate V allows the guns to be laid constantly on a moving setforward point, thus eliminating the time-interval system and the predicted point.

A plate glass is mounted on the movable block B, parallel to the floor and as shown in the sketch. A hole through the center marks the point directly above the target when the plotting board is in operation. A pencil is mounted, as shown in the lower sketch, to record the track of the target. Seated in this hole and resting on the upper surface of the glass plate is a small revolving metal cylinder G which holds the adjustable steel springs *a* and *b* and the travel indicator F. The lengths of *a*, *b*, and F are automatically kept the same and controlled in amount by knurled cylinder E. At the end of the steel spring *a*, and attached to sliding base H, is a steel needle kept exactly upright or vertical by means of the sliding base H. This steel needle is the setforward point. Another sliding metal base I keeps the spring *b* in place and vertical. By means of the rods *c* and *d*, the springs *a* and *b* and the setforward point can be set in any position or to fit any track quickly. Spring *b* is always kept over the plotted track as seen through the glass floor. Spring *a* is then adjusted to indicate the predicted track.

A small wheel under block B records the travel for the time of flight of the projectile. The time of flight is determined from correction charts and set on a time electrical current breaker which divides the time of flight into tenths automatically and gives actual travel for the total time of flight on the "electric travel-

finder" dial (on block B), at the end of each of these short intervals. Pointer F, which moves perpendicular to track of target, is set to this travel (etched in concentric circles on the glass plate) whenever a change is shown.

The operator of the range-azimuth instrument keeps his telescope crosswires constantly on the mark on the needle representing the setforward point.

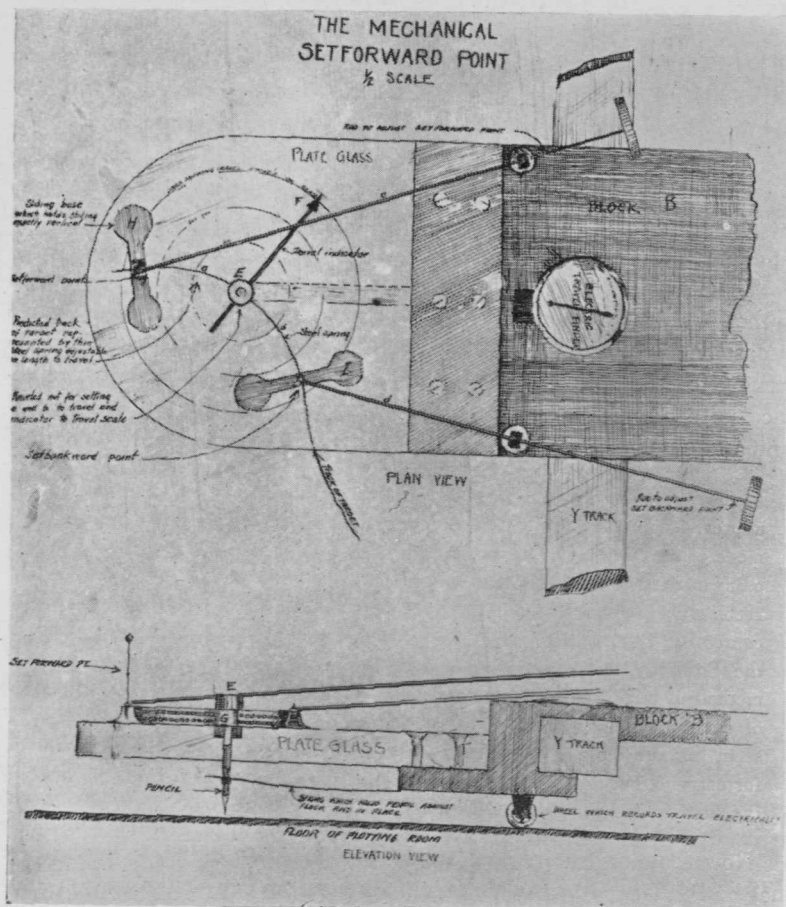


PLATE V

It may be advisable to state here that a safety device is contemplated with this system, whereby the operator of the range-azimuth instrument and the plotter could notify the gun commander by flashing a red light that either of their instruments was not working properly. The gun commander would not fire while the red light was showing. With a trained crew the use of such a warning light would be rare.

Military Mental Methods

Tactical Training as a Business Asset

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

THE following extract from a personal letter from a Reserve officer to his correspondence school instructor reveals an aspect of military training that has an interest value both within and without the Army. The appreciation it evinces is relatively inconsequential; what is important is that he finds certain military methods orthodox for his commercial purposes and is able to apply them with success, which merits an examination of the *raison d'être*.

The letter writer is Captain——, CA-Res., until recently assigned to the ——st Coast Artillery (Ry.). He is taking the Advanced Course (Coast Artillery), appropriate for Reserve officers of captain's grade seeking to establish capacity for advancement to major, and his reference is to Subcourse 1, "Combat Orders and Solution of Problems," which he lately concluded with a high rating. Here is what he says:

Thank you very much for your written critique on my examination. The approved solution afforded me a great deal of specific information as to mode of expression. I was particularly glad to note that my process of reasoning arrived at an identical conclusion. To me the ability to analyze and reconstruct and to reason logically is one of the finest faculties, and this course has been a distinct aid to me. I am now applying the "Estimate of the Situation" to all my personal and business problems, and my new method of attack on problems and their solutions has received a great deal of compliment from the people with whom I am in business contact, who seem to value an organized manner of thinking and application of means for carrying out a decision. So you see the value to me lies not only in having furthered my military education but also my commercial work.

Now the significance of Captain ——'s statement rests in the fact that he is engaged in the merchandising end of one of the largest concerns in New York City, in a capacity that requires seasonal estimates of the business situation from the marketing standpoint, wherein account must be taken of many collateral factors in the problem of procurement, and in which, as in most business affairs, the time factor is an important element. It would seem needless to add that the promptness and correctness of the conclusions drawn from such estimates naturally enter largely into the success of his employer's operations, if it were not for the purpose of rounding out the military tactical similitude.

It should be further stated, for qualificational effect, that Captain —— is a practical soldier. Between his World War service and appointment in the Officers' Reserve Corps, in which he has played an active and constructive part, he held a commission in the ——Coast Artillery (HD), Mass. N. G., where he is reputed to have shown marked practical ability. This tendency may be ascribed in part to an inherited talent, for a direct ancestor has fought in every war of our republic except that of 1812, beginning with a great-great-grandfather who was not only an officer in the revolutionary army but subsequently the first Secretary of the Treasury. All of them were also successful business men.

One not infrequently hears military training qualified as of no practical benefit in civil occupations. In fact, the comment is often made that constant military service as an officer unfits a man for successful competition in business, a broad statement that will be found to be only partially true if applied with due discriminations. Long professional military service, for instance, may truly impair ability to compete in many lines against those whose experience in business gives them the advantage of familiarity with the fine points of the game. The habit of disciplinary control, also, is mainly inapplicable outside of the military service; though the reverse effect, habitual subordination to discipline, is an individual enhancement for civil employment of most any sort. Again, it may be true that military administration methods are not applicable in civil corporate endeavors, yet one finds a striking general similarity in the administrative systems of many big corporations with extended interests engaging a large personnel, even if their details differ greatly. Nor is this unexpected considering that the same general principles underlie the systematic coordination and effective control of the subordinate operating groups of any large organization.

On the other hand, military training unquestionably develops leadership and directive ability, besides infusing self-confidence and a strong sense of responsibility, qualities whose value is by no means confined to the military services. But what is more to the point, which is what Captain ——'s testimony brings out, is that it instills a habit of clear, logical thinking towards a definite correct conclusion. This comes principally with the tactical training of an officer, as distinguished from his administrative training or his character development, in which this feature is not left to incidental growth, but is made openly a part of the training scheme.

Here is something that should have a high value in business efficiency, and yet is not necessarily assured from business experience. Nor is it believed that any commercial organization makes a point of

directly training this faculty, in so far as concerns teaching positively any method, as is done in the Army. The business man who inherently has the quality may evolve it by unconscious practice through the upward steps of his career towards the goal of success. But many do not succeed in business beyond a very ordinary measure because they have never recognized this faculty or have not known how to develop it, or else the opportunity to do so has never come to them. In this intensive age there is much lost talent because of that.

Lack of methodical thinking is manifested in the run of business letters, which indicate its existence also in the more direct transaction of affairs. George Palmer Putnam, of New York, treasurer of G. P. Putnam's Sons, in an address before the 20th Century Club of Boston recently, deplored what he called "the amazing inability of the average writer of business letters to write what should be expressed." It is so common to see such letters composed of one long choppy paragraph full of unsorted information, its statements of fact or thought inadequately linked, some essentials perhaps overlooked that may or may not have been obvious enough to the writer, which a careful man finds necessary to peruse more than once to be quite sure he gets the writer's full meaning. Of course, any man of ordinary dictional ability, given time, pencil, pad, and eraser, should be expected to draft an intelligent letter. It must be held in mind, however, that practically all business letters are dictated directly to the typist, most often in quantity at a stretch. The time element is here. Since a letter is but a means of mental expression, the condition that Mr. Putnam deplored therefore can be taken reasonably as proving a general lack of orderly thinking—a failure to coordinate ideas quickly and to marshal facts readily.

In the Army this failing is forestalled by strict rules that compel a logical and concise presentation of what must be stated. The prescribed rules for military letters are designed to restrict the writer to proper sequence in the grouping of facts and thoughts. They exact that the opening paragraph shall epitomize the general proposition, preceded by due references to connect it with its proper origin; that each succeeding paragraph shall embody separately and sequentially the various considerations and collateral facts; and that where there is much detail it shall be assorted into subparagraphs. This naturally tends to brevity and produces clarity, which of itself stimulates straight and orderly thinking, with a minimum of error.

But in tactical matters the Army has a more definite purpose in actually teaching method for the practice of clear thinking, and so makes it a direct part of its science. In tactical work the chance of false conclusions must be reduced to the minimum while the ability

to arrive quickly at a right decision must be developed to its maximum. When an officer of the combat branches comes to the grade of captain, and from then on through the field grades, the development of his tactical ability becomes paramount. In this the teaching of principles and their application to situations is but a part. A correct estimate of the situation is the really vital thing, for which orderly reasoning is necessary. A wrong conclusion may easily follow from a faulty balance of factors, whose relative values depend on their consideration in entirety—the oversight of any one essential may destroy that balance. Tactical ability therefore includes an ability to think clearly and reason logically, to discard readily the unessential and muster the essential considerations, to reach a definite conclusion promptly and express its results understandably. Without this a mere knowledge of tactical principles and their application is badly discounted.

This demands a correct and more or less fixed process. Our basic texts tell us that a commander in combat confronted by a special situation “must go through a certain well-defined mental process in order to arrive at a sound decision,” and that “experience has demonstrated that if the individual be trained to follow a prescribed sequence of reasoning, the handling of the elements of a problem becomes almost automatic and the chances for error and omission become more and more remote.” Military training along those lines by established method is therefore to a great extent made a mechanical process, which is no small part of the scheme of the general service schools. A form involving all the possible influencing factors is laid down as a guide in directing the mind, and repeated problems are imposed for its exercise. By this it is intended to fix in the military student’s mind “the sequence of reasoning followed therein so that he will follow a similar sequence in making estimates of the situation in actual operations when time does not permit of a leisurely estimate.” The underlying principle, to repeat, is that unless one habitually follows a definite and well-determined process in all situations, the certainty of estimating all factors and so insuring a prompt and well-judged conclusion under stress is lessened.

Here is where military methods are ahead of ordinary business practice, a fact which Captain —— has been quick to discern. Reverting again to our basic tactical texts, we find that the apparent intuitive ability of some commanders to solve military problems is ascribed less to any special gift of genius than to the keen working of an alert and highly-trained mind. The reverse is probably true generally in the business world. The outstanding commercialists will usually be found to be those who have an intuitive capability for quickly visualizing a situation in all its aspects, and thus are able to best utilize their know-

ledge of the practical details. Excluding these, most business men in the general run may make a correct estimate of any situation, but their mental procedure is usually comparatively slow and often indirect, and frequently errors remain for subsequent elimination. They are prone to take time to think things over. Where there is time to con over and deliberate all factors and considerations, this is no great handicap, but there is not the best efficiency in it where the judgment must be reached quickly and accurately. In competitive business the proverbial relation of time and money is a practical consideration, no less than is the relation between time and economy of lives and material in combat. An objective may be attained at too great a cost, so that little profit remains. Which brings to mind the fiction of the two soldiers who were discussing a certain general. Declared the one, "He's a winner; he'll take that salient if it costs him 50,000 men." Commented the other, "Say, he's a liberal guy, aint he!"

When a great emergency arises, such as are created from floods, organized violence, stampedes in crises, due to a sudden and severe disorganization of normal conditions, we find military men often put on the job. This is not only because of their ability for organization and effective administration, but because they are fitted by their training clearly to estimate situations suddenly confronting them, to formulate promptly a decision out of such an estimate, and to carry the decision through. A man who has served reasonably long as an officer is for the same reason by no means unfitted to cope with the problems of business life, and having acquired knowledge of the practical details of any line, the application of military methods in tackling its problems should prove an advantage.

It is therefore interesting to have this testimony from a Reserve officer that he finds military tactical training "a distinct aid" in solving his commercial problems, and it should encourage more to take up the tactical courses of the Army Correspondence School. It is the more interesting that Captain——'s employers appreciate the methods he has derived from his military schooling. It would be well indeed if more could do that.

Troops do not get disciplined in ninety days.—
Benjamin F. Butler, in Butler's Book.

An Improved T. I. System for Mobile Artillery

By TECHNICAL SERGEANT RALPH L. JOHNSON, C. A. C.

THE following is a description of a time-interval system which was tried out during the 1926 encampment of the 244th Coast Artillery, New York National Guard, which regiment is armed with 155-mm. guns. During the past few years several T. I. systems have been tested but all proved to be either too bulky for use in the field or else had some inherent fault that made it inadvisable to continue their use.

The circuit shown in Plate 1 was published in the COAST ARTILLERY JOURNAL a year or so ago and at first appeared to be a very good circuit. When tried out it was found to have three faults that needed overcoming before it could be used to advantage. First, and worst, there was cross-talk at all times, *i. e.*, the secondary reader and arm setter could hear all data being sent out over the primary line, and the primary reader and arm setter could also hear the data being sent over the secondary line. This caused a great deal of confusion, especially when training new men as arm setters or readers.

Second, the "Howlers" at the gun positions did not give enough volume of sound and on a windy day could not be heard at all.

Third, the number of service buzzers needed to outfit a regiment made the completed apparatus (exclusive of lines) cover so much space that it was hard to get at and adjust one part of the apparatus without interrupting the service of the whole, and there being at least four buzzers to keep adjusted it was quite a problem to keep the system operating without having endless delays for adjusting.

To overcome the first and chief fault it was suggested by Major Charles O. Schudt, then Senior Instructor, C. A. C., N. Y. N. G., that if the T. I. line connecting to each base-end line were kept open-circuited except at the instant the T. I. signal was given, there could be no possibility of cross-talk through this line, the opening and closing of this T. I. circuit to be accomplished by relays operated by the T. I. apparatus. This was tried and proved very satisfactory but left faults two and three still to be overcome.

It was decided then to mount the relay and buzzer coil on one base with a special buzzer for the "howlers" at the guns. This proved successful but we still had a number of buzzer vibrators to keep adjusted.

It was then decided to try a buzzer having one primary coil and several secondaries, each secondary coil to be wound for the work it was to do. Several trial buzzers were built and the following is the data for building the buzzer finally decided on.

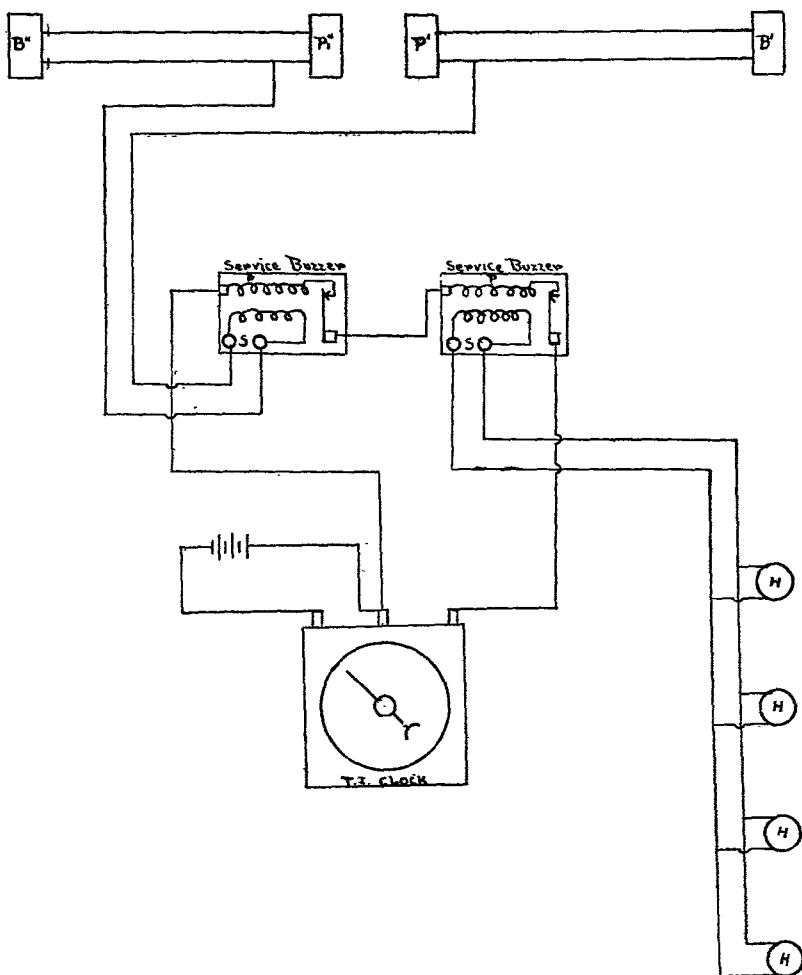


PLATE I

The core of the coil is of soft iron, $\frac{1}{2}$ inch in diameter and four inches long, the end pieces of the coil form are of bakelite, $\frac{1}{2}$ inch by 2 inches, with a hole $\frac{1}{2}$ inch in diameter through the center for the core. On this core was wound a layer of insulating material and on top of this 300 turns of No. 30 enameled wire were wound as evenly as it is possible to do it by hand.

This winding, which is the primary of the buzzer, was then given a coat of shellac and allowed to dry. One end piece was then removed from the form and four fiber rings slipped on over the primary winding and the end piece replaced. These rings are the spacers between the various secondaries and can be seen on the completed buzzer (Plate 5).

The Secondaries, S', S'', S''', Plate 4, that furnish the buzzer signal to the base-line stations, each consist of 300 turns of No. 30 enameled wire. The Secondaries S-S (Plate 4) are those that actuate the "howlers" for the gun positions, and also for the plotting rooms if so desired; each consists of 800 turns of No. 30 enameled wire.

The resistance of the telephone relay used was so high that it took

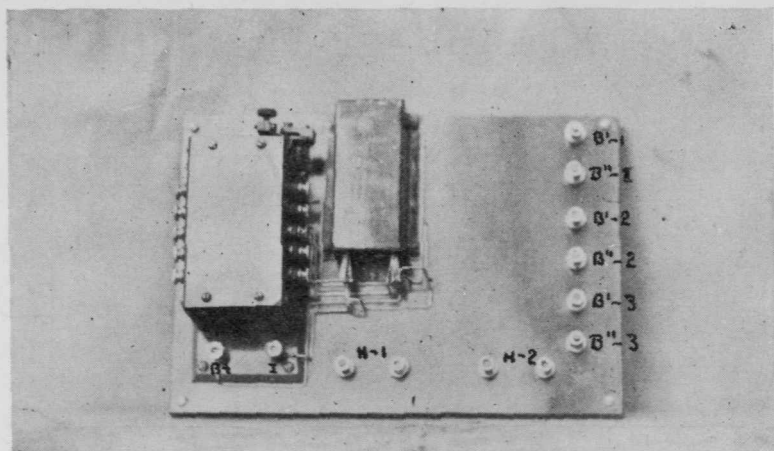


PLATE 2

about 15 volts to operate it, so it was rewound with 1000 turns of No. 34 enameled wire.

Plate 3 shows the relay with the cover removed and Plate 2 shows the completed apparatus as it looks when ready for use.

In Plate 2 the terminals to the right of the board connect as they are marked B'-1 going to one of the wires connecting B' Reader and B' Armsetter and the B''-1 to one of the wires connecting the B'' Reader and the B'' Armsetter—B'-1 and B''-1 being for use of one battalion's base line and B'-2 and B''-2 being for the base line of another battalion, etc. Either a T. I. clock or a T. I. apparatus may be used as an interrupter.

