

THE TRANSMISSION OF MILITARY INFORMATION

An outline of the service of a Corps of Intelligence, or
of a Signal Corps, under modern conditions affecting
the Transmission of Military Information to Troops
in the Field, and to the Coast Defense.

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PREFACE.

THE purpose of these papers, originally prepared for the JOURNAL OF THE MILITARY SERVICE INSTITUTION, and republished by direction of the Chief Signal Officer of the Army, is to endeavor to present a survey of the field opened by modern science to a corps entrusted with the service of military lines of intelligence, now technically called Lines of Information.

If it appears that the conclusions arrived at are based upon ideal rather than probable conditions in regard to numbers and completeness of organization, not only of signal troops, but of armies in the field and of a future coast defense—upon an ideal, indeed, that may never be realized in the United States; it should be remembered that these conditions are meant to define the superior limitations of the problem presented, and that they are, therefore, those which should govern its ultimate solution. They outline the whole from which a necessary part, commensurate with existing conditions, may be subtracted. The scope and value in military affairs of the lines of information of the future can hardly now be measured; and perhaps no branch of the military art offers a wider field for development than that of the service of intelligence. In the hope that the following contributions may assist in this development, they are submitted to signal-officers and to all others interested in the subject of the Transmission of Military Information.

GOVERNORS ISLAND, N. Y.,
March 15, 1908.

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THE TRANSMISSION OF MILITARY INFORMATION.*

PART I.



MANY as have been the changes that applied science has effected in civilized life during the past hundred years, no single one has been more revolutionary, perhaps, than that which has taken place in the transmission of human thought. A century ago the great semaphore system of France marked probably the farthest advance in the world's telegraphy, whereas to-day we put a girdle of thought around the earth in the twinkling of an eye; our uttered words pass beyond the range of sight or sound almost beyond the limit of years, and space and time have in this sense been annihilated.

That the change has been due to electricity is known to us all; yet who stops to realize, as he sends his voice over a thousand miles of distance, or receives in his comfortable office a message from some troubled ship at sea; or at a national capital reads the incidents of a battle almost as they occur on a foreign field, that at a time well within the memory of living men these things were not only impossible but were undreamed of. Indeed, until the first message of the Morse telegraph passed from Washington to Baltimore in May of the year 1844, intelligence was conveyed, if we neglect messages and messengers, much as it had been conveyed between men since the dawn of history. That the influence of this change has been as extended in war as it has in peace is perhaps too much to say, since peace is construction, war destruction; but that the value of the change is the greater in war is as sure as that the need is greater. If proof of this value is necessary, we have only to recall Shafter's communication at a critical moment with the White House from the field at Santiago, or the extent of Kuroki's fighting line made possible by electricity. It should seem that this force, applied to the transmission of thought, marks something new under the sun. Fifteen of the decisive battles of the world were fought before its advent.

*The word "intelligence," being of broader scope and including in its meaning the word "information," was employed in this paper when first published. But the expression "Lines of Information" has come to have an authoritative technical meaning, and has therefore been substituted.

But in war, as in peace, changes in the manner of transmitting thought—with all that this implies—have not been due to electricity alone; chemistry and the mechanical arts have, of themselves, or in conjunction with it, done their part and given us the search-light, the heliograph, the acetylene lantern, rockets and many other useful devices. But all of this class are merely improvements upon former methods of signaling as old in principle as thought itself, if not as old as the hills. They belong in essence to the language of signs used by the savage as it has been used by mankind throughout the ages, from the soldier of to-day to the fighting man of the ancient world and those before him. Who, for instance, cannot see in the wink of the Ardois the gleam of the acetylene lantern, or in Cossack beacons the signal lights of the Greek general Polybius; in the heliograph a suggestion of the mirrors of Archimedes; in the rocket the cloud by day and the pillar of fire by night of the Israelites? The wig-wag of the search-light recalls the waving of the Indian's lance,* the tree trimmed by a Filipino, its form outlined against the horizon, is a semaphore, and the clangor of the village fire-bell a harsh reminder of the tocsin of the middle ages. So the signal that Nelson's blind eye refused to see off Cape St. Vincent, the flagging of a railway train, or Corse's celebrated message from Altoona, and all non-electrical signals are as old in their origin as the flaming sword at the gate of Eden.

With nations, advance in the mechanical arts of peace makes for fighting power in war, and it may be assumed that the application of science to the usual business of life not only multiplies the comforts of man but tends to assure his safety; conveniences become scourges and the implements of progress become weapons of destruction; plow-shares are converted into swords and pruning hooks into spears as well as the converse. It follows that the material equipment of a people is a guide to their fighting power; but it does not follow that it is the measure of this power, since money can purchase many things in the markets of the world in spite of international laws; and men, not guns or any other inanimate thing, are the final argument of kings.

Perhaps this truth was never better illustrated than by the recent great struggle in the East, when a nation that had barely climbed to the edge of the plateau of modern civilization, and

*The origin of the present system of motion signaling by wig-wag, as related in a sketch of the life of Gen. Albert J. Myer.

was provided, before the event, with few of the material aids to modern life, and of these almost none of its own devising, had yet in its preparations for war sucked the brain of the world and carried on the struggle not merely in accordance with the highest standards of military art, but with the use of nearly every approved application of science to warfare. The meteoric success of Japan, which seems to have been due to a combination of highest intellect in the few with brute fighting power in the many, teaches various lessons, not the least important of which is the extraordinary value of modern lines of military intelligence. In this war so important did the transmission of intelligence become that it is said of the great Japanese general, Kuroki, the sound which interested him most was not that of firing, but the "click of the telegraph instrument which left nothing to the doubt of vision, but told him exactly what each unit was doing."* And further, on the bloody field of Liao Yang, it is related of him that, "Meanwhile the Japanese general, he of a race that only a half century ago fought with swords in battle where the leader must lead with his own fencing arm, sat in safety, with his staff around him, in touch with all his units, remedying errors and meeting situations as they appeared." To paraphrase the celebrated epigram of Balaclava—it is not magnificent but it is war—that is to say, it is a phase of war though not one that means there shall be no more a Richard Cœur de Lion, a Henry of Navarre, a Skobelev, or a Sheridan riding through the pages of history.