An apparatus was used by the 244th Coast Artillery, N. Y. N. G. during the past encampment although it was necessary to take a 30-

volt Edison Type battery to the field to operate it. The vibrator system requires from 4 to 6 volts and, as it draws very little current and for very short intervals, one 75-ampere-hour battery was all that was necessary for the two weeks in camp.

The terminal marked I (Plate 2) connects to one side of the interrupter and the one marked B plus to one side of the 4- or 6-volt battery, the other terminal of the battery connecting to the remaining terminal of the interrupter. The terminals H-1, H-2 are the "howler" terminals for the gun positions and plotting rooms.

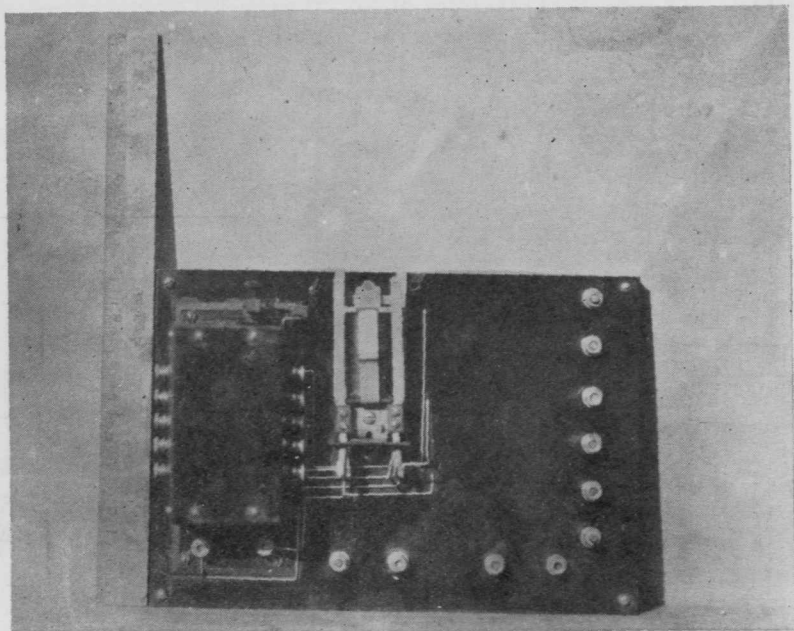


PLATE 3

The "howlers" at the guns were watch-case type telephone receivers lashed to small megaphones and placed in the rear of the gun positions. These howlers, when connected to the apparatus described, can easily be heard for a distance of 50 to 75 yards. The howlers used in the plotting rooms are the same as used at the gun positions excepting that no megaphones were used.

Plate 4 shows a complete schematic diagram of the system used when supplying T. I. signals for three separate battalion base lines, excepting that a T. I. apparatus was used as an interrupter instead of a T. I. clock.

The action of the apparatus is as follows:

When the contacts of the T. I. interrupter or clock close, the buzzer circuit is closed and vibrator operates; at the same instant the circuit through the relay coil is completed, the relay being in parallel

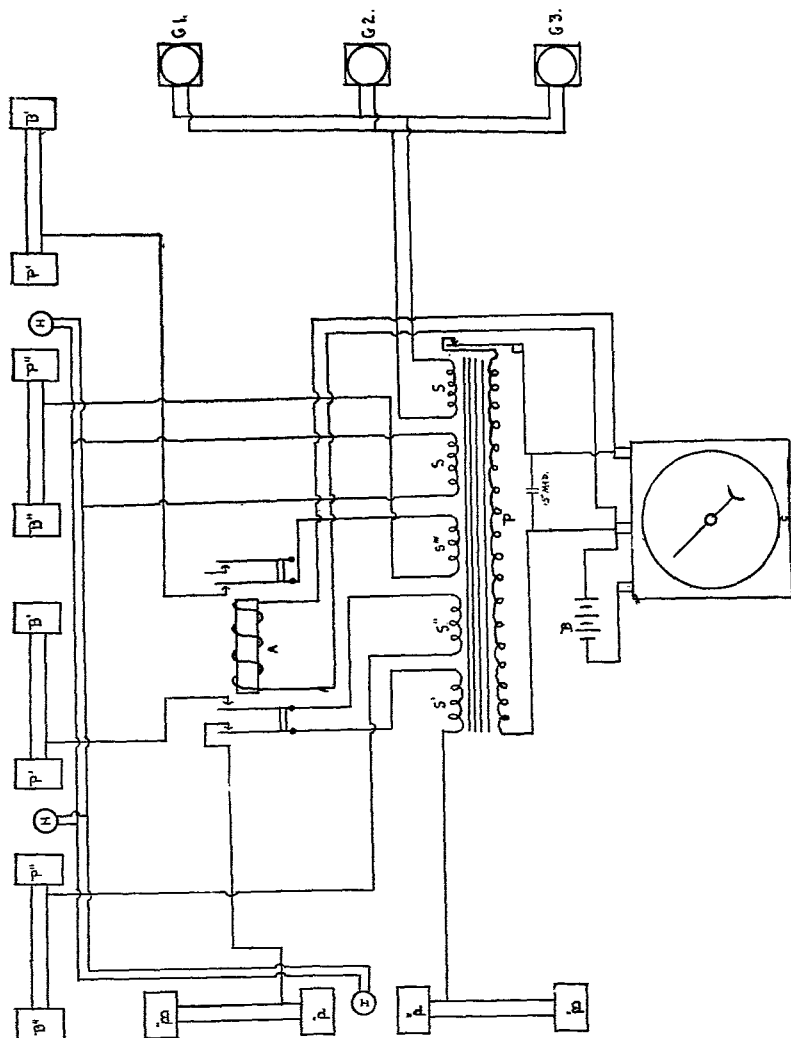


PLATE 4

with the primary of the vibrator coil. This causes the relay contact to close, thus closing the circuit between the primary and secondary lines of each base-end group, and the buzzer signal is superimposed on that group of lines.

When the T. I. interrupter contacts open the circuit through the buzzer and relay coils is broken, the relay contact open leaving no connection between the primary and secondary data lines until the instant the next time interval signal is given.

The apparatus described was designed to take care of the time-interval problems of a three-battalion group, each group having a separate base line.

The following is a legend of the diagram (Plate 4) which may be of assistance:

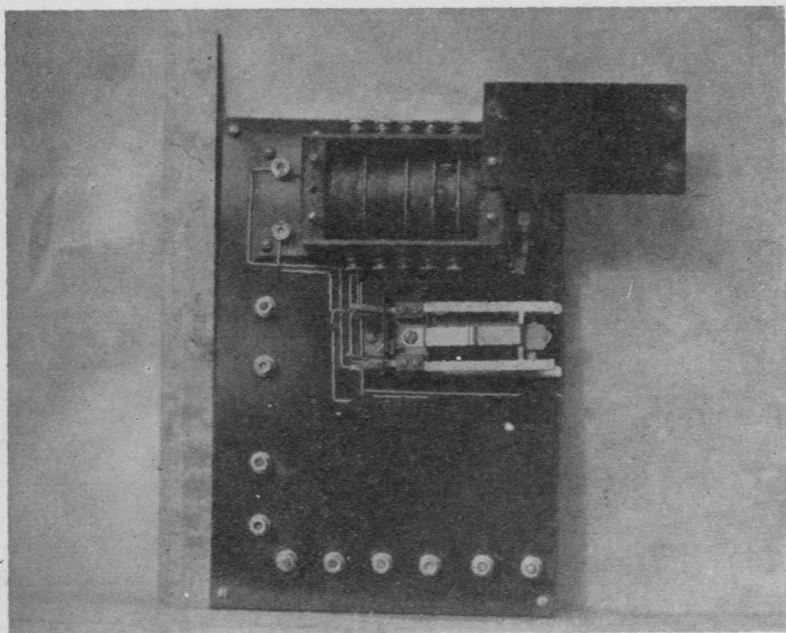


PLATE 5

P' = Primary Arm Setters.

P'' = Secondary Arm Setters.

B' = Primary Readers.

B'' = Secondary Readers.

H = Howlers in Plotting Room.

G-1, G-2, G-3 = Howlers at gun positions.

S'-S''-S''' = Secondaries of vibrator coil (400 turns of No. 30 enameled wire).

S-S = Howler Secondaries (800 turns of No. 30 enameled wire).

P = Primary of vibrator coil (300 turns of No. 30 enameled wire).

A = Telephone relay, 4-circuit (rewound with 1000 turns of No. 34 enameled wire).

B = 4 or 6-volt storage battery.

C = T. I. clock or T. I. apparatus.

Army Officers' Pay

Standards for Comparing Pay with Services Rendered

By MAJOR MARK L. IRELAND, *Quartermaster Corps*

INTRODUCTION

SECRETARY of War Dwight F. Davis, reporting December 10, 1926, as required by Section 4, Act of Congress approved July 2, 1926, the results of alleged injustices in promotion-list arrangement of officers according to the National Defense Act, said in part:

It has been the fixed policy of the Government to pay its military officers salaries that are barely sufficient for their current needs, savings from such salaries that would provide for their declining years being impossible. Officers were, prior to 1861, continued on the active list at full pay until the time of their death, even though precluded by age or disability from rendering any service. . . . Every officer contributes toward the expenditures for maintenance of the retired list, first, by rendering a long period of service at a salary that is exclusive of possible savings to provide for his future, and, second, by the reduction of his pay upon retirement. . . .

Properly conceived the cost of the retired list is but a necessary element of the cost of maintaining an efficient active list. In so far as proper expenditures for the retired list are curtailed, will the efficiency of the active list be reduced?

The time has arrived when the facts as to the proper relation of retirement and expenditures for the retired list to the maintenance of an efficient military establishment must be faced, and whatever increase in expenditures for the retired list is necessary in order to preserve efficiency in the active establishment, must be made.

THE OBJECTIVE

Secretary Davis is not discussing how much individual officers will receive in either active or retired pay, but how much must Congress appropriate over say a forty-year period for active and retired pay "in order to preserve efficiency in the active establishment." Qualitatively the problem is described. Quantitatively it remains to be measured.

The writer attempts no direct answer. He hopes to facilitate the solution by describing definite standards for comparing Army officers' pay with services rendered.

Standards are needed to determine what degree of "efficiency in the active establishment" a given sum will purchase, or conversely. Now, when wars involve all citizens, the art of war must be preserved and developed for the mass by technical experts. Since Americans will not

be content to hazard their fortunes and lives on inferior methods, the question is: How much will the highest efficiency cost? To obtain professional men of desired caliber, the government must compete with civilian professions and business in general.

STANDARDS PAST AND PRESENT

Need for higher standards for military officers created the Military Academy in 1802 and the Naval Academy in 1845. The term "Academy" bears testimony to constantly increasing requirements. Both academies were founded before the day of high schools. It was a great advance in standards then to take youths and give them training intermediate between elementary schools and colleges, adding rigid discipline. Tactics lagged far behind elementary science and engineering. Classical college courses prepared for "the professions." Few beside ministers, lawyers, or doctors possessed education sufficient to write early scientific and technical books.

To envision the change which has occurred, sharp contrast with present requirements is necessary. Army Regulations 605-5 prescribe:

The candidate must be at the time of appointment [as 2d lieutenant] . . . Between the ages of 21 and 30 years; . . . A warrant officer or enlisted man of the Regular Army of more than two years' service; . . . or a *graduate of technical institution* approved by the Secretary of War. . . . Approved institutions will be those maintaining the full equivalent of a four-year course of instruction in technical or scientific subjects, the successful completion of which entitles the graduate to a degree in a recognized technical science.

The real point is that examinations are competitive and the same basic mental examination applies to *all* candidates. He who lacks equivalent education must beat technical graduates on their own ground. Certain branches prescribe still more severe requirements.

With concentrations of men decreasing and of artillery and other engines of war increasing per unit of area on battlefields, modern war becomes a contest of engineers and scientists.

PAY, PAST AND PRESENT

TABLE I—CHANGING RATES OF ARMY PAY PER ANNUM

Grade	1782	1785	1790	1812	1833	1861	1867	1870-1907	1908	1917-8	1922
Major General	379						5772	* 8796	* 9668	* 9668	* 9700
Colonel	151						2544	5508	6328	6328	7200
Lt. Colonel		600					2256	4864	5654	5634	6926
Captain	76	420				%1800	1530	2916	3923	3923	3936
2d Lieutenant	38						1350	1688	2143	2143	2196
Private			24	96	72	132	192	158	180	360	252

* Includes money value of all allowances for all grades named except private. All enlisted men are quartered, rationed, clothed, etc., at government expense.

% Pay and allowances of captain were temporarily raised during the Civil War to \$2796.

Revolutionary history shows that our independence was dearly purchased, measured in privations and suffering of our Continental soldiers and their dependents, but inhabitants not located upon battlefields or Indian frontiers lived most comfortably and quite profitably. From community and colony treasuries they paid huge bounties (sometimes \$1000 above what Congress offered for Continental service) for short periods of summer militia service, and derided "the ragged and tattered Continentals." The pay of \$3.15 to second lieutenants, \$12.60 to colonels, and \$31.60 to major generals *per month*, when paid, if at all, in Continental paper money, the value of which gave birth to the expression: "Not worth a Continental," indicates that most Americans of 1776 purchased their independence at bargain rates.

Ganoe, referring to 1782, says:

Economy was made to bear hardest upon those who had shouldered the burdens of the conflict. The half pay promised to the officers had never been produced. . . . They had received not over one-sixth of their pay during the whole Revolution. Their private resources were at an end and their friends were wearied and disgusted with their repeated applications. . . . Since nothing had been given them for clothing after 1777, they were constantly chilled by zero weather and often in the unspeakable hospital. . . . The "deranged officers," who had been squeezed out of service by union of smaller regiments and *who had been provided for in no way*, often times had to sell their clothing or beg. They were treated by the public as idlers living on the public bounty and were derided by their neighbors as "half-pay officers." These very leaders, who had risked their lives to quell mutinies, who had stood before death and torture in order to make the country safe and independent, were ridiculed and neglected. So great was the public stigma on these men that the word "soldiering" came into use as a synonym for idleness.

If the country had given the Continental soldier honor and had made him independent for the rest of his life, it could not have begun to repay him for his services. But when it failed in its promises and even scorned him in public, the name of ingrate is scarcely too strong a term. As shall be seen later, this attitude is not going to be confined to Revolutionary days.

After each war the Regulars have suffered reductions of pay *in grade*. Sometimes pay has fallen below pre-war pay. Congress usually increases pay during war while citizen soldiers serve. During the World War, with officers, the increase came as especially favorable rules by which officers, other than those of the Regular Army, received increases for length of service. Inborn distrust of regulars, probably inherited from billeting British regulars upon the colonists prior to the Revolution, may account for this.

Viewing past experience, officers may congratulate themselves upon Secretary Davis' broad sane recommendations and their favorable re-

INFLUENCE OF FLUCTUATING VALUE OF THE DOLLAR ON PAY OF FEDERAL OFFICIALS

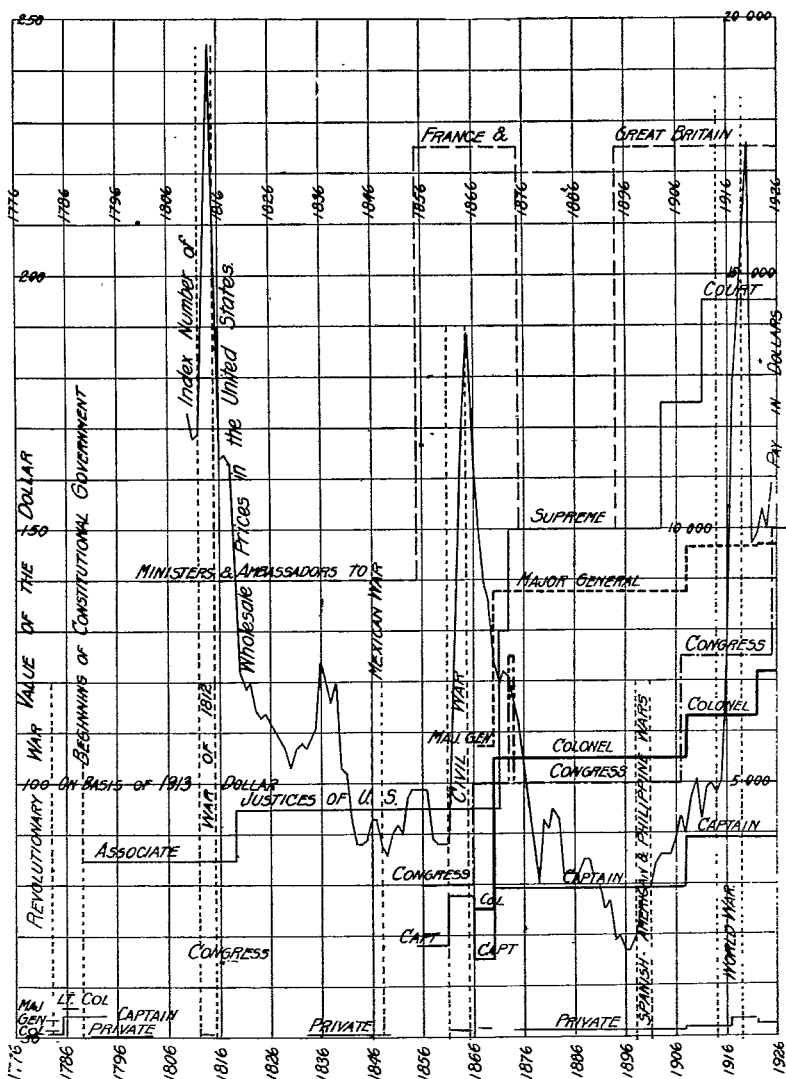


FIG. 1

ception by Congress. In 1920 Congress voted partial relief because of the high cost of living, and in 1922 replaced the bonus in part by nominal increases over 1908 rates.

HOW DOLLAR FLUCTUATIONS AFFECT FEDERAL PAY

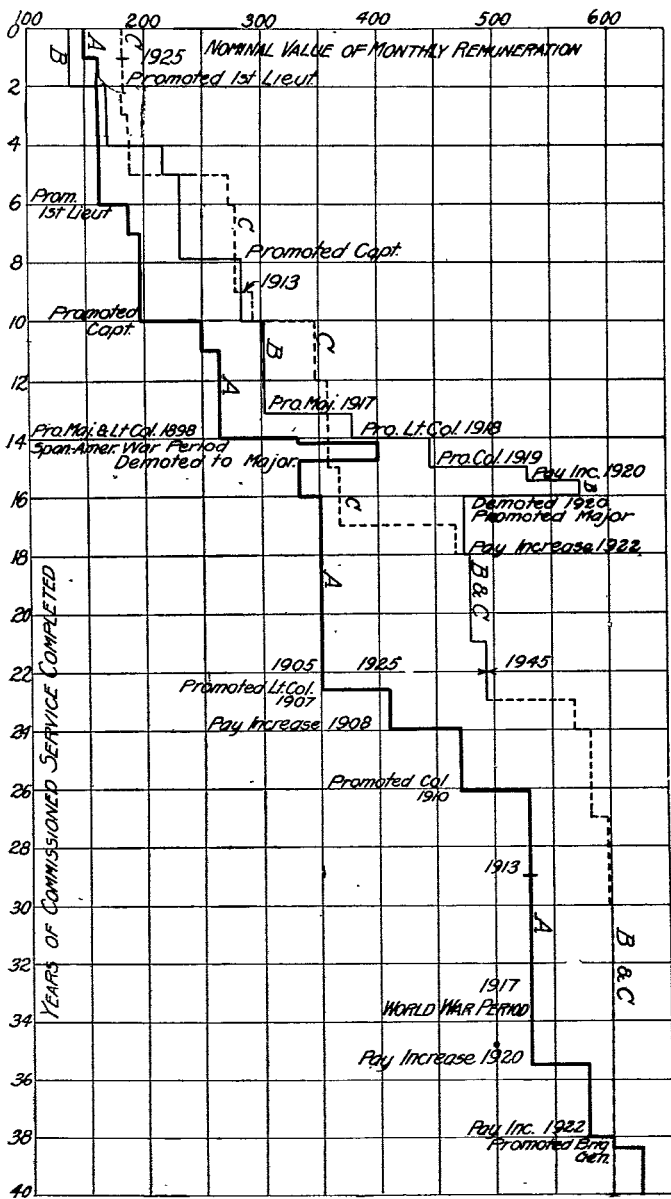
Fig. 1 charts pay of Congressmen, Associate Justices of the Supreme Court, Ministers, and Ambassadors to Great Britain in relation to Army pay in Table I. Pay of Congressmen at \$6 for each day of attendance and for each 20 miles of distance each way (30 cents per mile) from 1796–1816, or at \$8 per day of attendance and for each 20 miles (40 cents per mile) from 1818–1856, because of variable session lengths and variable distances, cannot be plotted.

Very recently economic research produced “index numbers.” “Index Numbers of Wholesale Prices in the United States” in Fig. 1 shows wide fluctuations in the dollar’s purchasing power. Lacking knowledge of causes of price changes, variations in purchasing power of money could not be earlier employed in automatic adjustment of pay. Remedies were undertaken after maximum need had passed. Higher salaries prevailed over depressions when purchasing values were high. Peaks and depressions are so spaced that alternate generations suffered hardships or “lived in clover” from legislation too late to alleviate distress requiring it.

Some will argue that Fig. 1 shows that time corrects distress and legislation would repeat belated benefits to wrong generations. *This is no argument against regulating pay by purchasing value.*

The hasty conclusion cited, errs in assuming that fluctuations repeat themselves at regular intervals with approximately equal price ranges. Knowledge of causes and effects is now far more common. Most interests profit from uniform prices. As economic knowledge increases these interests apply correctives. Speculators on fluctuations tend, by buying on low markets and selling on high, to lessen variations.

Many American traders were ruined by the Embargo Act of 1807 and British war blockades. Home industries, created to replace foreign goods, thrived. Since 1807 we have traversed all stages from poor fur-trading, agricultural, and sea-faring people to a nation importing food stuffs and raw materials and exporting large excess manufactures. In 1806 Congress began the National Pike from Cumberland, Md., to and beyond the Ohio. Fulton’s steamboat made its first trip in 1807. The first railroad train ran in England in 1829 and in America in 1830. In 1830 we ate, wore, and used products of the home farm. Today our food, clothing, furniture, etc., employ products of six continents transported over seven seas.



COMPARATIVE NOMINAL REMUNERATION OF OFFICERS

A is now a Brigadier General, B a Major and C a Second Lieutenant, originally appointed in 1884, 1904 and 1924, respectively. Future pay is derived from Act of June 10, 1922. Based on length of service. B's remuneration is set back 20 and C's 40 years to bring service of same length under A's.

FIG. 2

In 1876 telephones were invented. In 1892 Mr. Duryea operated our first gasoline automobile. Telephones and automobiles 20 years ago were luxuries. Now factory workmen, building trade artisans, and farm laborers drive their cars to work. Now Army captains may own Fords without being "victims of cost of high living, rather than high cost of living." *The prime cause for higher salaries is ascending standards.*

Increases of federal pay therefore reflect not mere growth in revenue, credit, and wealth (ability to pay), but ascending living standards. Government officials could live more cheaply if they wore homespun, ate frugally, and lived by fireplaces in their great-grandfathers' log houses. Where could they live under such conditions? *How long would American tax-payers accept such officials?*

Because Americans desire their Army to equal in appearance any organized force and soldiers reflect their officers' example, this precept holds:

Costly thy habit as thy purse can buy,
But not expressed in fancy; rich, not gaudy;
For the apparel oft proclaims the man.

Meeting required standards accounts for much of one's expenditures.

While post-war decreases in Army pay prevail, this is not apparent in other federal salaries. Congressional pay of March, 1873, was quickly repealed, due to the panic that autumn. Ambassadorial pay fell, too. Apparently their only decrease came then. Then 1873 Supreme Court increase stood. Army pay, increased July 15, 1870, weathered the panic. Those surviving the 1869 drastic eliminations profited by legislation terminating prior low pay eras, also from increased purchasing power.

Since 1871 pay of Associate Justices has increased from 78% to 203% of Major Generals'. Since 1866 Congressional pay has increased from about 52% to 105% of Major Generals'. During the Civil War Congressmen received little more than Captains; now they have gone about five grades senior to Captains. *Professional military requirements have greatly increased while relative pay has greatly decreased. Attractiveness of the profession has decreased correspondingly.*

While statutes restrict all federal officials as to private employments, duties of Army, Navy, Marine, Coast Guard, Public Health, and Coast and Geodetic Survey officers and frequent changes of station make distant supervision of private interests and even reasonable attention to investments most difficult. Other officials are much less hampered. They can make provision for their declining years which military officers cannot. Civilians, not forced to retire at 64 or earlier, nor on as slight physical disability, may extend their full pay periods beyond

COMPARATIVE PURCHASING POWER OF REMUNERATION OF OFFICERS

A is now a Brigadier General, B a Major and C a Second Lieutenant, originally appointed in 1881, 1904 and 1924, respectively. Future pay is derived from Act of June 10, 1922, based on length of service. B's remuneration is set back 20 and C's 40 years to bring service of same length under A's.

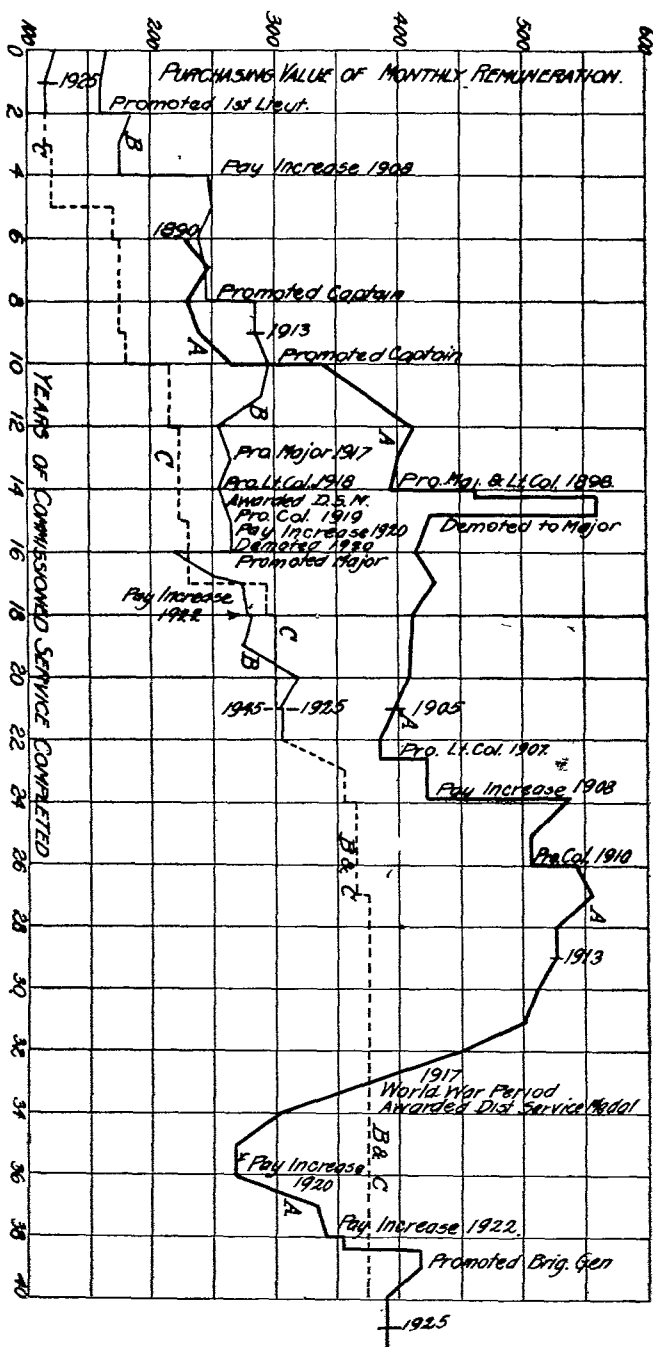


FIG. 3

ages open to military officers. *Fig. 1 shows that any decision, if made, in 1861 to lower active pay because of the retired pay then granted, has not been followed.* That affords no explanation for the relative large increases to other officials.

Earlier retiring ages require added compensation if high professional types are attracted. Retirement early enough to permit supplemental employment is advantageous. *When postponed beyond 45, the advantage becomes a marked disadvantage proportionate to extension of the period of eking out one's existence,* not on 75% of pay and allowances but of pay alone. Men between 45 and 60 encounter many demands that cease later.

Retired pay came in 1861, as stated by Secretary Davis, to rejuvenate the active establishment. High physical fitness and endurance are required because of extra hazards and demands of military service. Exigencies of service overtax one's stamina earlier than less trying occupations. Retaining for their last efforts those partially worn out, deadens the active establishment. To attract suitable youths to serve, worn out officers must receive adequate reward. The government must pay for what it demands. *Combining high standards in three lines—mental, moral and physical—raises cost.*

NOMINAL INCOME VERSUS PURCHASING POWER

Fig. 2 shows: "Comparative Nominal Remuneration of Officers." Three Quartermasters, a brigadier general, a major, and a second lieutenant in 1926, originally commissioned in 1884, 1904 and 1924, are compared. A is a West Pointer. B and C are graduate engineers. B's remuneration is set back 20 and C's 40 years, bringing equal service under A's experience. *Nominal* remuneration of B and C during practically the whole 40 years exceeds A's experience.

Fig. 3 shows: "Comparative Purchasing Power of Remuneration of Officers." The scheme and officers compared are identical with Fig. 2, except purchasing power of their remuneration appears.

A received maximum remuneration in 1898. Later increases never neutralized the falling dollar. *The General's salary precludes his living as well in 1926 as he could on captain's pay in 1896. While American living standards have risen, the Army's have fallen.*

B has never received on equal service as valuable remuneration as A, except after 4-6 and 8-9 years. B became a World War colonel and A a Spanish-American War lieutenant colonel, each with 14 years' service. Both received the D. S. M. for "exceptionally meritorious and distinguished service" in 1918. *B's 1912-5 captain's remuneration overmatches three promotions in 1917-9.* While rendering distinguished service, B's three promotions barely held his pay constant. A's de-

creased markedly. *Falling prices late in 1920 made B's demotion from colonel to major yield more than colonel's pay that spring.*

C began in 1924. A's experience exceeds C's prospects for 33 years. B's experience exceeds C's prospects except during three years.

This economic situation applies to civilian employees. A Depot's chief clerk receives \$2800, his maximum nominal pay after 44 years' service. He enjoyed maximum remuneration from \$1800, received in 1896.

* * * * *

ADDED DEMANDS UPON MILITARY OFFICERS

The principal former tasks were:

- a. Training personnel;
- b. Providing assurance against foreign aggression;
- c. Defense of insular possessions;
- d. Preserving and developing national capacity for defense;
- e. Sustaining civil government in republican form.

The National Defense Act eliminated or reduced none but added:

- a. Organization and training of new kinds of troops, all highly technical—Air Corps, Chemical Warfare, Motor Transport, Tank Service, Antiaircraft Artillery, Sound and Flash Ranging Companies, and numerous maintenance and supply units;
- b. More extensive and intensive National Guard instruction;
- c. Organization and training of Officers' Reserve Corps and Enlisted Reserve;
- d. Organization, development, and operation of Reserve Officers' Training Corps as the agency for military training in schools and colleges;
- e. Organization, development, and operation of Citizens' Military Training Camps for citizens not attending colleges;
- f. Aiding the Assistant Secretary of War to create and develop plans and surveys for emergency mobilization of industries—Tasks for Regulars to conduct in peace which required the most skillful business talent and technical knowledge in 1917-8.
- z. Mobilization planning to organize transition from peace to war and return.

STANDARDS REQUIRED IN MILITARY AND OTHER PROFESSIONS

Unrecorded policy to maintain "a small but perfect Regular Army" fixes standards for Army officers. In 1917-8, only 30.5% passed physical standards for enlistment. Civil professions do not bar physical defectives. Few, save the clergy, live under as exacting codes as the

Articles of War and Army Regulations. What other profession expels its members for "conduct unbecoming an officer and gentleman," tolerates no evasion in assuming personal responsibility, or measures everyone by: "Does he render willing and generous support to plans of his superiors, regardless of his personal views"? What civil profession requires as thorough and as wide range of professional knowledge and skill? *Where else must one advance two or three grades because of overnight expansion?*

Not all officers meet Army standards. Yet where are standards more rigidly enforced?

ARMY SERVICE AND PAY COMPARED WITH ENGINEERING SERVICE AND PAY

That modern wars are extremely technical and involve the whole nation is generally conceded. Accomplishments of the engineering profession win universal admiration. To what other profession are military men more comparable? *Neither profession is overpaid.* That the Navy, Marine Corps, Coast Guard, Public Health Service, Coast and Geodetic Survey receive Army pay intensifies the comparison's merit.

Not all members of either profession are college graduates. Each has its proportion of unsuccessful graduates. Professional ethics are similar. In neither may one conceal his diagnosis, plan of action, remedies, or expectancy. In both, one plans not merely his own activities but cooperative action of numbers outside his group. Military officers devise, invent, plan, energize, inspire, manage, and lead. The engineer's sphere is largely advisory; few manage and conduct. Big salaries usually come to engineers who do. Reluctance to assume directive responsibility does not disqualify the engineer, though it sometimes limits his pay.

Recent investigations directed by Mr. Wm. E. Wickenden for the Society for Promotion of Engineering Education afford ready means for pay comparisons. Fig. 4 shows: "Earnings of engineering graduates as determined from figures supplied by graduates themselves. . . . In view of all available information, it seems probable that the figures given herein are substantially reliable and give a fair picture of earnings of engineering graduates." The writer has superimposed the officers' pay zone as fixed by the Act of June 10, 1922.

Comparison shows:

a. Army income range is narrowly restricted. Not merit but rate of promotion determines high pay and years of service low pay.

b. "Superior" and "above average" men fare much better in civil life.

c. Elimination should leave few "below average" and "inferior" officers to compare with low-pay engineers.

d. Engineering graduates' average is a fair average for maximum Army pay. Prevailing Army pay approximates 83% of engineers' average. Even this understates the Army's disadvantage.

e. While retired pay affords some compensation for excessive physical demands, present age limits on active service, and restricted

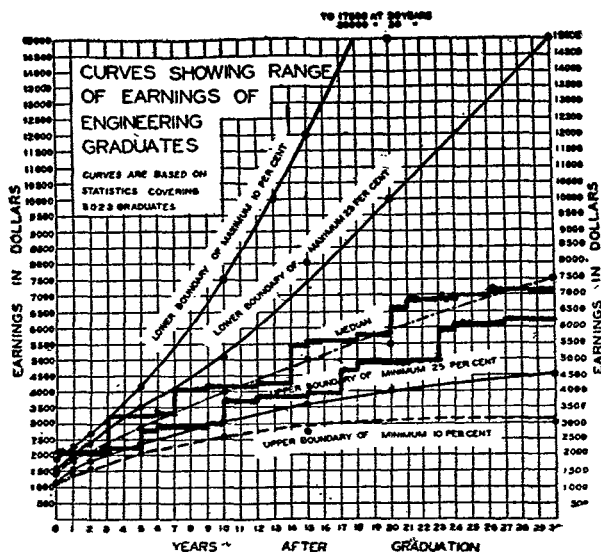


FIG. 4

private enterprise, no premium appears for high triple-standard qualifications, combined military and managerial abilities, nor lower age limits.

f. Adding what Secretary Davis says all officers contribute toward their retired pay would not bring the Army pay zone's center above engineer's average.

g. *Endless training produces capacity for emergency leadership two or more grades above officers' rank, pay, and experience.*

h. Business expense margins prohibit retaining such men. Supply and demand find each man's level. *Holding men far under their level is economically wasteful but is part of national insurance expense.*

i. Officers should be compared with others on relative abilities. A compensation basis ignores potentialities.

j. *The government buys military leadership, business management, or both combined far under prices for engineering executives.*

Fig. 5 shows:

The ratio of salaries of teachers of engineering to those of graduates in practice. At the start teachers' salary and total earned income exceed earnings of graduates by a small amount. At the end of one year their incomes are practically equal. After one year teachers earn steadily less than graduates in practice, until at the thirtieth year after graduation median total

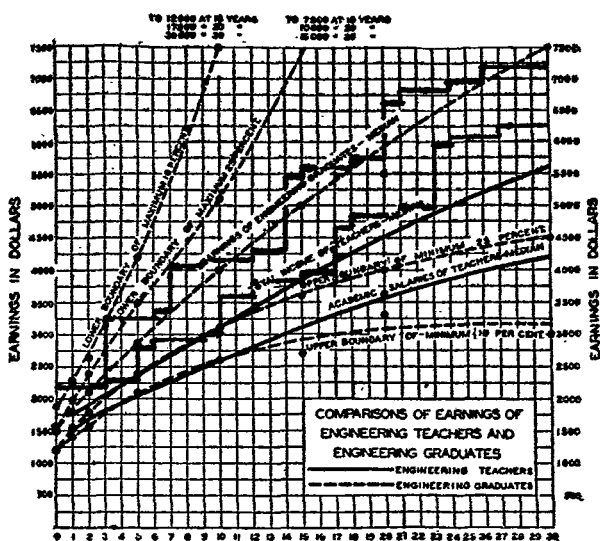


FIG. 5

earnings are but 74% of those of graduates in practice. When academic salaries—either median or most frequent—are made the basis of comparison the statue of the teacher . . . is still less favorable. The young teacher . . . must look forward . . . to smaller income than if he went into practice.

The Army pay zone has been superimposed, as in Fig. 4. Comparison shows:

a. Prevailing minimum Army pay slightly exceeds engineering teachers' median and is well above academic teachers' median.

b. Professors of military science and tactics receive more than college faculty averages. This emphasizes underpayment of college teachers—not overpayment of officers.

A Short Discourse on the Japanese Language

By LIEUT. THOMAS G. CRANFORD, JR., C. A. C.

TO a Westerner and especially to an American the Oriental languages are extremely difficult not only because of their absolute difference to our own tongues but because we are accustomed to languages which have a fundamental grammatical construction and not only is this true with English but with European tongues as well. With us given a fairly large vocabulary and a knowledge of the grammar we are able to converse and write freely in that language. And here is one of the greatest differences, the Japanese have no grammar themselves, it is a loosely constructed agglutinative tongue built up of words and suffixes on the base or stem. It is true that it does bear some similarity to other languages to which we are accustomed; namely, the main verb is always found at the end of the sentence as in Latin and I have been told that the language bears a slight resemblance to German in its facility to form compounds and in the construction of the sentence. However, neither of these two similarities are of much assistance to the student and he must face a language absolutely new and different from any which he has studied heretofore. It is true that a knowledge of other languages will help him, not because he will find similarities between the two, but because he has accustomed himself to speak and think in tongues other than his own and naturally will have a broader view of any language, for this reason we find Europeans making faster progress because usually they are forced by circumstances to know several languages while we Americans in our isolation generally know only our own.

As yet, the origin of the Japanese people has not been definitely determined. Some claim them to be descendents from wandering Malays, others from Polynesians, while others from the mainland of Asia. However, it is very probable that they are a mixture of all these races with others besides and the languages of all combine to form the present Japanese. We see many Japanese of pure Mongol type while others have almost Aryan features. Philologists have traced similarities of the Japanese to many languages but the two which have no doubt affected the language the most are the Chinese, from whom Japan derived her culture, and the Ainu, who occupied the country before the Japanese and who were pushed northward by them until now they occupy a very small portion of the northern islands.

Japanese words are of two kinds, the native Japanese and the Chinese, or Chinese-Japanese as they are called by some. There are some imported words from other languages such as *pan* from the French *pain*,* meaning bread, but they are negligible. The native words are usually of two or more syllables while the Chinese are monosyllabic. It is a peculiarity of the language that all syllables end in a vowel, *n* being the only consonant that stands alone. It is true that you do find other cases of this but the vowels are merely silent, e. g., *Hakki*, a white flag, a flag of truce, from *Haku*, white, and *Ki*, flag, both Chinese. The pronunciation is very simple and there are no intonations as in the Chinese. Most of the syllables are pronounced in a smooth-running monotone with practically no inflection on any particular syllable. There is also not so great a change in dialects as again there is with Chinese. The extreme southern and western dialects differ but slightly from that of the majority and the difference can be found chiefly in the idioms with which Japanese abounds, but there are also certain idioms even close to the capital, Tokyo, which differ greatly from the colloquial of the majority, so we cannot say that this difference forms distinct dialects. However, in many sections there is a slight difference in diction and pronunciation which is the natural result of the former lack of facilities for communication, and this difference exists even today. At first, this is confusing, even to the Japanese themselves, but is an obstacle easily overcome by a short stay in that locality. This exists only in the spoken language, while the written remains the same throughout the country. However today steps are being taken by the Department of Education to eliminate this, as all teachers are required to use the Tokyo dialect and within a short time this difference in dialects will disappear and we will find the same spoken language throughout the country.

Naturally, as the Ainu were pushed northward they left some trace of their language such as names of rivers, mountains, etc. It is, however, difficult to trace the connection and to say in just what way they have affected the language but we do know there are traces of Ainu in the present Japanese.