Considering the value of electrical methods of transmitting information shown in the Asiatic campaigns, and the use made of these methods by our own army in Cuba, the Philippines and in China, it should seem hardly necessary at this late day to dwell upon their importance. However, there are some officers, and good ones, who still think that the whole science of transmission of military information is summed up in a note-book and an orderly; and many of the younger men have never seen the telegraph work in the field and have rather less knowledge of a buzzer than of a catapult. But these are becoming exceptional, and it is probably safe to assume that every educated soldier of the younger school now understands the importance of the *immediate* transmission of intelligence. Indeed, without this,

*Mr. Frederick W. Palmer, as quoted by Gen. A. W. Greely, then Chief Signal Officer of the Army, in a paper read, in 1905, before the MILITARY SERVICE INSTITUTION, Governors Island; at Liaoyang General Kuroki controlled the entire force by wire from his headquarters, twelve miles in rear.

modern armies can no more be controlled than can great railway systems, and a commander in the field remains blind and deaf, incapable of maintaining touch with the military conditions that surround him, and out of touch with his superiors and with those under his authority, upon whom he depends for the execution of his plans. The brain lacks the power to control because the lines of information, the nerves of the army, are wanting. Time is the important factor in war, and to arrive first with the greatest number of men, and with the clearest understanding of the situation, is to succeed. The last, and often the first, of these conditions depends upon the intelligence communications of the army.

Lines of information are no longer theoretical. Of them a well-known authority on the subject remarks:* "Their practical operation is the story of the field duties of the American signal corps for six years past in China, Cuba, Porto Rico and the Philippines. Its work placed McKinley within five minutes of the south coast of Cuba. It first located Cervera's fleet, and first announced its destruction. At Santiago it stretched telephone wires along Shafter's front from San Juan Hill to Aguadores. In Porto Rico it opened up cables; and the telephones and sounders of its electric lines, keeping pace with every division, were in the forefront under fire. In China it followed Chaffee's columns, and, entering Peking on the heels of his victorious troops, kept alone the world in touch with the imperial city for a week. It repaired Dewey's cable at Cavite, and directed the fire of the *Monadnock* at La Loma. In the Philippines its ten thousand miles of constructed and maintained telegraph lines and cables connected all tactical points throughout the archipelago, whether in the field or camp, under fire or in quiet intervals; not only did its campaign work shorten the insurrection, but also its existence later rendered possible great reduction of forces without endangering peace, more than once saving a garrison.

"It is, perhaps, not too much to claim that the energy and resourcefulness of the American Army initiated a new epoch in lines of information, when in the war with Spain it applied electricity to military uses on a scale and with a success hitherto unprecedented."

Half a century ago rapidity of transmission of information was in general measured by the speed of couriers; distant movements were left to take care of themselves, or neglected on the

*Major-General Greely here quoted in part.

part of the enemy, since, if discovered, they could only be reported after the event; immediate operations were limited; the chess-board was small. Now all this is changed, and it is not too much to say that electricity among the other vast alterations it has produced in modern life has cut deeply into the science of war. It is useless to say that great campaigns were successfully conducted in the past without the aid of the telegraph; so they were, and many of the greatest battles of the world were fought without the aid of gun-powder; but the mere existence of superior methods forces their use upon the soldier lest his enemy be better prepared than he. Nations fight on the plane on which they live, and of everything concerned with war and with the efficiency of armies it is true that the best, and only the best, should find a place. Weapons, ammunition, equipments, lines of information—all must be the best lest a club be placed in the enemy's hand, to his adversary's destruction. This is a truth that every soldier knows in general, but it seems worth while to repeat, that if a commander's service of information are better than those of his adversary, he possesses wider knowledge and superior control; he selects with certainty his objective and arrives at it first; he perceives weakness before his own is discovered, or strength before his weakness is known; he anticipates movements, alters dispositions, executes plans unknown to his enemy. In short, he commands the situation by force of superior knowledge, and never is it more true than in war, that knowledge is power. But the knowledge commended by the old adage is not merely of the kind that is laboriously acquired by study and experience, and akin, perhaps, to the wisdom and understanding we are exhorted to seek, but of that ephemeral kind which relates to passing conditions, alters with them and changes from moment to moment as the shadows change.

This kind of knowledge may be called information or intelligence regarding current events, and is the understanding upon which successful action depends, and without which few of the enterprises of peace or the undertakings of war can be brought to successful conclusion. The means of securing this knowledge are vital in modern life, and the systems of transmitting the information upon which alone it can be based have been called the nerves of the corporate body, an expression become as trite as it is true. In civil life these nerves are the press, the mails and electricity; in military affairs they are the lines of military

remains in theory as in practice—in the air. Not so with the thin metal line that conveys the thought of the army; its place is with the first, and if possessed by a commander in campaign, all other things may be added unto him—including victory.

But no matter what reliance may be placed upon the telegraph, the wireless and buzzer, the more primitive means of signaling in the field must never be absent; for when useful, visual signaling is often absolutely necessary, and if the following note of an observer with the Japanese army emphasizes the importance of all lines of information in war, it points out still more strongly the danger of relying upon *any one* system alone, and the value at times of the heliograph, the flag or night-light. In the note referred to, Gen. Sir Ian Hamilton says:

"It seems hardly credible, but the First Army has been entirely cut off from all communication with Oyama and the Second and Fourth Armies from yesterday night until a few minutes ago. The wires were cut, as it was only natural to suppose they would be cut, and then the Japanese armies, separated by only twenty miles of mountainous country, were unable, although it was a brilliant sunny day, to talk to one another. Here the much abused British army may take comfort and realize how all its past thirty years' promiscuous fighting has not been time so entirely wasted as some of its critics would like it to suppose. There is nothing more trying to the nerves than isolation, and the cut wires go far to explain the unmistakable tension which existed during the day on the summit of Swallow's Nest Hill.

"Now a few moments ago communications were restored and headquarters have just heard that the second and fourth armies have not been able to occupy all the defenses on the south side of the river until 5 P. M. this evening.

"Poor General Kuroki! owing to the breakdown in the signaling arrangements and the consequent severance of communications, he had to act upon instructions many hours old. These had been his warranty for believing that the other armies would reach the river by the evening of the second, and now it turns out that they will barely have reached it by the evening of the third.

"This is rough on the First Army, which has shed its blood too freely in the firm belief that it was lagging behind in the great pursuit, and could not comprehend why, when pressing on to cut off the enemy's retreat, it should have found itself so suddenly on the very brink of destruction. *A dozen British soldiers*

*with a couple of heliographs would to-day have saved the Japanese many hundreds of lives that were wasted in attempting the impossible.**

Let us now consider the means of communication employed in the United States army, first recalling the fact that the duties of a corps of the intelligence communications are not confined to the transmission of information alone, though that, of course, is its principal business; but in addition to this service, its troops will have plenty of fighting if not of plain soldiering to do, not only with the infantry at the outposts and at detached stations, but with the cavalry in reconnaissance work, and with both when serving with contact troops and with patrols. The chief duty of signalmen is, of course, to transmit information collected, but they are by no means to remain blind and deaf to the events taking place around them. They should gather all the information possible and transmit it, through the proper channels, to headquarters, as is the duty of all soldiers. Obviously they have unusual opportunities for the collection of information in the enemy's country; they have at hand the means of transmission and thus form one of the strongest corps of observers with an army. Still it is not to be forgotten that an army has eyes and ears everywhere, and that the duty of obtaining information is imposed upon all; the chance observation of a sentinel; a report from an outpost; the story of a prisoner or native, may have value if sent in time to the proper authority. But the signal troops share with the cavalry the honor of being the eyes and ears of the army, and their duties lie very largely with that order.

Before proceeding to consider in detail the lines of information in our own service, it is purposed to touch briefly upon the methods of some other countries, especially those of Japan and Russia in the late war, and the status of the service in the German army, where much attention is being paid to the subject, and in that of England. As Japan is the latest addition to the galaxy of the great fighting nations, her methods are first considered.†

*A staff-officer's scrap-book.

†The larger part of the information contained in what follows was furnished the writer by the Second Division of the General Staff at Washington, to whom he desires to express his appreciation of the assistance rendered. The outline of the methods of the Japanese in the Eastern war is taken from the report of Maj. Joseph E. Kuhn, Corps of Engineers; their technical service regulations from the *Kriegstechnische Zeitschrift* (translated by Capt. F. L. Knudson, Eighth Infantry). The notes of the Russian service of information are from the report of Gen. T. H. Barry and Capt. S. A. Cloman,

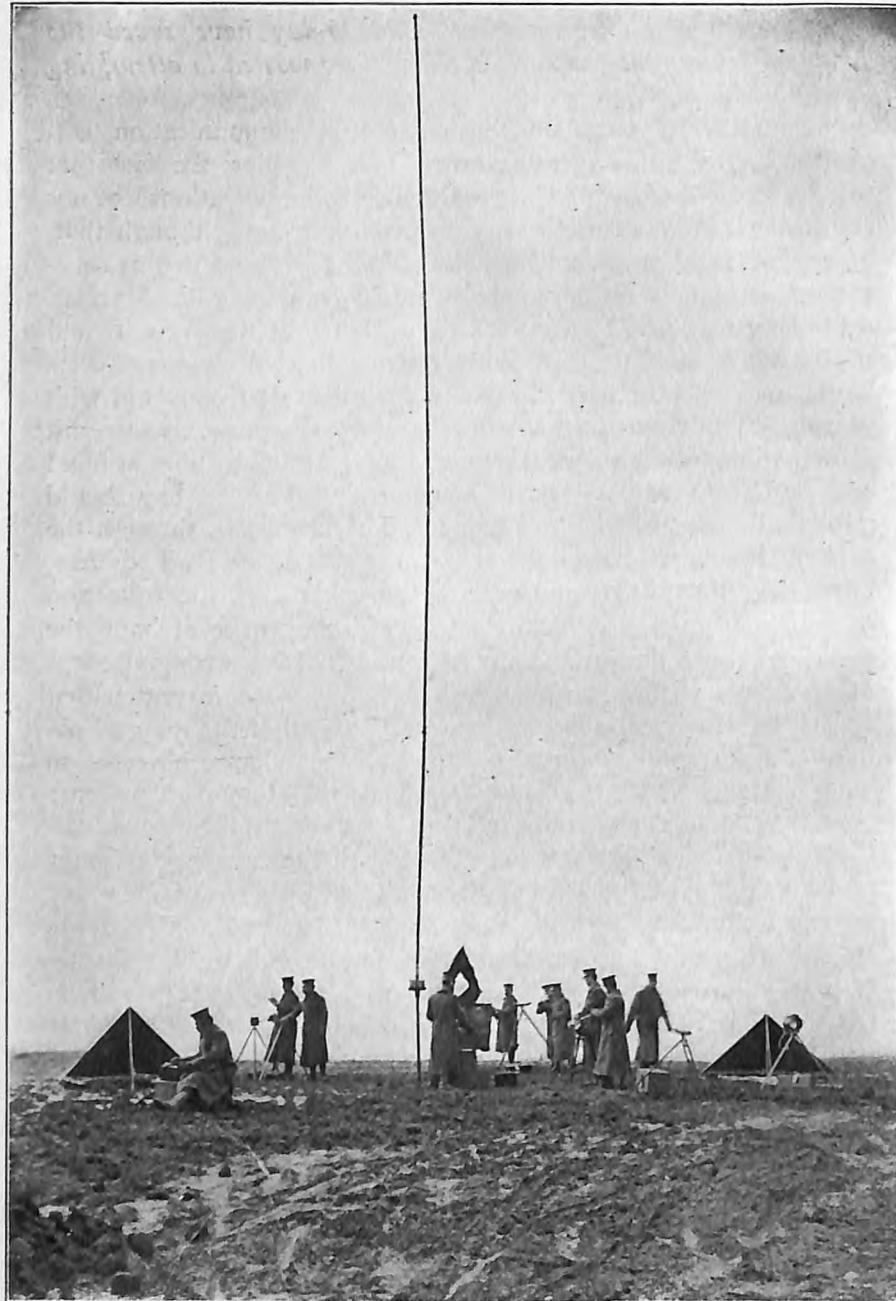


FIG. 2.—FIELD SIGNAL AND WIRELESS STATION.
(United States Signal Station, Fort Wood.)

Of the Japanese Army, one of our observers says,* the duty of maintaining intelligence communications between the different units of the field army devolves on the field-telegraph detachments, which correspond to the signal corps in the United States army.

In time of peace there is no separately organized telegraph detachment, but certain men, presumably those who are already practical telegraphers, are detailed from the engineer battalion to Tokyo, where they receive instruction.

In time of war the field-telegraph detachment, one to each division, is organized from the engineers' battalion, whose peace organization is changed from four companies to three of war strength. This telegraph detachment is commanded by a major or captain, and placed under the direct orders of the division commander. The personnel continues to wear the engineer uniform, but discards the rifle and ammunition pouches, wearing the side-arms only. The strength of the telegraph detachment is one hundred and ninety-five officers and men.

Besides the divisional telegraph detachment, an army telegraph detachment is formed from details from the divisional detachments and placed directly under the orders of the army commander. The army detachment is commanded by a major or captain and varies in strength according to the size of the army and other circumstances. For the third army (General Nogi) during the summer of 1905, it numbered over three hundred men. As the combatant strength of a division is about fourteen thousand men, the field-telegraph detachment forms about one and one-half per cent. of the command. In conversation with a staff-officer toward the close of the war, I* was in-

General Staff, United States army; and those of the Germans are from *Die Verkehrsmittel in Kriege* (translated by Mr. G. A. Deucher, clerk, signal corps).

The difficulty of summing up concisely the present methods of transmitting information in foreign armies is indicated by the following from the General Staff to the Chief Signal Officer of the Army.