Some say that Chinese was first introduced into Japan about the year 286 A. D. by a mission from Korea and it was in this way that Japan got her first written language, the Chinese characters. The first pronunciation was the GO-ON, the dialect of the Kingdom of Go of the Yangtse river valley of middle China. Later a second stream from China came from the north and is called the KANON. This latter was

* According to Inoue's Dictionary. However, Capt. Brinkley's Dictionary derives it from the Portuguese *Pan*.

adopted and finally became the normal pronunciation of the Chinese character as used by the Japanese. Another pronunciation of the characters was introduced by the Buddhists about the 17th Century called the TO-IN but its use is limited to a very small number of characters, mainly some of those used in connection with Buddhism. For some of the characters, the KAN-ON and the GO-ON coincide, in others one of them is not used. Certain of the characters have two pronunciations and very often both of them occur close together which is very confusing to the reader until he has thoroughly mastered the subject. It must be understood, however, that even though these characters have Chinese sounds they also have a purely native reading, or in other words, a native word having the same meaning has been applied to the character and one must determine from the style in which the sentence is written and the context whether to use the native or the Chinese sound. Take the character for water, as an example. It can be read either *Mizu*, the Japanese reading, or *sui*, the Chinese. Ordinarily when it stands alone it would be read *mizu*; in compounds *sui*. This rule holds true for all other characters as well. One of Japan's chief characteristics is to adopt wholesale anything that she desires from another people, whether it is the language, laws or customs, and to make them a part of her own structure. This she did with the Chinese. As Confucianism and Buddhism flourished through the Chinese missionaries, so did other forms of intercourse; and as she adopted Chinese culture and religion, so did she adopt the Chinese language. New ideas and thoughts continued to come in and consequently new words were imported to express these, with the result that the Chinese gradually replaced the Japanese in many respects. So greatly was the Japanese language subjugated by the Chinese that even today she is wholly dependent upon the Chinese for words to express new ideas and thoughts. Do not misconstrue this to mean that today Chinese and Japanese are the same. They are not, because the pronunciation used by the Japanese is that used by the Chinese in the two above-named sections of China over a thousand years ago, while in those two same sections today the Chinese have long since discarded those sounds and a Japanese is as unintelligible to a Chinese in talking as he is to us. However, they can read each other's writing provided the Japanese do not use too much of the *Kana* (to be discussed later).

On the whole, Chinese words are mostly found in compounds, even though many of them are used alone. As their first literature was in Chinese, naturally Chinese-Japanese has become the language of Japanese literature and of the well-educated Japanese. The better educated the Japanese the more Chinese-Japanese words he will use, while the ordinary coolie will probably use only native words.

As the writing branched away from the purely Chinese form it was necessary to produce some means of writing the purely Japanese suffixes, particles, postpositions and the like. Out of this necessity there were developed the syllabaries called the KANA. The KATAKANA was the first devised and later the HIRAGANA. The KANA are abbreviated forms of certain characters used merely phonetically to express the Japanese sound, the meaning of the Chinese character having no influence on the KANA character at all. The KATAKANA is the square character or the one written with straight lines, the HIRAGANA is the modified form of the cursive Chinese characters which are usually used in writing, being much more simpler to write but at the same time much harder for a foreigner to learn. The Katakana is used mainly in signs, official documents and the like, being always employed in writing the names of foreigners and the names of foreign places, etc. The Hiragana, due to the speed of writing, is more generally used and is by far the more important of the two. Formerly many kinds of Hiragana existed but efforts have been made to standardize them and we generally find one system used throughout the Empire. There are 49 of these phonetic sounds and together with their Nigori or surds there are 74 in all, each of which is made up of a consonant and a vowel with the exception of *n*, and the vowels *a*, *i*, *e*, *u* and *o*, which also stand alone. The student will notice that our *l* and *v* and *x* are lacking in Japanese. Outside of that the letters of our entire alphabet will be found in Japanese sounds.

It is a peculiarity of the Japanese that the nouns have no gender or number, the adjectives no degree of comparison and the verbs no person. Chamberlin says: "The fundamental rule of Japanese syntax is that qualifying words precede the word they qualify. Thus the adjective or genitive precedes the noun which it defines, the adverb precedes the verb, and the explanatory or dependent clauses precede the principle clause. The object likewise precedes the verb. The predicative verb or adjective of each clause is placed at the end of that clause, the predicative verb or adjective of the main clause rounding off the entire sentence, which often, even in familiar conversation, is extremely long and complicated." This will give the student a bird's eye view of the grammatical construction as a whole but he must remember always that the Japanese do not look upon things as we do, certain things do not call forth the same thoughts as they do with us, and consequently one cannot lay down a hard and fast grammatical rule upon which one can build his sentences but must first learn the way in which the Japanese would look upon the same subject and translate it in that way. This

difference in thought is very confusing and is but one of the many peculiarities of the Japanese people.

One might say the Japanese is divided into two great parts; namely, the colloquial or spoken and the classical or written. In the colloquial, purely native words are more often encountered than in the written. However, as stated above, the better educated the Japanese the more Chinese-Japanese words he will use. The colloquial abounds in idioms which must be memorized before the meaning is clear. As the Japanese are a very polite people, even among themselves, their language is filled with humilitatives, used by the person speaking of himself or his possessions and exaltatives used in speaking to or of others and their possessions. The written may be further divided into the classical in which Chinese dominates, the semiclassical and the epistolary style, all of which differ greatly from the colloquial. Should one wish to go further than just talking with the people he must know the written language, which will necessitate the knowledge of the Chinese characters as well as practically a new grammatical construction from that of the colloquial.

Very few foreigners have made a decided success with the Japanese language and not more than one or two of them at the greatest have mastered it and at that it took them years of hard work. Many may get some knowledge of it but few of them will excell. Lafcadio Hearn said that it is impossible for an adult to learn the language but a child with his more flexible mind could because he would absorb the Japanese viewpoint and way of thinking which an adult cannot do. However, for our Governments to work in closer harmony and for the people to know each other better, some of us must study it and get out of it what we can.

APHORISME XIV

Wee perceive it easier to oppose (in the Schooles of Art) than answer; So by prooffe wee finde the same in the art of Warre: For it is safer to obviate and meet danger in the way, than to tarry till it, comes home to our doors. For there is ever more courage in the assailer, and commonly better successe.—Ward's Animadversions of War (London, 1639).



COLONEL FRANCIS L. GUENTHER

Commandant Artillery School, September 3, 1900-February 22, 1902

EDITORIAL

Ex-Kaiser Reads the Journal

IT is always a matter of gratification to the JOURNAL to learn that its readers find something of profit within its covers, for it is, unfortunately, not a general habit with readers to send in their views concerning the articles published. Good, bad, or indifferent, most of these articles are worthy of some form of criticism, remark, or discussion; and if they receive no comment from readers, it is difficult to determine the needs and desires of subscribers. We therefore welcome such stray bits of information as come our way, culled from personal letters or other sources, as straws showing the direction of the wind of readers' interests.

One such item came to our notice recently, indicating the care with which the JOURNAL is being read abroad. We have noted heretofore an apparently increasing interest in the JOURNAL among our readers in other countries, as evinced by reprints or reviews in foreign periodicals, requests for exchange, and a gradually augmenting subscription list, which can only mean that our contributors are producing material of value.

In its issue of February 6, the *Washington Herald* published a conversation in which ex-Kaiser Wilhelm and his close friend and former aide, Colonel Alfred Niemann, discussed national defense and America's attitude toward preparedness. In the course of a most interesting exposition of his views, the Kaiser remarked:

A consciousness that it can defend itself in war is indispensable to the morale of a nation. It is this sense of invincibility that counts most. The army at the front, however well trained, well clothed, is absolutely nothing without the moral support at home based upon a heroic patriotism.

That is the heart of preparedness. Without this attitude toward the national defense there can be no patriotism worthy of the name. Nor will a people with any sense of a national existence give up the national defense upon any pretext of disarmament.

From this point of view I think the American people are not well advised by their pacifists. They have been afforded sufficient warning, too, among them the late Secretary of War, Mr. Weeks. I have been reading what he wrote in the COAST ARTILLERY JOURNAL on the subject of the value to a civilian of a Military Training. He insists that it is worth all the money it costs.

Sound as these views appear to be, the point of immediate interest is the fact that the JOURNAL had somewhat to do with their formulation. Our particular mission, however, is the dissemination of ideas within our own Corps, and we should be pleased to learn the extent to which

we are accomplishing that mission. After reading an article in the JOURNAL, talk about it. If you approve, tell others; if you disapprove, tell us. Compliment us or criticize us, as we may deserve; but do not ignore us.

The Army

The interesting discovery that an enlisted man in the regular army of the United States is supposed to live on 35 cents a day seems to have focussed a more than passing attention upon that frequently neglected branch of the national defense. The lower house of Congress has gallantly outaced the Budget Bureau to increase the allowance to all of 40 cents; it has voted to add 3750 men to the total strength, and, in the ruddy light of the blazing barracks on Governors Island, has allowed \$5,000,000 for new housing. Its heroism should be commended to the Senate. But even these gestures are unlikely to stem the deeper tide of criticism which is rising against our present military policy.

It is not coming from the merely professional soldiers, but from those public-spirited civilians and reserve officers upon whose unremunerated efforts it has been our method to rely for the effective maintenance of our larger defensive system. General Delafield, former president of the Reserve Officers' Association, makes the alarming calculation that out of the 111,000 regulars we now have, a bare 50,000 are actually available for first-line defense. General Reilly, another citizen-officer with a distinguished record, contributes to the January *Century* a strong picture of "our crumbling national defense." Secretary Davis, like Secretary Weeks before him, shows himself disturbed by his odd task of maintaining "all those divisions and other military organizations necessary to form the basis for a complete and immediate mobilization for the national defense" (as he is directed to do by the Act of 1920) on appropriations barely sufficient for maintaining any organization at all.

The Army, in fact, presents a queer picture. Under the plans worked out after the passage of the 1920 act (plans which it has never been directed to modify) it provides an organization, largely on paper, for six field armies, comprising fifty-four combat divisions with cavalry divisions and auxiliary troops in addition. A framework of 300,000 regulars was authorized, a leaven of half a million National Guardsmen was contemplated, and a reservoir of competent citizen officers and more or less trained civilians to fill the cadres. If we had possessed such a system in previous wars, as an optimistic lecturer in the War College pointed out at the time, more divisions than were needed "could have begun their war expansion within twenty-four hours after the declaration of hostilities."

Our fifty-four paper divisions can still do that; whether they would ever complete their expansion or not is another question. The twenty-

seven contemplated divisions of the reserve would find themselves fighting for the 150,000-odd civilians who have passed through the training camps; they would fill the remainder of their ranks with raw recruits and try to train them with their reserve officers. The latter number nearly 100,000; but, under the laxity and unreality of the reserve organization, resulting from small appropriations and large amounts of paralyzing paper-work, the percentage of them which would really know anything about the job must be very low. Material could probably be provided more quickly than the men; but it would be a long time before a reserve division could take the field, while even the National Guard officers would dislike to take their organizations, swollen with wholly untrained recruits, into action until they had had a considerable period for training. Meanwhile the 50,000 combat regulars would be doing the fighting.

But it is in the interests of this doubtful paper army that the regulars are expanding their energies, suffering paralyzing economies, losing their proper instruction periods and weakening their morale. The position is not satisfactory, and we are facing the question of whether the scale of our planning should not either be reduced or else paid for.—*Chicago Tribune.*

This Should Be Explained

The *Duluth News-Tribune* makes some pungent comment on recent news from Moscow which Sherwood Eddy and his fellow pacifist soviet lovers might properly be asked to explain:

*Those enthusiastic idealists who are always telling us that America should recognize Soviet Russia have received another kick in the pants from their brethren in the Red government.

For these American admirers of the Soviet have been among the most vehement opponents to military drill in American colleges and universities. They claimed all this drill had a tendency to breed militarism in the minds of college students, and woe be unto us, if by teaching young men how to march and execute a decent squads right, we sowed the seeds of another war.

And now comes the news from Moscow that all Russian high school boys between the ages of 12 and 16 will be compelled to take military training. In all Russian universities and colleges compulsory military training and drill has been the vogue for some time, but now the same rule will apply to boys in high schools down to and including the age of 12.

This training is to be no mere perfunctory drill, but include training in aviation, tanks, chemical warfare and the whole modern program.

Will some of our idealists who feel that we have been cruelly wrong in thus far highhatting the Soviet please explain why it is all wrong to train American college boys how to march and perfectly all right to train a 13-year-old Russian boy in the mysteries of poison gas?

—*Detroit Free Press.*

Mapping the Missouri River

In step with the times, surveyors have just finished for the War Department a photographic air map of the tortuous Missouri River from the mouth of that stream twenty miles above St. Louis to Yankton, S. D., a distance of about 900 miles. What a vision for the pioneers of the country. What would Laclede, Boone, Lewis, Pike, Clark, and the hundred other pathfinders who dared the wilderness in the early days have thought could they have anticipated, in their plodding course, what would be accomplished so shortly, as time goes, by flyers of the air?

* * * * *

The work was done under direction of the War Department and required expert work of very delicate nature that each five-mile section might coordinate perfectly with other sections that surround it. To this end, all of the pictures were taken at 14,500 feet. It is said that the details of river and physical surroundings in the present work are unusual in works of this nature, so highly developed during the war. It is also said that no undertaking approaching the magnitude of the photographic map of 900 miles of the Missouri has ever been attempted in this or any other country.

Thus was accomplished in 120 flying hours, spread over about four months, something that dwarfs in recorded accomplishment the earnest effort of several generations of pioneers as the mighty river was traced and roughly mapped, mile by mile, in the days when the West was all mystery and silence.—*St. Louis Globe Democrat*.

APHORISME XVI

To speak that which a man thinks not, is reproveable, being taken in strict morall sense; but necessity gives a larger latitude to the managing of greater affaires. For nothing is more expedient to a Generall, than that the enemy knows nothing of his deliberations till they bee put in action, nor of his preparations till they bee on foot. It is therefore an useful policie to pretend one service, and intend another.—Ward's Animadversions of War (London, 1639).

PROFESSIONAL NOTES

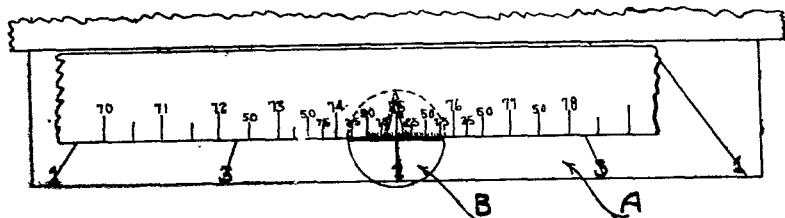
Interpolator for Coast Artillery Board Universal Deflection Board and Percentage Correctors

The Coast Artillery Board has had several inquiries from the service regarding the use of the Interpolator on the Percentage Corrector and the Coast Artillery Board Universal Deflection Board.

The use of the Interpolator is described as follows, the scale shown in the accompanying illustration being graduated in azimuth for use with the Deflection Board. (The operation in connection with the Percentage Corrector is similar except the tape is graduated in linear units.)

Assume observations every thirty seconds, predictions made one minute in advance, the first prediction being 75° . The tape is turned until 75° appears opposite the index or center line of the Interpolator (A); the marker (B) is also

FIGURE 1



placed on the tape at 75° (Fig. 1). The best type of movable marker that has come to the attention of the Coast Artillery Board is shown in detail (Fig. 3). Thirty seconds later the next prediction on the setforward point is made, which is assumed to be 77° . This data arrives at the Deflection Board about 24 seconds after observations are made. The tape is turned until 77° appears opposite the index line of the Interpolator. The Interpolator is then moved up or down until the line (1) on the left of the centre coincides with 75° on the tape, which is conveniently located by the marker (B). By means of the similar triangles, an interpolated reading, 76° , is made between the last two predictions opposite line (3) on the left. This is the azimuth for the next 15-second bell. If an observation is lost, there need be no interruption in the data sent to the battery. In this case the device is used as an "Extra-polator" by reading opposite lines (3) and (1) on the right of the center line of the Interpolator. For example, the reading opposite line (3), 78° , would be the extrapolated azimuth for the next 45-second bell, and opposite line (1), 79° , the extrapolated azimuth for the next minute bell. By means of the interpolating device data is furnished to the battery every fifteen seconds.

The scale on the left top side of the Coast Artillery Board Universal Deflection Board, graduated from zero to six degrees, has occasionally been referred to

as the "Arbitrary Correction" scale. The Coast Artillery Board believes this term a misleading one and that all permissible corrections applied during firing belong to two classes:

a. *Ballistic corrections*, as obtained from the range correction board.

FIGURE 2

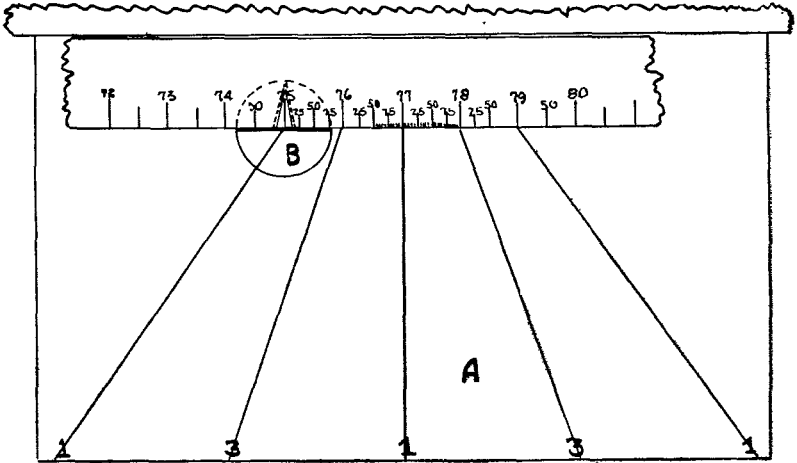
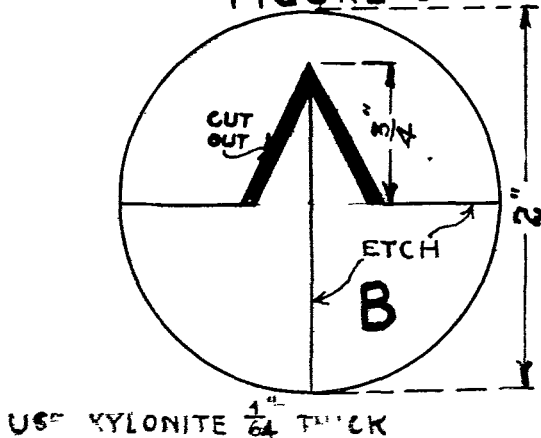


FIGURE 3



b. *Adjustment corrections*, as obtained from the application of one of the approved methods of fire adjustment and based upon observation of fire. (Calibration corrections may be considered as of this class.) There should be, in fact, nothing arbitrary about corrections of either class, and the Battery Commander should be able to show a sound reason for each correction applied.

The Thirteenth Coast Artillery (H. D.)

The Coat of Arms of the 13th Coast Artillery was approved by the War Department on August 9, 1924, and its blazonry is—

Shield: Gules on a saltire or voided of the field a fleur-de-lys of the second (or).

Crest: On a wreath of the colors, or saltire gules charged with three cannon paleways or.

Motto: Quod Habemus Defendemus (What we hold we will defend).

The red of the shield signifies artillery of which this organization is a unit. The outline in gold of the saltire or diagonal cross denotes that the regiment was organized in the south, viz: The Harbor Defenses of Charleston, Pensacola, Key West, and Galveston. The saltire is taken from the battle flag of the Confederacy and, as only its outline appears on the shield, denotes a suggestion of the south. The fleur-de-lys stands for the service in France during the World War of the Headquarters Battery, 13th Coast Artillery, which was then Battery C, 61st Artillery, Coast Artillery Corps. The motto: "What we hold we will defend," shows the spirit of the regiment, as was done by the troops in former years stationed at the same localities—Key West, Fort Pickens (1861), and Fort Sullivan (1776).

This regiment, or the units thereof, except the Headquarters Battery, have never had battle participation, as they were organized at a more or less recent date. The Headquarters Battery was organized in 1901 at Key West Barracks, Florida, as the 121st Company, Coast Artillery. In 1916 it became the 2d Company, Fort Screvens, Ga. In 1917 its name was changed to the 3d Company, Coast Defenses of Savannah, and as such was discontinued on December 31, 1917. The personnel was transferred to Battery C, 61st Artillery, Coast Artillery Corps, thereby organizing this unit. This Battery went overseas to France, but was not engaged in any battles; it returned to the United States in February, 1919, and was demobilized. Later, both the 121st Company, Coast Artillery Corps, and Battery C, 61st Artillery, Coast Artillery Corps, were reconstituted and are at present incorporated in the Headquarters Battery, 13th Coast Artillery.

Battery A, 13th Coast Artillery, was organized in 1907 at Key West Barracks, Florida, as the 162d Company, Coast Artillery Corps; became the 1st Company, Fort Dade, Florida, in 1916; changed in 1917 to the 1st Company, Coast Defenses of Tampa; and in 1924 received its present designation.

Battery B, 13th Coast Artillery, was organized in 1907 at Fort Barrancas, Florida, as the 163d Company, Coast Artillery Corps. In 1916 it became the 1st Company, Fort Pickens, Florida; in 1917, the 1st Company, Coast Defenses of Pensacola; and in 1924, its present designation.

Battery C, 13th Coast Artillery, was organized in 1907 at Fort Moultrie, South Carolina, as the 145th Company, Coast Artillery Corps; was designated the 3d Company, Fort Moultrie, in 1916, and 3d Company, Coast Defenses of Charleston, in 1917; and became Battery C, 13th Coast Artillery, in 1924.

Battery D, 13th Coast Artillery, was organized in 1908 at Fort Morgan, Alabama, as the 170th Company, Coast Artillery Corps; changed to 1st Company, Fort Moultrie, in 1916 and to 1st Company, Coast Defenses of Charleston, in 1917; and received its present designation in 1924.

Battery E, 13th Coast Artillery, was organized as the 2d Company, Key West Barracks, Florida; changed to 2d Company, Coast Defenses of Key West, in 1917; and was given the designation of the 182d Company, Coast Artillery Corps, in 1922, and Battery E, in 1924.

Battery F, 13th Coast Artillery, was organized as the 2d Company, Coast Defenses of Savannah, in 1918; was designated the 181st Company, Coast Artillery Corps, in 1922; and was changed to Battery F, 13th Coast Artillery, in 1924.

Battery G, 13th Coast Artillery, took its origin in 1917 as the 3d Company, Fort Crockett, Texas; became the 3d Company, Coast Defenses of Galveston, in 1917; and changed to 183d Company, Coast Artillery Corps, in 1922, and in 1924 to its present designation.

Battery H, 13th Coast Artillery, was organized in 1921 as the 3d Company, Coast Defenses of Delaware; and its designation was changed to the 179th Company, Coast Artillery Corps, in 1922, and to Battery H, 13th Coast Artillery, in 1924.

Battery I, 13th Coast Artillery, was originally the 18th Company, Coast Defenses of Manila and Subic Bays, in 1917; became the 188th Company, Coast Artillery Corps, in 1922; and in 1924 received its present title.

Battery K, 13th Coast Artillery, was organized as the 5th Company, Fort Moultrie, South Carolina, in 1917, and later in the same year became the 2d Company, Coast Defenses of Charleston; was designated the 180th Company, Coast Artillery Corps, in 1922; and became Battery K, 13th Coast Artillery, in 1924.

The personnel of the regiment wears on its uniforms, as a distinctive badge, the shield of the coat of arms, without the crest and motto, in metal and enamel, as was approved by the War Department in 1924.

A Moving Target Device for Training Range Sections

By MAJOR O. C. WARNER, C. A. C.

In the May, 1926, COAST ARTILLERY JOURNAL there appeared an article entitled "Training the Fire Control Sections" by Major C. O. Schudt, C. A. The moving target device that he constructed and used in the New York City National Guard armories is described. A modification of this device is shown in the accompanying Plates I, II, III, and IV. Plate I shows a 1/20 HP 110-volt, 60-cycle, AC, 1800 RPM, Type SA Form SI, constant-speed General Electric motor direct connected to a Boston Gear works BU-2 reduction gear, ratio 48 to 1. This gear runs in oil, and is belted to another Boston Gear works BU-I reduction gear, ratio 48 to 1. This gear runs slowly and is a cheaper gear not running in oil. It is best shown in Plate II. The four-inch driving pulley moves the target wire or line at a speed of one foot per minute. Plate III shows the complete driving unit with its cover, and Plate IV the driven pulley located at the other end of the target course. The unit gives a constant travel to the miniature target in two directions. The belt may be shifted to give three different speeds, one faster and one slower than one foot per minute.

A target travel of one foot per minute gives an angular travel of 1.63 degrees at 35 feet range, and an angular travel of only 0.57 degree at 100 feet range. In armories having over 100 feet range, it will be necessary to speed up the target to secure suitable angular travel.

It is unnecessary to shift the course of the moving target in order to shift the track to another location on the plotting board. Small armories will not permit such shifting. A change in the orientation of the azimuth instruments used at the base end stations will change the location of the plot on the plotting board. The Model 1910 azimuth instrument is easily and quickly changed in orientation. In the Sanford Armory, the base line is only three feet long, too short for the

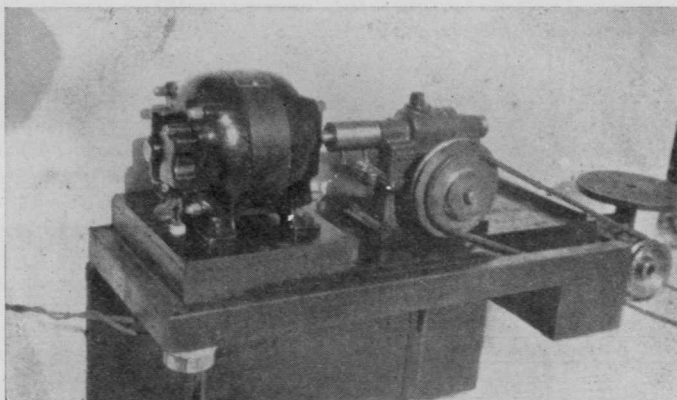


PLATE I

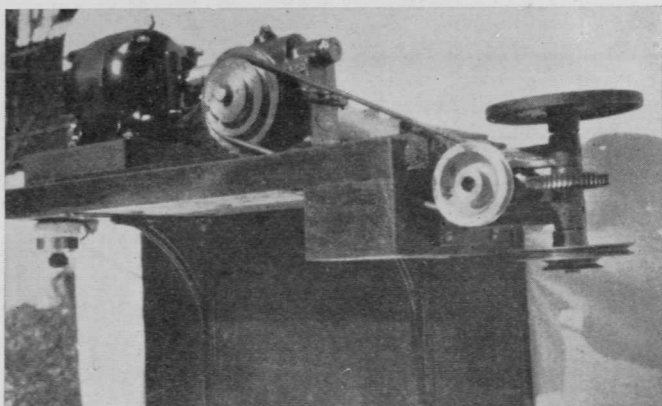


PLATE II

fifty-foot range, resulting in poor intersection angles. The target course there is only 20 feet long. Good intersection angles are obtained by orientation of the azimuth instruments at the base end stations on a prearranged plan, giving various tracks on the plotting board for variety and reduction of labor and loss of time in moving the paper on the plotting board. Units of the 240th Coast Artillery (H.D.) are now instructed to change the location of the target course

very frequently, since it is simpler to shift the location of the course on the plotting board than to shift the paper on the plotting board.

The essential in training of the National Guard Coast Artillery range sections is that they actually track a moving target or point. This device is simple, cheap, compact, easily assembled and installed, and quickly connected to any electric light lamp socket. It is designed to supply that essential heretofore lacking in

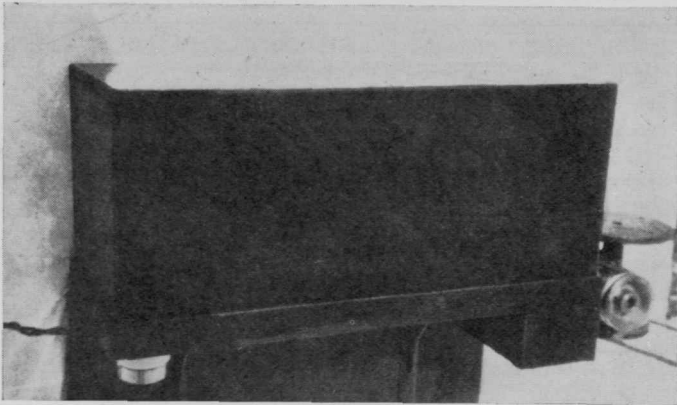


PLATE III

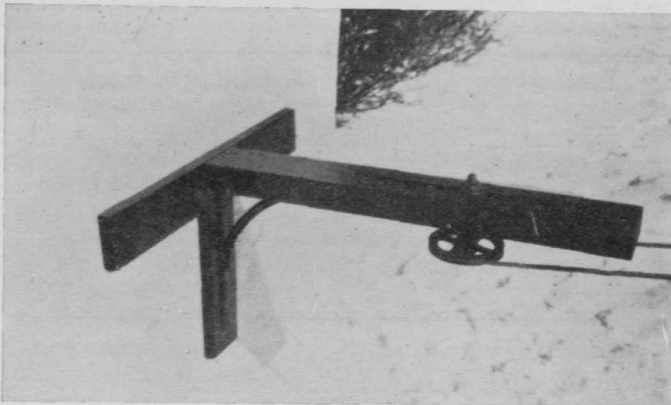


PLATE IV

six of Maine's National Guard armories. Six of these sets were recently assembled by Master Sergeant Peters, 240th Coast Artillery, Maine National Guard, during drill periods, at a total cost to the State of Maine of \$220.00 or \$37.00 per unit. Training of all six units having these new devices is actually progressing using a moving target frequently at armory drills. Improved armory training will certainly result by the use of this device.

Boarding Naval Vessels

Section II of AR 605-125 prescribes in detail the procedure to be followed by officers of the Army when making official or social calls upon a man-of-war. A commanding officer or staff officer, contemplating an official visit of courtesy, would familiarize himself with this procedure. But the average junior Coast Artilleryman is, one day, likely to find himself on his way to a naval ship with only the haziest idea of what is expected of him. The following outline based on the regulations and customs of the Services may pop up in his memory and save him some embarrassment.

When the small boat comes alongside the dock the junior jumps in first; the senior is the last to leave the dock.

When passing other small boats in the stream, salutes are exchanged as on land except that officers salute without rising. When passing a Flag Officer or Commanding Officer with pennant flying the engine is stopped while the hand salute is rendered. Do not overhaul and pass a senior without asking permission to pass.

A boat containing officers, other than General or Commanding Officers, should, when approaching a man-of-war, answer the hail by calling, "Aye, aye." Two short blasts of the whistle may be used to notify the ship that an officer, other than a General or Commanding Officer, is coming aboard.

Boats containing officers should go alongside the ship at the after starboard gangway. Wait until the gangway is clear before going alongside. If necessary to go aboard across another small boat always ask permission. The senior leaves the small boat first, and officers should reach the top of the gangway in order of rank. The small boat shoves off promptly and lays to, well away from the side of the ship.

Upon reaching the quarterdeck (normally at the top of the gangway) each officer faces aft and salutes the flag, then salutes the officer of the deck. Piping the side and sideboys require no acknowledgment.

When the National Anthem is played aboard ship, or when "Colors" is sounded, the same rules hold as on land. In going up or down hatchways aboard ship juniors always give way to seniors.

When leaving the ship the junior goes down the gangway and into the small boat first, not forgetting to salute the Officer of the Deck, and then the flag, before leaving the quarterdeck. Small boats should not be kept waiting at the gangway and should shove off promptly as soon as everyone is aboard.

Upon reaching the dock officers leave the small boat in order of rank.

The Problem of National Defense*

By COLONEL HANFORD MACNIDER, Assistant Secretary of War

Manpower is only half the problem of National Defense. We have no business calling men to the colors if we are not prepared to feed, clothe and shelter them. It is a far more serious thing to call them out if we cannot equip and arm them. They must be given some chance for their lives.

We hear a great deal about the necessity of training men for military leadership in possible emergency. But these men we train in the Reserve Corps, the Reserve Officers' Training Corps, and the Citizens' Military Training Camps will not be of much use if they are forced to march out to the nation's defense armed

* An address given before the Rhode Island Chapter of the Military Order of Foreign Wars.

with broomsticks. It happens that because we had a war we have rifles—Enfields, such as they are, ten years old—but ammunition ten years old is as dangerous to the shooter as to the shootee. What is more, our supply of small arms ammunition would not last three months. It takes nearly a year to get into quantity production. That is, we must win at once, or those rifles had better be broomsticks. They would not be so hard to carry, and they would be just as useful.

We have witnessed a sudden awakening by a great throng of patriots on our defenselessness in the air. We are told and retold of our obligation to develop that arm of the service. We could blacken the sky with planes flown by pilots trained to all necessary proficiency, but, unless we give them this same ammunition as well as bombs, they would be useless as combatants. All that a hundred unarmed planes could do to a battleship, for example, would be to give it a dirty look. Of course, flyers could smash themselves down on the decks of battleships or upon marching columns, but that's a costly method of attack.

We have cannon—"seventy-fives"—left from the war. New ones already developed shoot nearly twice as far and as effectively. Why haven't we any? We have, six. Have we ammunition? Perhaps a few months' supply, all nearly ten years old. How long to get into quantity production to make those guns useful? Ten months, at least.

You ask and you have a right to ask what the War Department is doing about this situation. It is the job of the Assistant Secretary of War to fill that gap. That's why I'm telling you about it. We are responsible under the National Defense Act. With personnel, time and money begged and borrowed from the Services of Supply, we have set up a great Industrial Preparedness structure. We are bending every effort to plan a speedy wartime manufacture of every one of the seven hundred thousand odd articles which our army used in the last war, and which would be needed again. Our best planning still leaves wide discrepancies between our estimated requirements and the best possible expectations in production. We have the whole-hearted cooperation of industry, which realizes the importance of such planning as national insurance. On articles which are not commercial, however, we must start from scratch. Take Ordnance, for example. No manufacturer is building 75-mm. shells in times of peace, or anything that resembles them. It will take nearly a year, even with the most painstaking advance planning, to get into high on delivery of the finished article.

War Reserves must be set up and maintained if there is to be any semblance of national protection. We cannot buy time once the emergency is upon us.

Our Ordnance Department and the other Services of Supply are made up of able men. With limited means they have put up a good fight to maintain their part of the defense structure. Their activities are not as picturesque as those of the combat branches. For that very reason, they need your interest, help and backing in Congress to a greater degree than those spectacular military activities already sold through their traditional gallantry in action—by the printed page, the silver screen, or from the bunting-draped platform on National holidays.

Manpower was not our great problem in the World War. Five million men held up their right hands as fast as we could take them, and a lot faster than we could equip them. Most of our men, when they finally reached the front a year after our entry, carried rifles built for other armies. We had been manufacturing munitions for the Allies for three years. Even with that running start we could not meet our own requirements. The division with which I served fought the war with a sputtering, ineffective French automatic rifle and a foreign machine gun. Our American-made Brownings reached us the day after the Armistice.

We prepared behind a barrier of Allied Arms. When finally we arrived in line, we fought with borrowed weapons. We have no right to assume that such a friendly barrier will always rise to protect us. Nor is it probable that any one will lend us the wherewithal to defend ourselves.

It took seventeen men behind the lines to make one man at the front an effective combat soldier. This proportion gives you some idea of the importance of supply in modern war. Seventeen interested citizens in every Congressional district could bring our present situation so forcibly to the attention of Congress that this unromantic, perhaps, but most necessary, defense requirement would receive proper attention.

If we are to have defense in the air, on the land, or on the sea, we must build along a balanced program. Until the gaps are filled, we cannot say that we have protection, nor that the mandates of the people in the National Defense Act are being carried out.

The Dardanelles Naval Attack

By LIEUT. S. M. MILLER, C. A. C.

After a study of the naval attack on the Dardanelles, the following figures will prove of interest. They are as nearly accurate as is possible to ascertain from the sources available. These sources are listed below.

The Inner and Intermediate defenses are here merged and called Inner defenses due to the difficulty in establishing a marked difference between these defenses in certain sources.

SUMMARY

1. Guns of Turkish Forts:

	<i>Heavy Guns</i>	<i>Medium Guns</i>	<i>Light Guns</i>	<i>Field Batteries</i>
Outer Defenses	20	2		
Inner Defenses	85	82	45	2
Total	105	84	45	2

2. Guns of Allied Fleet:

Battleships and Cruisers

Heavy 154 guns.
Medium 269 guns.

3. Ratio of Armament, heavy and medium.

$$\frac{\text{land}}{\text{navy}} = \frac{189}{423} = \frac{3}{7} \text{ (approx.)}$$

Ratio of heavy guns

$$\frac{\text{land}}{\text{navy}} = \frac{105}{154} = \frac{2}{3} \text{ (approx.)}$$

Ratio of medium guns

$$\frac{\text{land}}{\text{navy}} = \frac{84}{269} = \frac{3}{11} \text{ (approx.)}$$

4. *a.* The minor caliber guns (1-inch to 3.6-inch) were not considered in this summary.

b. Several field batteries of indeterminate caliber were used by the Turkish forces.

c. The armament on destroyers and mine sweepers of the Navy was not considered. The destroyers were used as sweepers. Also, they were of an old design and carried little armament, 4-inch being the largest gun and only one of these on the majority of destroyers.

5. *a.* The guns of the Allied Fleet by caliber are as listed:

15 " — 8	7.6" — 2
12 " — 62	7.5" — 28
10.8" — 6	4 " — 42
10 " — 8	6.5" — 8
4.7" — 2	6.4" — 10
9.4" — 2	6 " — 164
9.2" — 20	5.5" — 61

b. The guns of Turkish Defenses were of the following calibers:

Outer Defenses	10.2" — 4
	10 " — 6
	9.2" — 4
	5.9" — 2
Inner Defenses	14 " — 6
	11 " — 3
	10.2" — 1
	9.4" — 23
	8.2" — 4
	5.9" — 7

In addition to the above, there were in the inner defenses' (exact number in each caliber unknown)

Heavy guns	(8.2" — 14 ")	48
Medium	(4.7" — 5.9")	75

6. The following sources were consulted in arriving at the figures quoted above:

The London Times History of the World War
Harper's Pictorial History of the War
Gallipoli, Masfield
The Dardanelles Campaign, Nevison
The Dardanelles Campaign, Major Sherman Miles
Nelson's History of the War
New York Times' Current History of the War
Official Historical Account of the Dardanelles Campaign, by the
 Turkish General Staff
Jane's Fighting Ships, years 1913-1921.

Fort Morgan, Alabama

By J. R. JOHNSTON

Mobile Bay, Alabama, has been a scene of settlement and fortification since the early days of French attempts at colonizing the New World. There was, to begin with, Fort Louis de la Mobile, established in 1702, which protected the first settlement of Mobile. The evolution of Fort Morgan passed through several stages during the one hundred and one years between the erection of the first fortification in the vicinity and the acquisition of the territory purchased from France in 1803. There was Fort Conde, for instance, a wooden fort built in 1711, which replaced Fort Louis de la Mobile as the headquarters of the French in Louisiana. This post—Conde—was in good condition and in actual possession of the Spanish until April 15, 1813, when the alliance between Great Britain and Spain was directly responsible for the seizure of Mobile and environs, as part of the Louisiana Purchase, by General James Wilkinson, acting under instructions from President Madison.

Immediately Mobile Point, at the mouth of the bay, was fortified with a battery of nine guns, after which General Wilkinson proceeded to the city, where he began to fortify the presidio. Soon, however, Mobile Point appealed to him as a

much better spot for defensive works than one so far up the bay, and accordingly Fort Bowyer, named in honor of Lieutenant Colonel Bowyer, was constructed. The next occupant of this post was a more picturesque personage than General Wilkinson, none other than Andrew Jackson.

Retiring from Pensacola in August, 1814, General Jackson stopped and repaired Fort Bowyer, and left a garrison of 130 men there under Major William Lawrence. These precautions were taken just in time to resist an attack by a British fleet which appeared before the fort on September 12 and demanded the surrender of the little command. Major Lawrence refused to capitulate.

The enemy fleet consisted of four vessels; the *Hermes*, 22 guns, the *Sophia* and the *Anaconda*, 18 guns each, and the *Caron*, 20 guns, all of large size and commanded by Captain Percy. Jackson had driven this naval force from Pensacola and it was thirsting for revenge. Consequently, on September 15 the vessels began a heavy cannonading of Fort Bowyer which lasted without interruption until 5:30 in the afternoon. This attack was supplemented by the assault of a few marines and some six hundred Indians under Colonel Nichols from the landward side.

The fort returned the enemy fire with great vigor and determination, the watchword of the day for the garrison being "Don't give up the fort." In the midst of the battle the flag-staff of the *Hermes* was shot away, and Major Lawrence immediately gave the command to cease firing while he hailed the vessel to ascertain if she had struck her colors. The only answer was a murderous volley of grape from another quarter. It was now the turn of the fort to have its flag shot down, and the British and Indians on shore, thinking the plucky little garrison had surrendered, ran forward with shouts of glee. They were met by a terrific hail of lead which drove them back with great loss.

Finally the battered British ships withdrew. The *Hermes* was so badly damaged that her crew set her on fire and abandoned her. The explosion of the powder magazine sent her to the bottom. The enemy in this engagement outnumbered the Americans more than six to one, yet the latter lost but four killed and a like number wounded, while the British loss was 163 killed, 69 wounded.