Referring to your request of December 15, 1904, relative to information in regard to the forces of Great Britain, France, Germany, Spain, Japan and Russia, engaged in operating lines of communication, including signalers, telegraphers, balloonists, the following is submitted.

The exact information called for is made somewhat difficult by the fact that in foreign armies the organization of the signal corps is quite different from that in our country. In most countries the communication troops are included in the engineers. In Germany communication troops included not only telegraph and balloon, but also railroad troops. In Great Britain, in addition to telegraph and balloon troops, certain detachments of the line are detailed for visual signaling.

*Major Joseph E. Kuhn, Corps of Engineers.

formed that experience had shown that an increase of the telegraph detachment would be necessary in future wars.

As a general proposition, when the army is at rest the communications to the front are by telephone and to the rear by telegraph, although division headquarters may also be connected with army headquarters by telegraph and army headquarters with Manchurian headquarters by telephone. During battle, when the army and division headquarters are on the move, the telephone is used exclusively. Sometimes adjoining brigades and divisions are directly connected by telephone, but this is exceptional. The cavalry brigade is connected directly with army headquarters and also with the nearest division or brigade headquarters.

When an army occupies a fixed position for any length of time, the telephone is freely used for connecting up not only the tactical units of the army but its various depots and administrative offices. During the long halt after Mukden the headquarters of the third army at Fakuman maintained a central telegraph and telephone office with a regular switchboard for the different telephones, and four telegraph instruments, three to division headquarters and one to Manchurian headquarters. The freest use was made of the telephone in the third army before Port Arthur, not only all headquarters being connected up, but the various siege batteries and sapheads, so that any part of the besieging line could be reached at a moment's notice. The resulting saving in time and convenience may readily be imagined. In taking messages by telephone they are repeated back, the time noted and then written out in duplicate, using carbon paper.

So far as my observation extended, the Japanese field-telegraph detachments did remarkably good work during the war, keeping up connections at all times between the main army units regardless of weather or whether the army was on the move or at a halt. I have seen a section of the telegraph detachments march abreast of army headquarters, reeling out wire, and the moment a halt was made drive a bayonet into the ground, attach ground wire and commence talking with scarcely a moment's delay.

Visual signaling is but little used in the field. The heliograph is not used at all, and flag signaling is limited to the semaphore system, using two small sun flags. Apparently one non-commissioned officer in each company and battery carries a set of semaphore flags. The only occasion on which I observed flag

signaling used was at Port Arthur, where it was employed by an observer on the flank to direct the fire of a mortar battery located in a ravine.

The service along lines of communication is in charge of an étape telegraph detachment, a branch of the office of the inspector-general of the lines of communication.

The free use of the telegraph and telephone for connecting up the units of the field armies was rendered possible largely owing to the passive attitude of the Chinese and the lack of enterprise of the Russian cavalry, and very few interruptions of the service occurred. Where hostile inhabitants and an active



FIG. 3.—FIELD WIRELESS—HAND DRIVEN.
(United States Signal Station, Fort Wood.)

enemy have to be reckoned with, it may well be questioned whether an extensive telephone and telegraph service will alone meet the requirements of maintaining connections, and whether it will not be necessary to supplement it by some means of visual signaling.

A mounted telegraph detachment is supplied with one hundred pack animals for the transport of telegraph and telephone equipment.

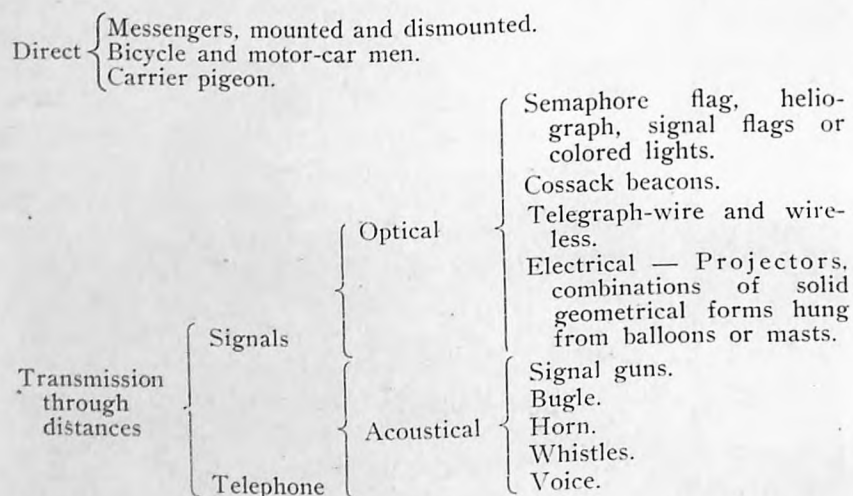
The success of the Japanese in the use of electrical communications in the field may lead to the conclusion that no attempt

was made by the Russians in this direction, or that such efforts were feeble or futile. Such, however, was not the case, and it may be interesting to here give a few notes from the observations of our officers in Manchuria.

TELEGRAPH TROOPS WITH THE MANCHURIAN ARMY.

One sapper battalion is detailed for duty, as a general rule, with each army corps, the first and second sapper companies going to the two infantry divisions and the third sapper company remaining under the battalion commander.

MEANS OF TRANSMITTING MESSAGES AND INFORMATION.



Messengers.—The courier corps consists of trustworthy, experienced and intelligent officers and non-commissioned officers who are employed in carrying important despatches or as orderlies at headquarters. In war eight officers and eight non-commissioned officers are attached to the staff of the commander-in-chief of the armies in the field and four officers and four non-commissioned officers to the staff of each army commander.

When necessary, regular relay stations of horses, carriages, etc., are established on the roads by the chief of communications in conjunction with the chief of transport, and for inspection purposes; these are under the latter official.

In each infantry regiment thirteen men are mounted and

used as orderlies and messengers. These are picked men, chosen for their intelligence, horsemanship, knowledge of woodcraft, etc. These men and others detailed from the mounted troops, headquarters guards, etc., were used extensively as messengers, especially during battles, when the Russian commanders seemed to distrust mechanical appliances. Hence, during the battles the transmission of orders and information was often slow and unreliable.

Motor-car men and bicyclists.—During the war eight automobiles with gasoline motors were sent to the Far East. Owing to the state of the roads they could not be used for the rapid transmission of orders and information, and were usually kept standing in sheds in the various headquarters in a highly polished condition. Two men in each infantry regiment are trained as bicyclists, but for the same reason as above they could not be employed to advantage.

Carrier pigeons.—There were pigeon lofts at Vladivostok and probably at other places. It is not thought they were ever used except for practice.

Semaphore flags.—There is no system of wig-wag flag signaling in the Russian army. Semaphore flag signaling was introduced in 1904, and now in every company, sotnia, battery and squadron there must be four trained signalmen and stores for the maintenance of two stations. All non-commissioned officers and men of the scout detachments must also be so trained. In general, the use of visual signaling of this character is confined to cases where communication by orderly, telegraph or telephone is impracticable.