The great adventure in Fort Morgan's stormy career occurred in the Civil War. The stronghold on Mobile Point had been greatly strengthened and rechristened by the Confederates, its armament consisting of 86 guns of various calibers and its garrison numbering 640 officers and men. It was here that Admiral Farragut, on the morning of August 5, 1864, began the attack which was to result in the capture of Mobile. At 4:00 A. M. the fleet of the Union forces were set in motion, led by four iron-clads. At 6:47 the booming of the iron-clad *Tecumseh's* guns was heard on the flag-ship *Hartford*. A few minutes past seven Fort Morgan replied, having waited until the ships were well within range. The *Tecumseh* drew abreast of the fort and was about to enter the bay when suddenly she reeled to port and sank with almost every soul on board. She had struck a mine.

The disaster spread confusion in the fleet. A question was shouted to the *Brooklyn*, just ahead, from the *Hartford*. The answer called forth Farragut's famous order: "Damn the torpedos! Go ahead!" The fleet went ahead and Fort Gaines, on the western side of the channel, surrendered. The Union vessels were in Mobile Bay, at a cost of 335 men, 113 of whom had gone down with the *Tecumseh*, but still the indomitable fort on Mobile Point thundered out its defiance. For seventeen days, though bombarded ceaselessly, Fort Morgan held out. At last, her citadel destroyed by the pounding of the Union guns, and her walls nearly blown to bits, she was compelled to surrender.

With the end of the war the United States troops continued to occupy the fort for some time, though it was never thoroughly rebuilt. Today it is abandoned, though still the property of the War Department, but it is remembered, nevertheless, as the scene of one of the hottest and most stubbornly fought battles of the Civil War.

Adequate Defense of Nation Necessary to Peace of World and Prosperity of America

By GEORGE WHEELER HINMAN

In all the present day debate on national defense the nation's business as such stands aside.

The idea seems to be that this nation's defense against war has to do only with patriotism, politics, and diplomacy. A worse delusion could not exist. After the supreme issue of self-preservation, the next American obligation is for the permanent well-being of the American people, and that well-being is only another name for employment and industry and business in its widest sense.

Everybody knows what domestic security means to a nation's business. International safety means the same thing. That is a fact to be thought about at a time when, after reducing the United States Army to a skeleton, the Washington Government proposes now to scrape the bones—at a time when, after reducing the Navy to second rank by treaty, the Government is reducing it still further without treaty.

National defense! What is its business meaning just now?

The business meaning of national defense just now is that it is the chief bulwark behind which the greatest aggregation of national wealth and welfare ever known is sheltered and assured.

The American people have 350 billions in property, 75 billions gross income, 14 or 15 billions net income to be safeguarded from those who have no such wealth but long to share in it.

Among other nations a man may read daily of the envy, dislike, even hatred, of the American people as seen with foreign eyes. Why are the American people thus envied, disliked, and even hated? If but one reason were to be given it would be "because the American people are so rich." That reason flames out in every denunciation of the United States as reported in the foreign press.

But it is not America's wealth alone that requires the bulwark of adequate defense. There is also the swift encroachment of American business upon the commerce of the world. A few years ago American business had only one-tenth of the world's trade. Today, American business has nearly one-sixth. A few years ago American business sold the world only about two billions of goods a year. Today American business sells the world some four and a half billions.

Some silly dreamers who know only things that aren't so, tell the world that the ties of international business are the best guarantees against war—are the real national safeguards which make even skeleton armies and obsolescent navies superfluous relics of the past.

What nonsense! Let any middle-aged man recall how the clouds of international envy, dislike and hatred began to gather over Germany in 1895 and 1900—began to gather as soon as Germany began to push her way into the great commerce of the world and gathered increasingly for the final storm as her domestic wealth piled up and her share in the business of the world was increased.

Then let the same middle-aged man consider the storm of dislike and distrust that is launched at the American people from the capitals of the great commercial powers in Europe today. What will he find? He will find that under different pretenses, the American people are getting the same sort of treatment that every other nation has got when that nation dared to rise, expand in business, and encroach upon the trade of the ruling business powers. The similarity is complete.

Heretofore, the eventual penalty for such an encroachment has usually been war. There is no case where a rising nation has been able to kiss its way through to commercial supremacy. Only the capacity to defend itself has enabled such a nation to gain its business rights and at the same time keep the peace.

But suppose the United States takes the chances and, by reducing Army and Navy in the future as in the past, keeps up the purely American illusion that all wars are impossible. And suppose there then falls to the United States the fate of defeat that has overtaken other progressive nations of the same sort. What then?

In accordance with present practice, a war indemnity of fifty billions, a surrender of ships and railways and industries to the conqueror, a loss of all territorial possessions except the continental United States, a destruction of two-thirds of the nation's wealth, and hunger, revolution and business chaos everywhere.

There is the risk! There is the penalty! Although it may come only once in a century, the emergency has in it enough trouble for all the years.

Probable Errors in Bombing and Antiaircraft Fire

By H. B. HEDRICK, *Ph. D.*

It is assumed that the errors of bombing and antiaircraft fire follow the usual law of errors; namely,

$$P(t) = \frac{2}{\sqrt{\pi}} \int_0^t e^{-t^2} dt \quad (1)$$

where the factor $2/\sqrt{\pi}$ is required in order to make the integral from 0 to $+\infty$ equal to one. This P function of t is tabulated in many places; for instance, on page 56 of the Smithsonian Physical Tables where hx is written for t (Table 23).

It is more convenient to have this function tabulated for different arguments according to the need. For statistical work it is usual to tabulate in terms of the standard deviation (mean-square-error), but in ballistics it has been customary to use the probable error (p) and to tabulate the P function with argument x/p ; for example, as given on page 57 of the Smithsonian Physical Tables (Table 24).

The table of page 57 (Table 24) is derived from the table on page 56 (Table 23) as follows:

For x/p equal to one (*i. e.* $x = p$) the value of the integral in Table 23 on page 56 should equal to one half (by definition of the probable error, p).

Let ρ_1 be the upper limit of the integral when $P(t) = 1/2$, thus

$$\frac{2}{\sqrt{\pi}} \int_0^{\rho_1} e^{-t^2} dt = 1/2 \quad (2)$$

By interpolation in Table 23 there results

$$\rho_1 = 0.47694 \quad (3)$$

Hence,

$$P(x/p) = \frac{2}{\sqrt{\pi}} \int_0^{\frac{\rho_1 x}{p}} \frac{e^{-t^2}}{e} dt \quad (4)$$

which gives Table 24 by interpolation from Table 23 with argument $\rho_1 x/p$.

This is the table usually used in artillery fire. It is sometimes called "linear" probability since it treats of only one coordinate at the time but it would be better to call it "zonal" probability since the other two coordinates are unlimited. Thus an error less than x yards in range means a shot within the zone of width $-x$ to $+x$ and of unlimited extent in length and thickness. To obtain the probability of fire in the other coordinates it is necessary to enter the table again with the second and, if required, with the third coordinate. For example, if it is desired to obtain the probability of hitting within the rectangle whose half sides are the probable error in range px and the probable error in deflection, py , we have

$$P(px) = \frac{1}{2}; P(py) = \frac{1}{2}; P(px, py) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$$

That is, only one shot in four, in the long run, will hit the given rectangle of two probable errors in x by two probable errors in y .

In order to obtain a "probability rectangle," that is, a rectangle where the probability of a hit is $\frac{1}{2}$, it is necessary that $P(px) \times P(py) = \frac{1}{2}$, so each must equal $\sqrt{\frac{1}{2}}$ or 0.70711. Calling this probable rectangle δ and the corresponding limit ρ_z , we have, similarly to equation (2),

$$\frac{2}{\sqrt{\pi}} \int_0^{\rho_z} e^{-t^2} dt = \sqrt{\frac{1}{2}} = 0.70711 \quad (5)$$

By interpolation in Table 23 on page 56 we obtain

$$\rho_z = 0.74375 \quad (6)$$

and from the same Table 23 a table is prepared similar to Table 24 on page 57 but with the argument δ instead of x/p by the formula

$$p^2(\delta) = \left\{ \frac{2}{\sqrt{\pi}} \int_0^{\rho_z} e^{-t^2} dt \right\}^2 \quad (7)$$

Table I was thus prepared. When the probability in deflection equals the probability in range the rectangle becomes a square.

The half side of this square in terms of either probable error ($px = py$) is given by

$$\delta = \frac{\rho_z}{\rho_1} px = 1.559 px, \text{ or } p = .641 \delta \quad (8)$$

Thus it is seen that x (and y) must equal to 1.559 times the probable error in x (and in y) in order to obtain a "probable square."

Instead of the square it is often more convenient to use a "circle of probability" of radius r . This is obtained from the formula for rectangular coordinates by passing to polar coordinates.

Thus, in rectangular coordinates we have

$$\frac{h}{\sqrt{\pi}} e^{-h^2 x^2} dx, \frac{h'}{\sqrt{\pi}} e^{-h'^2 y^2} dy, \frac{hh'}{\pi} e^{-h^2 x^2} e^{-h'^2 y^2} dxdy \quad (9)$$

as the probability that a shot will fall between x and $x + dx$, between y and $y + dy$, or in the small rectangle common to the two zones.

When the probable error in x is equal to the probable error in y , h will equal h' and the rectangle becomes a square. The probability then becomes

$$\frac{h^2}{\pi} e^{-h^2} (x^2 + y^2) dxdy \quad (10)$$

Passing to polar coordinates this becomes

$$\frac{h^2}{\pi} e^{-\frac{h^2}{2} r^2} r \, dr \, d\phi \quad (11)$$

Integrating with respect to ϕ this becomes

$$2 h^2 e^{-\frac{h^2}{2} r^2} r \, dr \quad (12)$$

which is the probability that the shot lies in the ring from r to $r + dr$.

Integrating this between zero and r gives the probability that the shot lies within the distance r from the center

$$P(r) = 2 h^2 \int_0^r e^{-\frac{h^2}{2} r^2} r \, dr = 1 - e^{-\frac{h^2}{2} r^2} \quad (13)$$

where h is the measure of accuracy of the marksman.

Setting this equal to $\frac{1}{2}$ we obtain the radius, a , of the probability circle. Hence

$$e^{-\frac{h^2}{2} a^2} = \frac{1}{2} \quad (14)$$

and

$$a = \sqrt{\frac{\log 2}{h^2}} \quad (15)$$

Introducing this value of h in (13) above gives

$$P(r) = 1 - e^{-\frac{r^2}{a^2} \log 2} \quad (16)$$

or

$$\log [1 - P(r)] = -\frac{r^2}{a^2} \log 2 \quad (17)$$

Let n denote the whole number of shots, and m the number of these which miss a circular target of radius r ; then, if n and m are sufficiently large, we may put

$$1 - P = m/n$$

and (17) becomes

$$\log n - \log m = \frac{r^2}{a^2} \log 2 \quad (18)$$

or

$$a/r = \sqrt{\frac{\log 2}{\log n - \log m}}, \quad \log m = \log n - \frac{r^2}{a^2} \log 2 \quad (19)$$

By this formula Table II was prepared, giving for argument r/a the corresponding values of $(n - m)/n$, when $n = 10,000$. Common logarithms may be used in this computation since logarithms appear in both numerator and denominator, or on both sides of the equation.

Comparison of Tables I and II is interesting since Table I was derived from "the error function" given in Table 23 of the Smithsonian Physical Tables by interpolation for $t = 0.74375 \delta$ and the probability circle as given in Table II was derived from the number of misses in a given large number of shots in a circle of radius r by use of a table of common logarithms.

The two tables are in substantial agreement. The arguments are slightly different. The δ in Table I is the half side of a "probable error rectangle" (or square

in the special case $px=py$), and the a in Table II is the radius of the "probable error circle." The ratio of radius of a circle to half the side of square of the same area is 2 to the $\sqrt{\pi}$, so we may assume that

$$a = 1.12838 \delta \text{ (for } px=py), \delta = 0.8862a \quad (20)$$

Equation (8), above, gives the value of δ in terms of p , the zonal probable error. Using (20) we obtain the relation between a and p ; namely,

$$a = 1.12838 (1.559 p) = 1.759 p \quad (21)$$

or

$$p = 0.5685 a$$

that is, the square whose half side is $0.5685 a$ should have a probability of 0.25 or a zonal probability in each coordinate of 0.50, the "probable error."

From the above, one method of procedure for bombing is to determine the zonal probable error in deflection (lateral) and in range (longitudinal) as is given on page 12 of the McNair report. These results are so nearly equal that we may use the mean for our value of p , and then determine δ by formula (8) and a by formula (21).

Comparison of a for bombs with a for antiaircraft.

Altitude feet	p in yds. (Page 9 of report)		p mean	δ 1.559 p	Bombs AA (Page 15 of report)	
	Lateral	Longitudinal			a	a
2000	25	25	25	39	44	
3000	30	32	31	48	54	
4000	35	37	36	56	63	78
5000	39	41	40	62	70	88
6000	42	45	44	68	76	98
7000	45	49	47	73	82	106
8000	48	52	50	78	88	114
9000	50	55	52	82	92	119
10000	52	58	55	86	97	124
11000	54	61	57	89	100	127
12000	56	63	59	92	104	130
13000	57	65	61	95	107	133
14000	58	66	62	97	109	136
15000	59	67	63	98	111	

Table III is derived in a manner similar to Table I. A cube whose half side equals the zonal probable error in each of the three coordinates has a probability of $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$ or $\frac{1}{8}$. In order to obtain a cube of probability one half each side should have the probability of $3\sqrt{\frac{1}{2}}$ or 0.79370. By interpolation in Table 23 of the Smithsonian Physical Tables it is found that

$$\rho_3 = 0.89364$$

With this value Table III is interpolated from Table 23 by the formula

$$P^3(C) = \left\{ \frac{2}{\sqrt{\pi}} \int_0^{\rho_3 C} e^{-t^2} dt \right\}^3$$

The table given as *Inclosure 10* of the *Report*, although called "Spherical Probability Table," is more like Tables I and II (surface) than Table III (cubic) for small values of the argument, say 0.4 and less, but for large values of the argument, say 1.1 and greater, the probabilities are greater than the corresponding ones of Table III and much greater for argument 1.5 and greater.

TABLE I

P^2 is the probability of a shot within a rectangle whose half sides are δ x and δ y . $P^2 = 0.74375$

δ	$P^2 \delta = t$	P sub t (Table 23)	P^2
0.1	.07437	.08376	.0070
0.2	.14075	.16662	.0278
0.3	.22312	.24765	.0613
0.4	.29750	.32604	.1063
0.5	.37187	.40104	.1608
0.6	.44624	.47200	.2228
0.7	.42062	.53843	.2899
0.8	.59199	.59990	.3599
0.9	.66937	.65617	.4305
1.0	.74374	.70711	.5000
1.1	.81811	.75372	.5666
1.2	.89249	.79310	.6290
1.3	.96686	.82854	.6864
1.4	1.04124	.85913	.7361
1.5	1.11561	.88533	.7788
1.6	1.18998	.90700	.8237
1.7	1.26436	.92623	.8579
1.8	1.33873	.94167	.8867
1.9	1.41311	.95433	.9107
2.0	1.48748	.96459	.9305
2.1	1.56185	.97281	.9463
2.2	1.63623	.97933	.9590
2.3	1.71060	.98445	.9690
2.4	1.78498	.98840	.9769
2.5	1.85935	.99145	.9829
2.6	1.93372	.99376	.9875
2.7	2.00810	.99548	.9910
2.8	2.08247	.99677	.9936
2.9	2.15685	.99771	.9954
3.0	2.23122	.99840	.9968
3.1	2.30559	.99880	.9978
3.2	2.37997	.99924	.9984
3.3	2.45434	.99948	.9989
3.4	2.52872	.99965	.9993
3.5	2.60309	.99977	.9996

TABLE II

$P(a)$ is the probability of a shot within a circle whose radius is a . $P(a) = (n-m)/n$, where n = number of shots and m = number of misses when n is very large. $\log m = \log n - a^2 \log 2$

a	a^2	$a^2 \log 2$	$P(a)$
0.1	.01	.00301	.0069
0.2	.04	.01204	.0273
0.3	.09	.02709	.0605
0.4	.16	.04816	.1050
0.5	.25	.07526	.1591
0.6	.36	.10837	.2208
0.7	.49	.14750	.2880
0.8	.64	.19266	.3583
0.9	.81	.24393	.4296
1.0	1.00	.30103	.5000
1.1	1.21	.36425	.5677
1.2	1.44	.43348	.6314
1.3	1.69	.50874	.6901
1.4	1.96	.59002	.7430
1.5	2.25	.67732	.7898
1.6	2.56	.77064	.8304
1.7	2.89	.86998	.8651
1.8	3.24	.97534	.8942
1.9	3.61	1.08672	.9181
2.0	4.00	1.20412	.9375
2.1	4.41	1.32754	.9530
2.2	4.84	1.45699	.9651
2.3	5.29	1.59245	.9744
2.4	5.76	1.73393	.9815
2.5	6.25	1.88144	.9869
2.6	6.76	2.03496	.9908
2.7	7.29	2.19451	.9936
2.8	7.84	2.36008	.9956
2.9	8.41	2.53166	.9971
3.0	9.00	2.70927	.9980
3.1	9.61	2.89290	.9987
3.2	10.24	3.08255	.9992
3.3	10.89	3.27822	.9995
3.4	11.56	3.47991	.9997
3.5	12.25	3.68762	.9998

TABLE III

P^3 is the probability of a shot within a rectangular parallelepiped whose half sides are c x' , c y' , and c z' . $P^3 = 0.89364$

C	$P^3 c = t$	P sub t (Table 23)	P^3
0.1	.08936	.10056	.0010
0.2	.17873	.19935	.0070
0.3	.26809	.29540	.0257
0.4	.35746	.38683	.0579
0.5	.44682	.47256	.1056
0.6	.53619	.55174	.1679
0.7	.62555	.62366	.2426
0.8	.71492	.68801	.3257
0.9	.80428	.74464	.4129
1.0	.89364	.79370	.5000
1.1	.98301	.83532	.5882
1.2	1.07237	.87061	.6599
1.3	1.16174	.89660	.7280
1.4	1.25110	.92316	.7867
1.5	1.34047	.94200	.8359
1.6	1.42983	.95683	.8760
1.7	1.51920	.96832	.9078
1.8	1.60856	.97709	.9326
1.9	1.69793	.98366	.9517
2.0	1.78729	.98852	.9659
2.1	1.87665	.99205	.9763
2.2	1.96602	.99457	.9838
2.3	2.05538	.99634	.9891
2.4	2.14475	.99757	.9928
2.5	2.23411	.99842	.9953
2.6	2.32348	.99899	.9970
2.7	2.41284	.99936	.9981
2.8	2.50221	.99959	.9988
2.9	2.59157	.99975	.9993
3.0	2.68094	.99985	.9996
3.1	2.77030	.99991	.9997
3.2	2.85966	.99995	.9998
3.3	2.94903	.99997	.9999

COAST ARTILLERY BOARD NOTES

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

Projects Initiated During the Month of February

Project No. 528, Axle Draft Hooks for 155-mm. Gun Units.—The opinion of the Chief of Coast Artillery has been requested by the Ordnance Department as to whether Axle Draft Hooks for 155-mm. gun carriages should be manufactured for materiel now in service, and whether it should be manufactured in future production of this materiel.

Project No. 529, Battery Commanders' Telescope for Antiaircraft Artillery.—The new B. C. Telescope tested at Aberdeen Proving Ground in 1926 has been re-designed to permit easier operation by the observer.

Project No. 530, Revision of T. R. 435-280.—The Coast Artillery Board was directed by the Chief of Coast Artillery to make a study of this Training Regulation and submit recommendations with reference to any suggested changes.

Project No. 531, Suggestions in Connection with Program for Antiaircraft Firings, Aberdeen Proving Ground, 1927.—The tests of some materiel, first tried last autumn, will be continued, and the test of much new antiaircraft materiel will begin in September, 1927. The program will be similar to that of 1926.

Project No. 532, Pins for Infantry Panels (Signalling).—The Coast Artillery Board has been directed to make recommendations as to whether a change in the method of anchoring identification and signalling panels is desirable.

Project No. 533, Method of Transporting and Housing Fire Control Equipment for Tractor Artillery.—The Coast Artillery Board has been directed by the Chief of Coast Artillery to make a study of the method of transporting and housing fire control equipment for Tractor Artillery, having in mind the desirability of meeting requirements with the minimum increase in amount of equipment to be carried.

Project No. 534, Continuous Fuze Setter T-1.—The Continuous Fuze Setter T-1 has been unsatisfactory in that it cuts a large percentage of fuzes inaccurately. The trouble was believed to be due to the tendency to remove the round from the fuze setter before the fuze was fully set. This evidently occurred in cases where the frictional resistance of the setting ring of the fuze was high. It is known that the torque required to set the fuzes varies considerable, which at least would prevent smoothness of operation of the fuze setter. Consideration is being given to the re-tensioning of time rings so that the turning moment required to set them will be uniform.