Heliograph.—Heliographs of the Mans system form part of the equipment of all telegraph companies in the sapper battalions, fortress and independent telegraph troops, railway troops, and also in Central Asia of all cavalry regiments and infantry battalions. With mounted troops the telegraph detachments are also mounted and the heliograph and other apparatus usually carried on pack animals. Central Asia, consisting of vast plains and deserts traversed by high mountain ranges, is a most favorable field for the heliograph. Manchuria did not have these advantages to the same extent, but the heliograph was often used, particularly immediately after the occupation of a new position and before the telegraph and telephone wires were strung. Acetylene lamps were provided for night work, and

heliographs of both the shutter and movable mirror types were used.

Signal flags (day), and colored lights (night), and geometrical forms were used to a limited extent, displayed from masts or balloons. It is believed that this was largely experimental and that the results did not justify this ponderous style of signaling.

Cossack beacons are simply a means of night signaling, by fire, in its most primitive form, but they were seen on every hand. A mast was set in the ground and covered with twisted straw, either soaked in oil or with a vessel of the latter hanging near to throw on it before lighting. A brilliant blaze is produced for a few minutes which will alarm adjacent posts, and that is all. These beacons were erected in the rear of observation stations, scout posts and in a continuous line along the railroad east of Manchuria station, so that it was rare indeed when one was not in sight. They undoubtedly had their uses.

Electrical projectors were installed along the front for the double purpose of illuminating the locality and signaling. For the latter purpose a special apparatus is attached, but this, so far as known, was never used except for practice. Signaling by moving the light beam of the projector was not attempted. At least ten and possibly more of these machines were in use on the Sipingai position in October. The power was furnished by compact and portable electric machines drawn by three or more horses. These could also be used for the illumination of hospitals, etc., by the incandescent system.

Telephones and telegraph.—When the Manchurian army was visited by me,* it had been in its camps and positions for several months and it remained there until I left. Hence, all headquarters were bound together by a network of wires, and except with the screen and most advanced posts on the front and flanks these were virtually the only means used in transmitting messages. As might have been expected under the above circumstances, the system seemed to work as smoothly as permanent lines.

The Russians classed telegraphy under the head of optical signals, because the message is transmitted in the form of conventional signs on tape. The Eastern Siberian companies were hastily outfitted with a portable field apparatus of a standard type for wireless telegraphy (Marconi's) late in the war, but owing

*General Barry or Captain Cloman.

to the fact that they had never been instructed in its use, the stations were useless. A young engineer by the name of Vladimir F. Gnosin, who had received training in wireless telegraph in New York city, came out as a volunteer to instruct the troops, but it was then too late to produce good results before peace was declared. Since the end of the war the Third East Siberian Independent Telegraph Company has been changed to the First Wireless Telegraph Company, and will hereafter form a nucleus for the instruction of men in the Far East in this important branch of signaling.

At the beginning of the war there were in use about eight hundred magneto (outpost) telephones with the "rebec" (buzzer) call. The deficiencies of this apparatus were so great that twelve hundred fortress type telephones with magneto call and battery transmitter were sent out. Later these were reinforced by three hundred and eighty stations of the Mix and Henst types, and just before the end of the war ninety-five stations of a special type, worked out by the engineers, were set up. As far as could be learned they were similar to the combined telegraph and telephone used by our signal corps. The Russians admitted the abnormal bulk of their apparatus and stores, and the inconvenience of their transportation for the rapid work necessary in laying and operating lines, and their engineers proposed a change in the latter to two-wheeled carts of only three types station, material and reserve stores. It is probable that this change will be made, at least in the Far East. This does not mean one-horse carts, for as high as ten horses were used to pull these vehicles; but the two-wheeled carts were found to have advantages over the four-wheeled wagons on the Manchurian roads.

It was found necessary during the war to design portable towers for use in observation, signaling, stands for projectors, etc. Various types were tried from steel, bamboo, light woods combined with steel wire, etc., and of different heights. The last type, and probably the best, was a knock-down affair of pine frame braced with steel wire, of an extreme height of seventy-seven feet, carried in three carts. It was provided with a simple elevator holding two men, pulled up by man or horse-power. Platforms built in trees were also extensively used for the same purpose.

GERMANY.

Such were, in general, the methods used in the last war; but it is probable that, except the United States, Germany has given more attention to the subject of the lines of information than other countries, and especially in connection with her field operations in Southwest Africa. A few notes from German authorities may therefore be of interest.

In Bavaria there was formed (October 1, 1900) a telegraph company in connection with the engineer corps. The first battalion, composed of one Saxon company and a Württemberg detachment, is designated as the cavalry telegraph school, whose duty it is to instruct officers and non-commissioned officers of the cavalry in the construction and use of the telegraph. There are annually instructed thirty-four officers and eighty-three non-commissioned officers. The non-commissioned officers are assigned as cavalry telegraphers. In war, the net of telegraph lines is to extend across the frontier, so that an advancing army may be in continued communication with the home country.

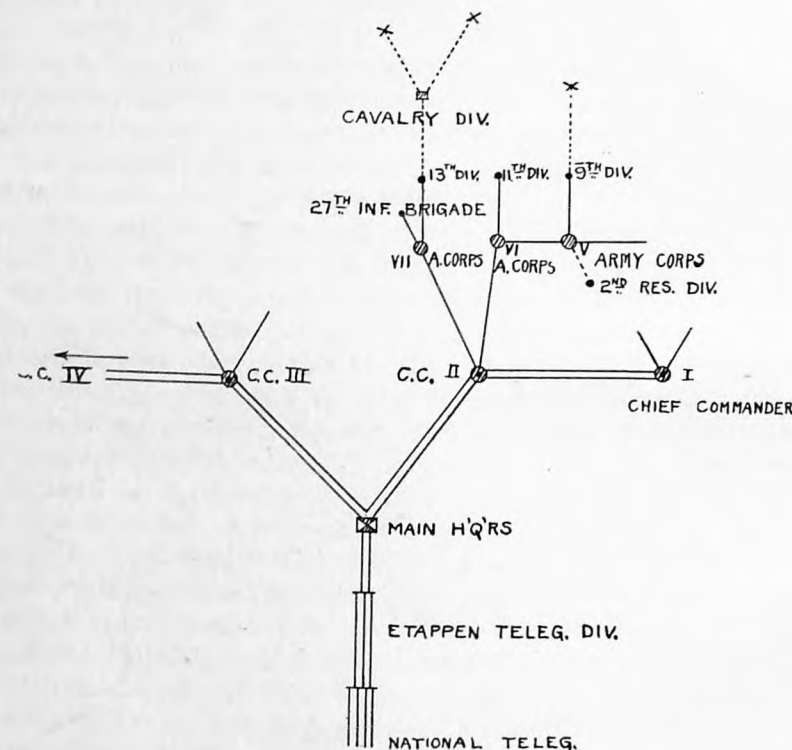
Depending upon the distance of the enemy, different telegraph zones are formed. In the first zone is found the cavalry, whose instruments are light in weight and simple in construction, in order that the lines may be quickly installed. The next zone comprises the mass of the advancing army, and as the marching speed of the infantry is not so great as the cavalry which precedes it, the telegraphic material may be heavier and more serviceable. In this zone is placed the telegraph corps and the army telegraph division. It is the duty of the former to establish communication as quickly as possible, and of the latter to repair interruption from all causes. (In sketch page 26.)

In the rear of the army the etappen telegraph division* performs the duty of completing the telegraphic connection with the home country and of rendering it as secure as possible.

At the head of the whole telegraph division there is for every central point a chief of the telegraph corps, who is stationed at the main headquarters. His duty is to cause the army and etappen telegraph to work in conjunction with the state telegraph; the etappen telegraph divisions and the army telegraph divisions are under his immediate command; the corps telegraph division is under the chief of the general staff of the

*The etappen division corresponds, as nearly as may be, to the proposed base line troops of our service.

FIG. 4.
DIAGRAM SHOWING CONNECTIONS
OF THE VARIOUS TELEGRAPH
DIVISIONS.



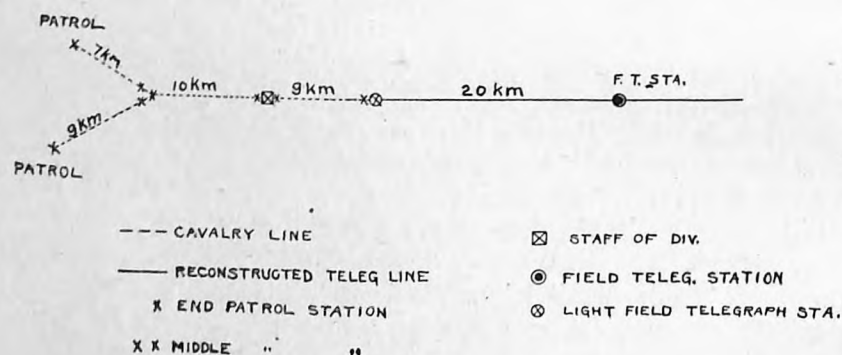
----- CAVALRY TELEG. DIV.
- - - - - RESERVE TELEG. DIV.
——— CORPS TELEG. DIV.
===== ARMY TELEG. DIV.

army; the reserve telegraph divisions are under the general staff-officer of the division, and the cavalry telegraph under the cavalry division.

The cavalry telegraph division establishes connections between the advanced cavalry patrols and regiments, and the commander of the cavalry division, who maintains communication with the nearest field-telegraph station. The reserve division connects the staff of the reserve division with the nearest commanding officer's headquarters. The corps telegraph division maintains the communications of the commanding general with the commander-in-chief of the army. The army telegraph division connects the commander-in-chief of the army with the main headquarters, and the latter with the etappen telegraph.

FIG. 5.

DIAGRAM OF CONNECTIONS
OF A CAVALRY DIVISION.



The etappen telegraph, the last division of the army telegraph, then connects with the state telegraph lines, and thus complete communication is established.

In fortifications there is a post telegraph which is of a permanent character.

The telegraphic equipment of a cavalry regiment consists first of the patrol equipment, and second of a special equipment which is carried in a two-horse cavalry wagon.

In each regiment there is a telegraphic patrol, to which four non-commissioned officers and four men are assigned. The non-commissioned officers must be cavalry telegraphers, and the men,

as assistants, must have a knowledge of line construction work. The leader of the patrol is an officer who has attended the cavalry telegraph school. The patrol is divided into two equal divisions or groups. When the patrol commences work, one man of each group acts as advance guard.

The corps telegraph division consists of a telegraph company with a wagon-train section. The company is divided into four divisions, all being equipped identically. Each division consists of one lieutenant, four non-commissioned officers, twenty-three men and one train soldier. The train section is composed of one non-commissioned officer and six men. To the latter are assigned three wagons for material, one station wagon and one reserve wagon. There are in addition two bicycles.

The reserve telegraph division is composed of one detachment, in charge of a lieutenant, and has the same strength and equipment as the corps telegraph division. Their duty is to connect this division with the nearest commanding officer's headquarters. The army telegraph division, on account of the work which it has to perform, differs in strength and equipment from the others. It is the duty of this division to see that all lines are in good working order, to re-establish communication where the lines have been interrupted.

The duties of telegraphic patrols are:

1. Transmitting messages and orders between the advanced patrols and divisions, and the regiment and division commanders; also between these and the commander-in-chief, by connection with the nearest field-telegraph station; also between individual cavalry divisions.

2. To destroy the enemy's telegraphic connections.

3. To capture the enemy's lines and convert them to their own use.

The patrol is composed of six officers (one captain in command, four lieutenants, and one lieutenant as leader of the train section), one doctor, thirty non-commissioned officers and two hundred men, including the train section with eighteen wagons (fourteen four-horse material wagons, two four-horse reserve wagons, one baggage and one two-horse officer's wagon). The etappen telegraph division receives its instructions from the chief of the field-telegraph. It is placed in the rear of the army and its duty is to secure and make permanent the lines and stations set up hurriedly by the field-telegraph division; also to erect and maintain telegraph lines within the etappen district.

For the organization of etappen telegraph divisions, whose technical personnel consists exclusively of officials and employees of the national telegraph, no definite number of men is given, as this will depend entirely upon the conditions. The field-signal division, which accompanies a cavalry division, consists of a sufficient number of field-signal troops to provide for intervening stations established between the advanced cavalry and the army in the rear, and thus maintain communications.

ENGLAND.

In the British army, as appears from the following remarks quoted from an important English journal, the methods now employed in the transmission of military information are varying and unsatisfactory, and a tendency is evident toward change to a permanent corps of signalmen, similar to that of the United States army.* Of the signalers or visual signalmen it is said:

"Signalers are trained in every unit, and in many cases reach a high standard of efficiency. They are taken for this duty only from their units and placed under signaling officers, who, in their turn, are withdrawn from their companies for this service during peace; on mobilization they are replaced in their units. The duty of these men is to their unit first, their signaling duties rank only second. The instruction given them is necessarily limited, and they cannot reach that standard of excellence which may be expected from men whose foremost duties are those of signaling. Moreover, during company training, when they might spend a great deal of time in signaling, their opportunities for practicing their technical work is small, owing to the limited area their units cover.