Project No. 535, Earth Induction Compass for use in Aerial Spotting Orientation.—The Coast Artillery Board is being supplied an earth induction compass to test as a method of orienting an aerial spotting instrument.

Project No. 536, Data on Sound Ranging for Field Forces for the Field Artillery Board.—The Coast Artillery Board has been directed by the Chief of Coast Artillery to recommend information to be sent the Field Artillery Board in its studies of Sound Ranging for Field Forces.

Completed Projects

Project No. 427, Effect of Horizontal Distance on Antiaircraft Ballistic Wind

I—HISTORY OF THE PROJECT.

1. The Chief of Coast Artillery directed the Coast Artillery Board to conduct ballistic wind tests in the following letter:

1. Present regulations provide that meteorological data will be broadcast for artillery and other uses by the Signal Corps from one point for the area of an Army.

2. During the past summer the 62d Coast Artillery (AA) at first obtained ballistic wind once daily from Mitchell Field. In order to get more frequent data, arrangements were made to have the harbor defense meteorological station at Fort Hancock, N. J., telephone the ballistic wind to Fort Tilden once an hour. To further improve the data used during these important exercises, a Signal Corps detail was secured for station at Fort Tilden; and from about July 1 on, the ballistic wind was obtained by this detail, at the location of the firing batteries.

3. There are no data on which to base a comparison of the value of observations taken in the vicinity of the firing batteries with those taken at a distance (as for the entire Army area).

It is desired to obtain such data in order to decide whether or not it is necessary that a meteorological detail be included in the antiaircraft gun battalion.

4. The Chief of Coast Artillery directs that the Board prepare and carry through a program which will enable a determination to be made of this question.

It is suggested that simultaneous readings be taken hourly at Fort Monroe and Eustis until approximately 100 sets of readings have been obtained.

5. It is desired that, as a part of this project, the ballistic wind be obtained at night as well as during daylight. It is necessary that means be developed for obtaining the ballistic wind at night for use with the sound locating devices as well as for the use of the guns.

II—DISCUSSION.

2. Exhibit "A" [omitted] is a copy of the program of tests drawn up by the Coast Artillery Board. Ninety-nine ascensions were made at Fort Eustis, and 114 ascensions at Fort Monroe. Exhibit "B" [omitted] is a tabulation of 87 simultaneous ascensions obtained. The others were disregarded because they were either not made simultaneously or did not attain sufficient altitude to warrant consideration.

3. The Chief of Coast Artillery sent the Coast Artillery Board tabulated results of about 200 readings taken by the U. S. Weather Bureau at Washington, D. C., Bolling Field, Aberdeen Proving Ground, and Dahlgren Proving Ground. In this Weather Bureau tabulation, Aberdeen Proving Ground and Dahlgren Proving Ground ascensions were made at approximately the same time, in general differing by only a few minutes. The distance from Aberdeen Proving Ground to Dahlgren Proving Ground is about 90 miles. The results of the Weather Bureau tests show even less variation than the tests conducted by the Coast Artillery Board.

4. In general, except for surface winds up to a few hundred feet, no great variation in wind velocity obtains at Fort Monroe and Fort Eustis.

5. There are several examples where wide variations occurred, examples of these are the ascensions at 9:00 A. M., January 13, 1926, showing a direction variation of 150° at 1300 yards altitude; at 10:00 A. M., January 15, 1926; and all ascensions of January 21, 1926, showing large velocity variations.

6. A letter was written by the Coast Artillery Board to the Chief of Weather Bureau showing the variations mentioned in paragraph 5 above. He explained the large direction variation as being due to the low velocities prevailing at the time, explaining that variation in direction is quite likely to occur when the velocities are low. He stated that the velocity variations on January 15, 21, and 27, 1926, were excessive and, from the experiences of the Weather Bureau, highly improbable. He explained these variations as probably being due to leaky balloons at the stations showing the higher velocities. The Coast Artillery Board concurs in this opinion and further believes that there is a possibility of a mistake having been made in inflating the balloons to give the proper free lift.

7. Except for the above excessive variations it is noted that the variations between Fort Eustis and Fort Monroe are no greater than the hourly variation at any one station. To make an ascension and send out a meteorological message will, for all ascensions of sufficient altitude to be of value for antiaircraft fire, require at least one hour.

8. The airline distance from Fort Monroe to Fort Eustis, is about 20 miles, the surrounding country consisting of flat terrain and water. Winds up to an altitude of 500 to 1000 yards are affected by surface conditions. This surface effect is probably less in this locality than in others where the terrain is more broken. However, it is not believed that surface conditions will have any appreciable effect on ballistic winds for antiaircraft artillery since, in general, the greater part of the time of flight is above 1000 yards.

9. The Coast Artillery Board understands that it is now proposed to have three meteorological stations per army.

10. In the January, 1926, issue of the *Monthly Weather Review*, issued by the Weather Bureau, there appeared an article on the winds of the Middle and Northern California Coast. In this article it is indicated that the winds vary greatly in direction and velocity at points separated by comparatively short distances. These variations are so great that it is not believed a Ballistic Wind measured at one point in this locality would be of value for antiaircraft artillery at other points even though separated by comparatively short distances.

III—CONCLUSIONS.

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

a. Ballistic winds taken at one place are sufficiently accurate for antiaircraft ballistic wind for all localities lying within a radius of 30 miles.

b. Three meteorological stations per army is a sufficiently dense distribution of meteorological stations to supply ballistic winds for antiaircraft artillery.

c. No greater accuracy of ballistic winds would be obtained by issuing meteorological equipment for measuring ballistic winds to antiaircraft artillery organizations.

d. In some exceptional localities, such as that around the Golden Gate, California, winds vary so greatly over short distances that it is doubtful whether satisfactory ballistic winds can be obtained except at or very near the guns.

IV—RECOMMENDATIONS.

12. The Coast Artillery Board recommends that:

a. No meteorological equipment for measuring ballistic wind be issued to mobile antiaircraft artillery organizations.

b. No meteorological equipment be issued to antiaircraft organizations defending rear areas or localities where there is a possibility of obtaining ballistic wind data from a meteorological station not more than 30 miles distant.

V—ACTION OF THE CHIEF OF COAST ARTILLERY.

The Chief of Coast Artillery concurs in the conclusion and approves the recommendations contained in the Proceedings of the Board on Project No. 427, Effect of Horizontal Distance on Antiaircraft Ballistic Wind.

Project No. 494, Jackson Sound Lag Computer

February 4, 1927.

Subject: Project No. 494.

To: President, Coast Artillery Board, Ft. Monroe, Va.
(Thru Commandant, C. A. School).

1. There is forwarded herewith for your information copy of an indorsement showing the action of this office on the above named project.

2. It is requested that you arrange with the Editor, COAST ARTILLERY JOURNAL, for the publication of the subject matter of this project in an early issue of the JOURNAL.

By order of the Chief of Coast Artillery:

C. E. KILBOURNE, *Colonel, C. A. C.,*
Executive Assistant.

1 Incl.

I—HISTORY OF THE PROJECT.

1. The device covered herein was designed by Captain Albert M. Jackson, Coast Artillery Corps. An improvised arrangement of the device was constructed by the designer and used in connection with the recent tests of antiaircraft materiel made at Aberdeen Proving Ground, Maryland.

II—DESCRIPTION, (See Exhibits A and B).

2. The sound lag computer is designed to furnish continuously the following elements: apparent sound lag, predicted sound lag, predicted elevation, and correction due to temperature refraction.

3. It may be used with either the exponential sound locator Type T1 or Type T2, the only difference being in the method of attachment of the disc to the elevation semi-circle, and the attachment of the pointer assembly.

4. *Installation on the Type T1 Sound Locator.* The disc has three holes and is attached to the semi-circle by means of the three bolts that hold the latter to its hub. The pointer assembly is attached to the elevation index bracket by means of the two screws that normally hold the elevation index arrow in place.

5. *Installation on the Type T2 Sound Locator.* The disc is attached to the elevation semi-circle by boring two holes along the diameter of the latter and bolting the disc through these holes. The pointer assembly must be attached by a special bracket as shown in Exhibit A.

6. The disc is a brass semi-circle of twelve and three-eighths inches radius. It is covered with heavy drawing paper on which are drawn the sound-lag curves and temperature refraction curves.

7. The sound-lag curves are plotted on polar coordinates with apparent elevation of the emitted sound plotted against altitudes radially. For example, to plot the 10-second sound-lag curve, assuming the velocity of sound to be 1100 feet per second, this corresponds to a slant range of 11,000 feet. Keeping this value constant, the altitude X is computed for several apparent elevations between 0 degrees and 90 degrees, and plotted radially from the periphery of the semi-circle. A curve connecting the points thus plotted represents the 10-second sound-lag curve. The curves are plotted for each second up to twenty inclusive.

8. The temperature refraction curves are plotted in red and represent the correction to be applied to the apparent elevation. The three refraction curves actually plotted, 0.5° , 1.0° and 1.5° , are based on a mean summer temperature of 70° F.

9. The pointer assembly (Exhibit B) is constructed of brass, and consists of an index box a which slides over an arc b concentric to the elevation semi-circle. The index box is equipped with a friction device c consisting of a steel plunger which bears against the lower edge of the arc through the action of a spring. The left edge of the index box is the reading edge. The arc is graduated in degrees and half-degrees. The pointer slides through the index box and normal to the arc. It is notched on its right edge, the left edge being the reading edge for elevation. By means of a ratchet e and spring f on the right side of the index box the pointer is held at any notch corresponding to the altitude desired. The tension of the ratchet spring is sufficient to hold the pointer at a given altitude, but permits with ease the sliding of the pointer when changing the altitude setting. The pointer is graduated in altitudes from 1,000 to 17,000 feet. By sliding the pointer through the index box, until the estimated or approximate altitude appears in the reading window shown on front side, the ratchet is engaged in the proper notch.

III—OPERATION.

10. When using a predicting interval, that is, the dead time necessary for transmission of data, the device is operated as follows: The pointer is moved until the estimated altitude appears in the reading window. As the first elevation is called, the elevation computer notes the sound lag opposite pointer and sets it on whatever predicting device is being used. When the second elevation is called, ten seconds later, the computer determines the vertical deflection (predicted travel in elevation during the next ten seconds plus the sound lag), and this is set by sliding the index box along the arc by the amount of the predicted travel. This will now give the predicted sound lag. The whole operation is repeated, the first few determinations being successive approximations. It will be noted that the pointer is always set ahead of the apparent elevation by an amount equal to the vertical deflection; after the first few readings the elevation reader transmits the predicted elevation directly to the pilot light. By equipping the azimuth scale with a movable pointer which could be separated from the fixed pointer by an angle equal to the lateral deflection, the same operation could be used in predicting azimuths.

11. When using electrical transmitting training devices such as the Sperry Comparator or the General Electric self-synchronous system, the operation of the sound-lag computer is as follows: The index box is set at zero correction, when the altitude has been set and first apparent elevation has been determined—the vertical deflection setter notes the refraction curve nearest the pointer and corrects the setting of the index box by the amount of the correction. The pointer

now reads sound lag corrected for refraction. The angular travel in azimuth and elevation is measured during the sound lag only as the latter is indicated continuously. It has been found practical to measure the travel mentally during the indicated sound lag, but with the addition of a movable pointer on the azimuth and elevation scales, the chance of error will be greatly reduced. When the deflections have been determined they are set on the corrector dials L and V, which automatically set the pilot light ahead of the listening device by the amount of the deflections. The deflection setters repeat this operation, changing the observing interval each time the sound-lag computer indicates a new interval, that is, a

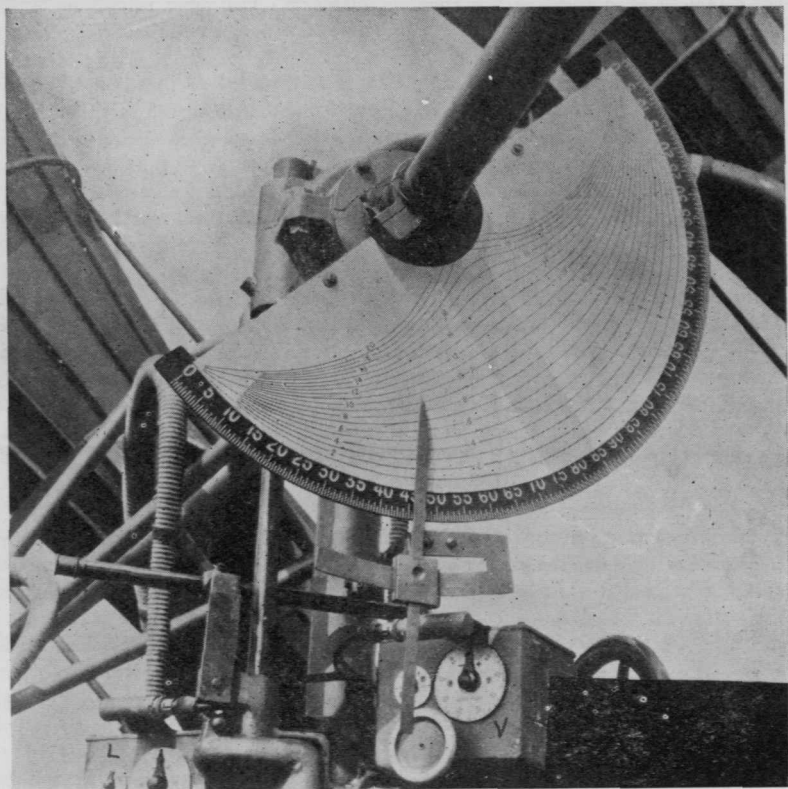


EXHIBIT A

different sound lag. The section serving the sound locator is reduced to four men, consisting of two listeners, a lateral deflection setter, and a vertical deflection setter.

IV—DISCUSSION.

12. The sound lag computer described herein was used extensively during the recent tests of antiaircraft material at Aberdeen Proving Ground, Maryland, and was found to be more satisfactory than any device yet designed for this purpose. In the case where a predicting interval is used, the advantage lies in the fact that the data goes directly to the light instead of through the intermediary of plotting devices. The noise due to verbal transmission of data, which is very disturbing

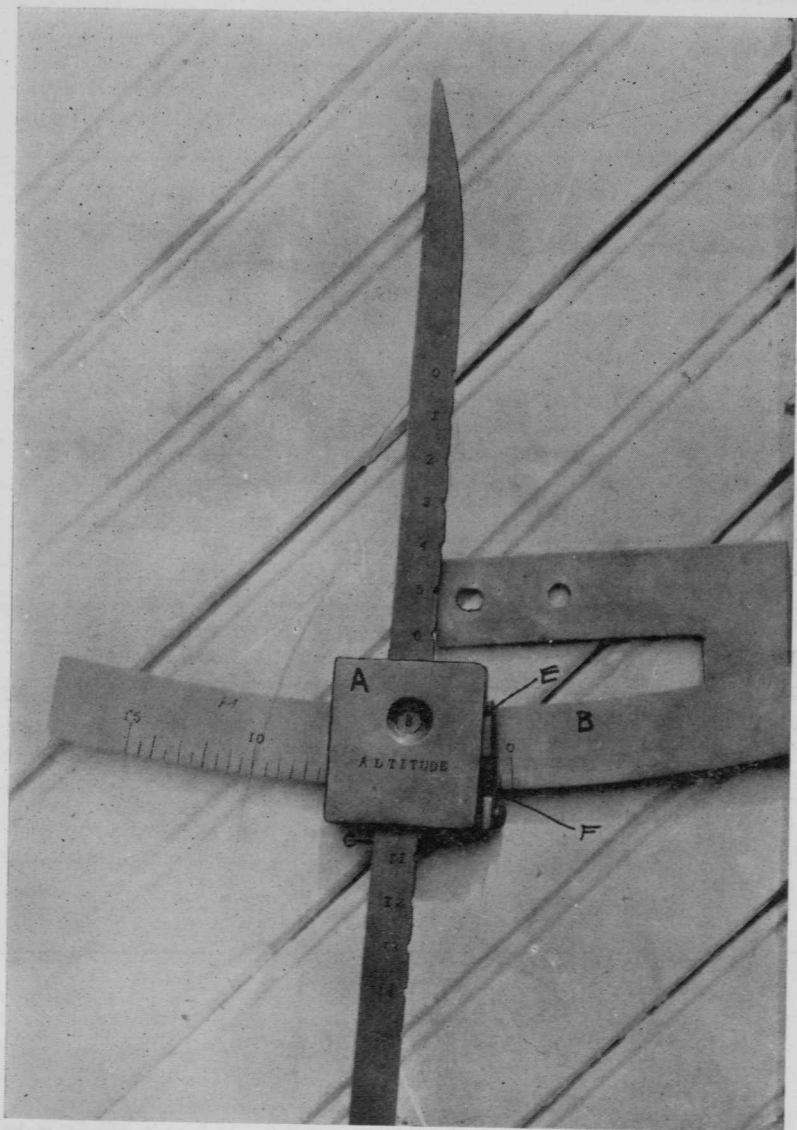


EXHIBIT B

and confusing to the listeners, is reduced by fifty per cent. The operation of the sound-lag computer becomes entirely noiseless when using electrical training devices. The corrections made for sound refraction are so small that they appear insignificant as compared to other errors involved in the sound locating system for which no corrections are made at the present time. During the tests at Aberdeen this feature was finally disregarded, the index box being kept at zero reading on the arc. There is a "dead time" of about two seconds in the case of electrical transmission for which no correction has been considered, the time involved in setting the corrector dials.

V—CONCLUSIONS.

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

a. The Jackson Sound-Lag Computer is the most satisfactory and most practical device so far developed for the determination of sound lag.

b. It can be cheaply and easily constructed.

c. The temperature refraction curves are not necessary to its successful operation.

d. It should be equipped with a device which will indicate travel deflections mechanically. The present design requires a mental estimate of the deflections, which is susceptible to error even with an intelligent and experienced operator.

e. The sound-lag curves used in connection with electrical training devices should include two seconds "dead-time" necessary to set the deflection dials.

f. The basic principle involved in the sound-lag computer, the setting of apparent elevations and azimuth simultaneously with the movement of the listening device, is desirable.

g. Future development will undoubtedly add improvements to the device described herein.

VI—RECOMMENDATIONS.

14. The Coast Artillery Board recommends:

a. That the Jackson Sound-Lag Computer be authorized for use in Coast Artillery Searchlight Batteries (Antiaircraft).

b. That a description of this Sound-Lag Computer be published to the Coast Artillery Corps.

c. That local construction and use of this computer be encouraged.

d. That the Ordnance Department continue the study of the sound-lag problem with a view to developing a computer, along the lines described herein, for permanent installation on all sound locating devices.

Exhibits "A" and "B" accompanying.

VII—ACTION BY THE CHIEF OF COAST ARTILLERY.

477.12/CW

1st Ind.

War Department, OCCA, February 4, 1927.—To Chief of Ordnance.

1. The conclusions and recommendations of the Coast Artillery Board contained in the enclosed proceedings under Project No. 494 are concurred in. Attention is especially invited to paragraph 14 d.

2. It is requested that steps be taken to install the Jackson Sound Lag Computer on all the sound locators to be furnished by the Ordnance Department for the Aberdeen exercises next fall. This office will take action to equip the sound locators in the hands of the 61st Coast Artillery with this computer. In this connection attention is invited to correspondence on this line of development work transmitted to your office * * *

BOOK REVIEWS

Statesmen and Soldiers of the Civil War. Major General Sir Frederick Maurice. Little Brown and Co., Boston. 1926. 5¾"x 8½". 173 pp. Ill.

At the beginning of Chapter V, which is the last and is entitled "A System for the Conduct of War," we find this resumé and statement of theme:

We have now examined the relations which existed between two statesmen and four soldiers during a great war under democratic systems of government. They have been examined frankly, in the light of our own experience and not in that of the experience and knowledge of war prevailing in the sixties of the last century. What are we to learn to our advantage from the successes and failures of these men? The first lesson is, I think, obvious. Any government which hopes to wage war successfully and without undue cost, must have established before arms clash, a well considered system of conducting war. Lincoln, as we have seen, built up such a system under the stress of bitter experience. Davis, starting on his task with a far greater technical equipment than Lincoln possessed never devised any effective system.

. . . It is not sufficient for the statesmen to choose leaders for armies, navies, and air forces, and to say to them, "Now go and fight." I hope to have shown that was not Lincoln's attitude to Grant. There must be direction—and constant direction—of strategy, but if direction is not to become mischievous interference, the director must know how to direct. . . .

The statesmen and soldiers whose relations are considered in the earlier chapters, are Davis and J. E. Johnston, Davis and Lee, Lincoln and McClellan, and Lincoln and Grant. It is interesting to note that Davis and Johnston disliked each other, and Lincoln and McClellan were politically antagonistic, that much of Davis's success in dealing with Lee was due to Lee's tact, and some failures to Lee's self-effacing modesty, while Grant's tact and judgment in his relations to Lincoln and in keeping Lincoln informed contributed enormously to Lincoln's success.