"Telephones which may be said to be still in an experimental stage† are worked under various arrangements, sometimes by the the R. E. of the field companies, and sometimes by the men of the purely combatant arms.

*A very interesting article entitled "Information on the Battle-Field," by Bvt.-Col. J. E. Capper, C. B., R. E., published in the July, 1907, number of the *Royal Engineers' Journal*. The order of Colonel Capper's remarks has been changed. The italics are my own. The remarks regarding the signal service in the United States Army were made in a lecture by Lieut.-Col. Watson, Central Indian Horse, before the Indian Staff College.—G. P. S.

†It is still so considered abroad to some extent, but probably not where the best types of military telephones are known. Colonel Capper, before quoted, says, "Telephones which may be said to be still in an experimental stage," etc. He elsewhere remarks, however, that the "Telephone is a most valuable instrument," and states that "The Japanese found they answered admirably when ample time was available for preparations.

"Telegraphs alone are worked throughout as a combined unit, by the R. E. of the telegraph companies under one head—the Director of Army Telegraphs. Each method is independent of the other, and we have, in fact, no system at all.

"Orderlies are provided haphazard from any troops which happen to be handy, without any reference to their special fitness for the duty. The O. C's of regiments or battalions called on to provide them are deprived of their services just as they are going into action, when their ranks should be as strong as possible; whilst the men themselves would, in most cases, far prefer being with their comrades in the fight, and have no special keenness in their work.

"To distribute the methods available so that all parts of the field are well served without waste, it is essential that our transmission services should be combined under one chief into one perfect piece of machinery, in which every method has its proper place, and where at a moment's notice any method may be replaced or duplicated by another. Moreover, the economical use under varying circumstances of the means of transmission provided entails a thorough grasp of the subject by both officers and men. It is a matter of close and careful study, and is in itself a science.

"To insure one control and a thorough co-operation, it appears to me to be absolutely necessary that the whole of the transmission service should be formed into one corps, and that all members of this corps should be specially trained for the important and complicated services they have to render."

In referring to the signal corps of the United States army, it is said that:

"This system has the supreme advantage of cohesion; moreover, its chief is a permanent general officer of the headquarters staff, who can devote his time entirely to the problem of communication, and should be able to complete all arrangements during peace, so that everything may be ready for war. * * * The whole system up to the most advanced detachment is intrusted to the signal corps, who, realizing the danger to the wires to be apprehended from the exploits of the enemy, and the possible failures of the visual apparatus from the effects of the weather, carry a complete equipment of both."

In concluding this summary of the modern estimate of the value of military lines of information, it is to the point to quote here the following remarks of Gen. James Allen:*

*Annual Report of the Chief Signal Officer of the Army, June, 1907.

"Modern conditions have completely changed the military methods of operating armies and handling troops in the field. With the great range and efficiency of modern arms and the widely extended terrain now employed, it is essential to success that there shall be ample and reliable lines of information connecting the different armies and the different units of a single army in order to insure constant and accurate control of the forces involved.

"It is now fully recognized by the leaders of military thought that the strength of an army is not alone measured by the number of men it contains, but by the number of rifles, guns and sabers it can put into co-operatively effective action at any one time.

"Although the late Russian-Japanese conflict furnished an example of the use of this 'military weapon' in advance of anything previously attempted, yet it is believed that the development of the power of accurate control upon the field of battle through perfect lines of information makes it possible for the commander who first utilizes it to the limit for tactical purposes to gain as decisive victories in the future as any that have ever been gained in the past.

"Electricity is the swift and accurate messenger which now conducts the commercial business of the world, and which is even more important in war, where the element of time is always a controlling factor.

"If troops are to succeed in war, they must have field lines of information which are so reliable and certain in action as to inspire and insure the complete confidence of the mobile army which has to depend upon them. The equipment must also be so mobile as to provide instant communication by the side of the commander, wherever he may be required to go in the exercise of his duties."

In the words of a distinguished English military authority:

"There is no salvation for an army, however brave, however well trained to fight, which on the field of battle has to trust to the blind and semi-independent work of isolated units, if it is opposed by the combined force of an equally capable army acting as a whole under the well-informed guidance of its supreme leader."

A second general officer of our service who speaks from experience and with authority in regard to lines of information,

says:* "The subject of military signaling in all its branches has been brought to such great prominence during the past few years that it has occupied the minds of all thinking military men and stimulated the inventive genius of our experts along these lines.

"The vast possibilities opened by a well equipped and competent signal corps, the satisfactory results already obtained, the celerity of transmitting orders on the battle-field, and the immense number of miles of wire required for this purpose even in a great battle makes this branch of our service of the utmost importance, calls for the careful consideration of those in authority as to its requirements and favorable action by Congress in furnishing men and money to carry out its work.

"It is believed that great advance has been made in the application of military lines of information to the art of war by the faculty and student officers of the United States Signal School during the past school year.

As a final and most important word on this subject, the lieutenant-general of the army has declared that the service of information has become so important in modern military operations that it is entitled to be ranked with the cavalry, field-artillery and infantry as a fourth arm of the service. This corps should be placed in the hands of officers pre-eminently qualified for professional work; they must have comprehensive knowledge of the organization, strategy and tactics of war, and must be qualified to conduct original, practical and theoretical investigation of various scientific agencies. Such an organization cannot be extemporized after war has become imminent.†

It should be evident from the statements of the distinguished authorities quoted; and also, it is believed, from the experience of England, and perhaps of other countries, that the United States

*Annual report of Gen. William P. Hall, Commandant United States Infantry and Cavalry School, United States Signal School and Army Staff College. There is perhaps no training school in the world where the use of signal troops or the service of the transmission of information is better understood than at Fort Leavenworth, or where the applications of this service to the mobile army are more thoroughly taught in the field. Major D. H. Boughton, Assistant Commandant of the school, in regard to the signal corps says in part:

"Our experience at these schools in developing the capabilities of the signal corps proves that a regiment of three squadrons of three troops is not too large. The cavalry buzzer now makes it possible for lines of information to be maintained more easily between the colonel and his three squadrons than could be done in the case of two squadrons without that valuable instrument. It may be surprising to know that a cavalry man can be sent away at a trot, unreeling the buzzer wire as he goes, and telegraph or telephone back without dismounting from his horse. The signal corps will revolutionize the handling of troops in the field."

†The substance of these opinions of the Lieutenant-General as stated in the New York Telegram of January 31, 1908.

in creating a special corps for the transmission of military information has placed itself well toward the front in this phase of military progress. So far as known to the writer, it is the only important country that has yet done so to the fullest extent. Other countries rely upon men detailed from different corps or arms of service for the transmission of information, but the viciousness of temporary detail of men trained primarily to other duties has become more obvious as the service of information has grown. No corps of amateurs will now answer its needs.