This text appears fairer to Davis than other foreign studies of his conduct of war. It is pointed out that Davis foresaw that the North would fight and fight hard; that he prevented a 60-day enlistment law; later obtained authority to accept volunteers in unlimited number for the duration of the war; and in April, 1862, procured the passage of a conscription act. The charge that Davis displayed lack of energy in providing arms and equipment is answered by reference to the very little better progress made by the Federal government with established organization, considerable manufacturing facilities, and free access to Europe.

Some of Davis's weaknesses and failures as seen by General Maurice are: the influence upon his conduct of the war of his conviction that a cotton famine (or some other cause) would cause Great Britain or France to intervene; his failure to insist that the interests of the Confederacy should take precedence over the interests of the several states (a weakness inherent in the Confederate cause and theory of government); his excess of caution; his tendency to rely too much on his small military experience, which caused him to concern himself too much with detail and prevented him from seeing the necessity for competent military advice; his failure in 1862 after the second Battle of Manassas, and again after

Chancellorsville in 1863, to see, as did Lee, that the best chance of winning the war lay in subordinating everything else to a retention of the initiative and to confronting the Federals with a victorious army in their territory; and his organization of the army into departments under direct control of his War Department instead of relieving Lee from command of the Army of Northern Virginia and placing that general in supreme military command. General Maurice points out that Davis did approve Lee's invasion of Maryland in 1862, and of Maryland and Pennsylvania in 1863, but failed sufficiently to subordinate other operations to the support of these invasions; that Davis did offer Lee supreme command in Virginia and the Carolinas in June, 1863, but only while remaining in executive command of the Army of Northern Virginia.

The reviewer feels that General Maurice is not quite fair to Davis on this last matter for, while he credits Lincoln at least with having evolved a satisfactory plan for the conduct of war when Grant was given supreme command, he fails to note that in 1864 Grant was sent with the Army of the Potomac not merely to accompany it, but actually in direct command (Burnside's Corps and Sheridan's Cavalry included).

The chapters on Lincoln and McClellan, and Lincoln and Grant, afford a clear and logical study of the evolution of Lincoln's plan for the conduct of war, and show that, although Lincoln never fully recognized the inadvisability of suggesting military operations, he eventually accepted and loyally supported each of Grant's plans, despite almost continuous adverse political pressure, and in the face of apparent failure. Particular importance is attached (and properly so) to Lincoln's "hold on with a bulldog grip" telegram to Grant in August, 1864, after Grant had indicated his opinion that it would be inadvisable to withdraw troops from the James for the suppression of expected draft riots.

These four chapters furnish a concise but astonishingly complete study of the major operations, with the changing situations and varying fortunes of the entire war. Only the most exceptional reader can fail to have his picture of the whole clarified and sharpened.

In the last chapter the attempt is made to outline a system for conduct of war by a democracy which should give success with the average statesmen and soldiers to be expected. Here he returns to the Civil War to point out that "statesman and soldier should mutually understand each other's functions and needs." He adds:

The Confederate President cannot, as I have tried to show, fairly be charged with undue interference with the operations of his generals in the field; the charge rather should be that he did not interfere enough in the right way. Abraham Lincoln had a very definite and sound policy from the beginning of the war; but he did not know how to translate that policy into instructions to McClellan, and McClellan did not know what advice to give his political chief, nor indeed was he aware that it was his duty to advise him at all.

It will appear from the foregoing that General Maurice rejects the commonly held view that Lincoln's original idea as to the purpose of military operations was the capture of the Confederate capital and other important positions, and that from Grant came the idea that the essential object was the destruction of the armed forces of the Confederacy.

Briefly, Sir Frederick Maurice believes that for effective conduct of war, it is necessary: to give some one statesman supreme directing authority; to provide him with a competent chief military adviser for land, sea, and air, whose duties

and functions as such are established constitutionally or legally, but who shall be subject to removal or replacement by the civilian dictator; to consider the relation between the statesman and the soldier as a partnership with the statesman as senior partner, who should be kept informed of, but not interfere in the junior's intentions and plans; and most important of all to provide in advance a workable system for government in war to be known and understood by statesmen, soldiers, and at least those people who guide public opinion.

If the reviewer has taken more space than he is entitled to, he pleads in justification the importance and interest of this admirably written book, the reading of which should furnish the unusual sensation of enjoying a professional and patriotic duty.—R. S. A.

The American Civil War. By David Knowles. Oxford University Press, New York. 1926. 4¾"x 7¼". 224 pp. \$3.00.

This book, which, to use the words of the author, "sketches in short compass the causes, characteristics, personalities, and consequences of the war between the Northern and Southern States of America in the years 1861-1865," brings a novel and interesting viewpoint to the reader, for it is the viewpoint of an Englishman who says he can scarcely remember a time when the events of this particular epoch of American history did not charm and fascinate him. "My earliest interest in Stonewall Jackson and the forest fighting," says Mr. Knowles, "gave place to a deeper admiration for the genius of Lee and the devoted bravery of the army of Northern Virginia; this led me to a study of the causes of the war and to an appreciation of the aims of the North, and these in their turn took me to Abraham Lincoln, the deepest and richest personality among those affected by the war, and one whom I have come more and more to regard as the greatest statesman of his age and the man who, above all others in modern times, has gone far to solve the deep moral problems underlying the exercise of power over others."

The volume, in spite of its brevity, covers an amazing amount of ground very satisfactorily. Every important campaign of the Civil War and every major engagement is treated concisely but adequately; and Mr. Knowles finds space for a discussion of the contrasting civilizations of the North and the South, as well as for a masterly summary of the causes which still further alienated the two sections and that promoted the hostility which terminated in war.

The tabloid biographies of McClellan, Grant, Jackson, Lee, and Lincoln are models of clear and direct thinking and character analysis; and the eulogy on Lincoln is particularly impressive. It is one of the finest tributes ever offered to the martyred President, and would in itself make the book worth the owning.—E. L. B.

New Methods in Exterior Ballistics. Forest R. Moulton. University of Chicago Press, Chicago, Ill. 1926. 5¼"x 8½". 257 pp. \$4.00.

In 1918 Prof. Moulton (then Lieutenant Colonel in the Ordnance Reserve Corps) was placed in charge of the Ballistics Branch of the Ordnance Department. The preceding years of the World War had witnessed a tremendous expansion in the scope of artillery. Long range artillery, antiaircraft artillery, the multiplication in the types of projectiles, and the great variety in the methods of firing placed increased demands upon the ballisticians. Notwithstanding the fact that the subject of ballistics had attracted the serious attention of some of the most

eminent mathematicians for ages, Prof. Moulton found that the classical ballistic methods were inadequate to meet the situation. The task fell to him to organize anew the bases of ballistic computations. This he set about to do with a view toward coordinating adequate theory with scientific experiment.

As a result of this reorganization the ballistic methods now employed differ materially from the methods in use prior to the World War. Necessarily, they are more comprehensive. The studies and experiments made have laid the foundation for marked improvement in the design of guns and projectiles. The practical gunner has also been furnished with more adequate working data in the form of the new firing tables.

The book is an outgrowth of the author's experience in the Ordnance Department and his later work at the University of Chicago with military, naval, and mathematical students. It is essentially a mathematical treatise, and as such it is comprehensive and logically presented. It will appeal particularly to the ballistician; but, in general, the method of presentation is beyond the comprehension of the casual reader in ordinary artillery circles.—C. S. H.

George Washington, the Human Being and the Hero, 1732-1762. By Rupert Hughes. William Morrow and Co., Inc., New York. 1926. 5¾"x 8½". 580 pp. Ill. \$4.00.

In a speech made at a banquet of the Sons of the American Revolution in Washington in January, 1926, Mr. Hughes advanced the idea that the American public was grossly misinformed, or uninformed, as to the genuine life and character of George Washington. More specifically, he intimated that the foremost of all of our national heroes was a land speculator on a large scale and that he enjoyed immensely the dances and the frolics, the hunts, the drinks, and the races of his period. The author and his publishers claim that his speech was misinterpreted. At any rate, it attracted much attention and the ideas advanced were attacked by a number of public men and a part of the press. Consequently, the appearance of the book was awaited with wide interest. The book easily measures up to the expectation, although it may disappoint a few who may have expected it to contain a mass of shocking information.

The author has succeeded in presenting Washington as a human being. The sentences quoted below give an idea of the manner in which the work is presented:

My incessant effort in this biography has been to see his life as he saw it. All other biographers have tactically assumed that he knew the future and builded himself grandly for it. They have looked backward upon him through the dazzling aureole of his apotheosis. But this was not the way he saw the world. He had to grope for his faith and he missed few of the pitfalls, the thorns and torments of the way. No more did he miss the primroses, the festivals, the dances and the sports and romances.

Mr. Hughes was well prepared for this work. As an assistant editor of the *Historian's History of the World* he had occasion to handle the period of George Washington. Throughout the book there is the imprint of careful research among the original sources.

Early in the book there appears to be unnecessary emphasis placed on the mistakes of the young man. Later, the story of his romance with the clever and attractive Sally Fairfax is studied in detail—and perhaps over-emphasized. These faults are excusable on the grounds that so many of Washington's biographers have so carefully removed all traces of the hero's mistakes. The most valuable

feature of the work is its splendid story of Washington's career as a young colonial leader of the Virginia militia. At the age of 22, and before he had learned well the school of the soldier, circumstances placed Washington at the head of the entire forces of his colony in a campaign of importance. This is another story of that ever recurring story of the militia unprepared. The soldiers—unclothed and unfed, unpaid, untrained, and undisciplined—rum houses, deserters, and disturbing camp followers. Washington had his troubles and, if he did put on a hypocritical front to his officers and his soldiers, he did not fail to make sufficient complaints to the Governor. Later he served with Braddock and Forbes. It is interesting to note that Hughes defends admirably Braddock's conduct of his campaign. This part of the book has much historical value. It furnishes a particularly valuable study for the officers in the American Army.—C. S. H.

A History of Hawaii. By Ralph S. Kuykendall. The MacMillan Company. 1926. 5"x7¾". 375 pp. Ill. \$2.50.

A photographically illustrated school text-book of Hawaiian history based on the topical method of instruction and containing questions at the end of each chapter. The book was prepared under the direction of the Hawaiian Historical Commission, in accordance with a recent territorial law.

The first three chapters of the book, written by Dr. Herbert E. Gregory, give an excellent and very interesting picture of the islands of the Pacific Ocean and cover briefly but clearly such subjects as the flora, fauna, and geology of those islands, the customs, language, and traditions of the Polynesian peoples, and their early legendary history. The remaining chapters, written by Mr. Kuykendall, cover Hawaiian events beginning with the discovery of the islands by Capt. James Cook, R. N., in 1778 and continuing up to the year 1925. These chapters are written in the usual text-book language; the writer arrives at no important conclusions, his main object apparently being to give an accurate outline of Hawaiian history. The book is illustrated with well chosen maps and photographs.—W. D. H.

British War Budgets. By F. W. Hirst and J. E. Allen. Yale University Press, New Haven. 1926. 6½"x9¾". 511 pp. \$5.00.

In an attempt to measure the economic cost of the World War and the displacement it has caused in the process of civilization, the Division of Economics and History of the Carnegie Endowment for International Peace has undertaken a scientific study of the economic phases of the War. Under the general editorship of Professor James T. Shotwell, of Columbia University, editors or editorial boards have been appointed in the countries of Europe most seriously affected by the war, and the services of more than two hundred distinguished economists, historians, statesmen, diplomatists, scientists, lawyers, soldiers, and men of affairs have been enlisted to collaborate in the preparation of a series of economic monographs, which combine to make an Economic and Social History of the World War. The subjects with which these studies will deal include war governments, economic controls, labor in wartime, industrial mobilization and reorganization, shifting of wealth, evaluation of war costs, and allied matters. More than thirty of these monographs have already been prepared, and four times that number are in course of preparation.

The volume by Messrs. Hirst and Allen is a presentation of British war finance as shown in the twelve budgets from 1914 to 1924. Each of these budgets is examined in considerable detail, and the development and changes of policy in

dealing with debt, expenditure, and taxation are traced through the period of the war and through the years immediately following. With the national debt increased from \$650,000,000 in 1914 to £7,766,000,000 in 1923, it can not be said that British war financing has yet come to an end, and the authors admit that the apparent stability reached in 1924 is the principal reason for bringing their study to a close at that particular period. The work is thorough within the space limitations of the volume; it is interesting as an economic study; it is well and carefully written; and it will be valuable to any one interested in the subject of taxation or in the matter of war financing.

Conquering the Air. By Archibald Williams. Thomas Nelson and Sons, New York. 1926. 5½"x 8". 315 pp. Ill.

It is little more than twenty years since the Wright brothers, "now universally recognized as the fathers of practical human flight," made the first "hop" in a power-driven machine. It is only eighteen years since Bleriot of France managed to stay in the air long enough to cross the English Channel. Yet today the airman is accepted by the inhabitants of the civilized countries as part of the routine activity of the times; although there are millions of people who have never seen an airplane or a dirigible, and millions more who have not yet experienced their first air ride.

The history of the development of aviation forms one of the most interesting chapters in the story of the progress of the human race; yet few people know anything of the tedious steps by which man, little by little, has conquered the air. Therefore a book like *Conquering the Air* by Archibald Williams, written in a simple but interesting narrative style, free from technical terms, should have a wide-spread appeal to all kinds and conditions of readers.

In his introduction Mr. Williams explains the purpose and the scope of his book.

This book is . . . more concerned with the past history of aeronautics than with future possible developments. In the rush of present progress we must not forget the work of the pioneers of aeronautics, who, like pioneers in other fields, had to break the trail for those that have come after. The difficulties to be overcome were great, the courage shown in overcoming them even greater; and the story of the men who opened the paths of the air to their kind is surely worth telling, for their success heralded a new era for humanity. . . . We shall devote our attention first to the origin of spherical balloons and to the most notable voyages made in them. Next, we shall see how the balloon was altered in form, provided with motive power of its own, and converted from a mere gas-container into a self-directing aerial ship. Then follows an account of the experiments which led up to the production of the first practical flying-machine; to be succeeded by a series of chapters devoted to these flights, of successively increasing length, which, as first exemplifying the conquest of the air on the grand scale, may justly be termed epoch-making. . . . The part that aircraft took in the Great War, and the influence of the war in speeding up their development, then come under review; also the post-war application of aircraft to peaceful uses, and the organizing of aerial transport on commercial lines. As a fitting conclusion comes a consideration of the lines along which aeronautics are likely to develop and a short flight into that future when humanity will really have taken to the air.

The book is printed in very clear type; is profusely illustrated with photographs and drawings; and in addition to the interest it possesses for the adult reader, is an ideal gift book for the active-minded boy of high school age.—E. L. B.

The Book of the Aeroplane. By Capt. J. Laurence Pritchard. Longmans, Green & Co. 1926. 4¾"x 7½". 225 pp. Ill. \$2.75.

An absorbing story of the history and development of the heavier-than-air flying machine, written in a non-technical manner, yet sufficiently complete to give the average reader a clear idea of the mechanism of flying, the construction of the aeroplane, the use and limitation of various types, and the organization of the ground necessary to keep an aeroplane in the air.

While the author deals almost entirely with British aviation and British types of planes, he devotes an entire chapter to the Wright brothers giving them and America full credit for the first heavier-than-air machine.

The American, when reading the chapter on "Famous Flights," may feel that too scant mention is made of the American Round-the-World Flight and the first flight across the Atlantic by our seaplanes. These were great flights, it is true, but carried out in such a leisurely manner and with such complete organization of ground that there lacked the sporting element which so stirred men's imaginations in the Atlantic flight of Hawker and Alcock and the flight from London to Australia by Ross Smith. After all, world records and the "first" and "greatest" are sometimes misnomers; the world remembers longest the events of dramatic daring and outstanding sportsmanship. We believe the author is quite fair.

The chapter on "The Great Airways of the World" gives a picture of commercial aviation in Europe well worth reading.

In dealing with the subject of military aviation the author makes the significant statement: "The all-metal machine will, in a very short time, be the only machine in use in the Royal Air Force."

The author measures the progress of aviation with the statement: "Twenty-five years ago, no man had seen an aeroplane fly, and twenty-five years hence few will have the imagination to realize what the world was like before the air was conquered."—W. D. H.

Army Posts. By Captain Charles J. Sullivan. Free Press Publishing Co. 1926. 5¾"x 9". 255 pp. \$3.00.

To sell or not to sell! That is the question that oft confronts the army auto owner when the more or less expected change of station orders come. Whether 'tis better to let old Henry go—and shed a silent tear—or pack him up in hopes of finding roads whereon to roam.

This perplexing question—and almost any other concerning the new post—is answered in Capt. Sullivan's exceedingly useful book. The number and kind of quarters, the ever-vexatious servant problem, the equally changeable climatic conditions, the location of the nearest golf pasture (African or otherwise), the best town in which to shop, where to procure food and (we were about to say drink but on second perusal we find this item has been omitted), the uniforms worn and whether civies are allowed, the educational and recreational facilities and practically all other pertinent points (with the possible exception of the color of the C. O.'s hair) are carefully covered to the great benefit and profit of the uninitiated.

Insofar as the reviewer may judge from his knowledge of a necessarily limited number of Army Posts the information so painstakingly gathered by Captain Sullivan is accurate, comprehensive, and up-to-date, and in publishing it he has rendered to Army personnel a service far in excess of his personal profits. We unhesitatingly recommend it as a book no Army officer can afford to be without.

—D. L. D.

Elements of Radio Communication. By Ellery W. Stone. D. Van Nostrand Company, New York. 1926. $5\frac{1}{4}" \times 7\frac{1}{2}"$. 694 pp. Ill. \$3.00.

A good elementary book on the subject of radio communication written primarily for the guidance and instruction of radio students in the Communication Service of the Navy. Although it is not a hand book for the Radio amateur it contains interesting explanations of radio phenomena from the physical rather than the mathematical viewpoint.

The first part of the book is given to simple explanations of wave motion, direct and alternating current, a very good explanation of decrement, and oscillating circuits. The remainder of the book follows the development of radio telegraph with special stress on transmitting devices including radio broadcasting. The explanations are mostly descriptive.

The book is profusely illustrated and could be used to advantage as a text in a course of instruction for radio operators.—R. W. A.

Reminder List for Field Training. ed., Colonel W. Irving Taylor. State of New York. 1926. $4" \times 6"$. 88 pp.

In condensed form in this little pamphlet the State of New York has had prepared a reminder list for the benefit of the National Guard personnel in the Coast Artillery Corps of that state. In five parts, under the headings of Administration, Materiel, Target Practice, Shore-Tug Shore-Airplane Communications, and Sanitary Regulations, are covered the equipment of individuals and organizations and the duties of the various commanding and staff officers for the period immediately prior to, during, and following the annual encampment. The reminder list should be of great value to all officers—Regular or National Guard—participating in such camps.

Our Mobile Earth. By Reginald A. Daly. Charles Scribner's Sons, New York. 1926. $6" \times 9"$. 342 pp. Ill. \$5.00.

The book is intended for the general reader; it does not follow, however, that it smacks of superficiality. Far from it: the eight chapters of the work are bold in outline and they contain a mass of organized information concerning the crust and interior of this planet of ours. The nature of the study presented is indicated by the first paragraph of the author's introduction.

In its response to external forces the earth acts as if it were very much alive. Ceaselessly the sun pours its radiant energy. Hence, winds are always blowing; rivers are always flowing; sea waves are always touring the oceans and pounding the continents; glaciers, also children of the sun, keep steadily ploughing out the rocks. The mobility, the liveliness, of air or ocean is familiar to us. Less obvious is the real mobility of the earth's rocky body. This phase of the earth's "aliveness" is the subject of the present book.

The book is largely devoted to a study of the history and the nature of earthquakes and volcanic actions and their causes; the nature and composition of the earth's interior; the sinking and rising of portions of the earth's surface—changes in sea level; and to the origin and formation of mountain ranges. The work is scholarly and attractively presented. One hundred and eighty-seven photographs of earth's phenomena serve to illustrate.—C. S. H.

Walter Garvin in Mexico. Gen. S. D. Butler and Lieut. A. J. Burks. Dorrance and Company, Inc. 1927. $5" \times 7\frac{1}{4}"$. 238 pp. \$1.75.

A stirring tale of a young lieutenant of the Marine Corps during a critical phase in relations between Mexico and the United States.



PATROL VESSEL "ISABEL"

Displacement, 795 tons. Length, waterline, 230 feet. Beam, 26 $\frac{1}{4}$ feet. Draft, 9 $\frac{1}{8}$ feet. Armament, four 3" guns, two 3" AA guns, 50 cal. Speed, 28.8 knots. Driven by