In the armies the transmission of military information of the United States is performed by a signal corps. The duties imposed upon this corps are many and varied, but they divide themselves into two general classes, widely different in character, though of equal importance. These are:

First, The Transmission of Information for the Mobile Army.

Second, The Transmission of Information for the Coast Defense.

We now proceed to consider, somewhat in detail, the first of these services.*

*It is believed that this service should be known as the Intelligence Service; the Corps, as the Intelligence Corps; and the Men, as Intelligence Troops, or Intelligencers.—G. P. S.



FIG. 6.—AUTOMATIC WIRE SPOOL-CART PAYING OUT FIELD WIRE AT A TROT.
(United States Signal School, Fort Leavenworth, Kans.)

PART II.

THE SIGNAL CORPS AND THE MOBILE ARMY.

DUTIES, LINES OF INFORMATION, ORGANIZATION, THE WIRELESS.

The transmission of information in the United States Army is, as has been seen, intrusted to a signal corps composed of men selected or appointed to perform the more technical duties devolving upon them. These duties have become formidable in peace and vital in war, and to signal officers they at times seem to cover the whole field of human endeavor. Doubtless this is an exaggeration; still from constructing with snow-shoe and dog-sled lines of information over the frozen wastes of Alaska; operating the wireless telegraph across the ice-bound waters of Norton's Sound, and the cables south to civilization; from building telegraph lines for the improvement or correction of our little brown brothers in the Philippine Islands; and from assisting to quiet the troubled spirit of Cuba, to the highly technical work of the fire control of our fortifications; instruction of the men at the coast training station at Fort Wood, the school duties and service with the mobile army at Leavenworth; ballooning at Omaha; and the wireless crying out for installation everywhere; it should seem that this field is quite sufficiently extended. If it is not cultivated to the highest point of utility throughout its vast area, it is because the means are not furnished. The crying need of the corps is men, not money.

In war the field of operations of the signal corps contracts strongly, almost fiercely; but the thin layer of work made to answer in peace will no longer suffice to meet the strenuous conditions imposed. Then, indeed, the duties become so imperative and exacting that no means may, without danger, be omitted to fit the corps to fully meet them.

To perform the work at present imposed upon the signal corps of the army, there is provided* an organization made up of one chief signal officer, nine field-officers, eighteen captains, eighteen first lieutenants and 1212 enlisted men. Of the commissioned officers of the corps at this time, two of the captains and seventeen of the first lieutenants are detailed for service for

*December 31, 1907.

a period of four years, but the average service will probably be much less on account of promotions and from other causes. Additional officers are added from time to time for temporary duty.*

It will probably be conceded, considering the scope and variety of the duties of this corps, that the men who form it should be intelligent and well instructed; furthermore, that both officers and men should remain long with the service and make it their profession. But such is not now the law, at least for the officers. Criticism of the law, however, is injudicious, if not improper, and it will be here sufficient to quote, as an indication of expert opinion,† this remark, "Information service fails especially because the world is ignorant of its principles, processes and mode of action. The transmission of intelligence demands special organs. Most armies give some telegraphic training to non-commissioned officers and troopers; it is lost time. Those partly informed are always incompetent; special trained men are necessary." This brief statement contains, in the opinion of the writer of this article, the wisdom of volumes; it might well be considered a military axiom to be placed at the head of all treatises and laws affecting the army.

It is not intended, however, to discuss here the commissioned personnel of the signal corps, a subject which has its own place; and we will therefore pass on to a brief consideration of the conditions affecting the work of this corps in peace, and to its services and probable strength and organization in war. These considerations will, no doubt, prove dry and technical, but they are not to be avoided. It has been the experience, not only of the writer, but of many officers of rank with whom he has talked, that in the field the value of a signal corps is not so generally understood as it might be by officers of the regular army and of the militia, and for this reason its use is frequently neglected or contemned in maneuvers. When war comes it is reasonably certain, unless a change takes place in this respect, that many officers who will be called upon to use the lines of information will not be sufficiently familiar with them to employ to their full measure of usefulness the appliances which are now provided for the service, and preferring the traditional note-book and orderly to the telegraph

*There are four captains and four first lieutenants so detailed.

†General Lewel, the author of whom Maj.-Gen. A. W. Greeley, in the articles before mentioned, says: "By all means, the most forceful and far-seeing writer on this subject (lines of information) is General Lewel, whose *Etudes de Guerre*" are among the most thoughtful and comprehensive, especially as to practical details, of any modern essays that have come under my notice."

will make as little use of modern lines of information as the Russians appear to have done in the last war. It has been assumed that progressive officers in these days appreciate to some extent the importance of the subject; and it is known that general officers, especially those credited with the long service which alone entitles them to the rank, have, as the name implies, the experience and knowledge necessary for the control and direction of the combatant arms and of their staff services. But it by no means follows that even experienced and capable officers know all about the use of auxiliary corps, which are often of recent creation and unappreciated importance. Chief among these auxiliaries is the signal corps of the army, which, though by no means new in *esse* is very new, indeed, in *posse*. Its importance has been proved, but its modern value is not yet known even to itself, perhaps, for who can tell what part in the future the balloon, the wireless and other devices may play in the operations of mobile armies, or what may be the field of usefulness of electricity as applied to the coast defense? But whatever these may accomplish, it is reasonably certain that their value will depend almost wholly upon the men who use them. Not upon the actual manipulator alone, be it understood, but upon the directing brain, the man whose plans the lines of information are designed to carry out. He it is who must give life to systems of transmission, for without the directing mind they are mere inert collections of useless material, valuable in theory alone.

It should be remembered that, like all staff and auxiliary troops, a signal corps is merely an adjunct to the line of the army and can have no separate existence. Its value depends solely upon the use made of it by the line, and this in turn upon the knowledge and capacity of commanding officers to whom familiarity with its scope and power is vital. If, as has been said, this knowledge is far less common among officers of the army and of the militia than it should be, it is a condition by no means due to neglect, but rather to lack of opportunity. In peace the means of acquiring knowledge of the use of a signal corps in a practical way are few, for the field exercises are almost the only school; and when war comes the time to learn has passed. The theory at least may be acquired by other means than maneuvers and should be insisted upon, but instruction should not begin and end with senior officers. As with other military studies the commencement must be made far down the scale of rank;

that the general may put in use instinctively, perhaps, knowledge, the beginnings of which were acquired as a subaltern. In this the school at Leavenworth is doing notable work, and it is hoped that West Point will some day see the importance of teaching fully the lesson of the intelligence communications and not merely its alphabet, to the lads who stand at the very threshold of the military career.

It is believed that the signal corps in peace should be associated as closely as possible with the line of the army in whose methods and service the signalman must be trained, and with whom his duties are most intimately connected; and that a force of signalmen should be present at all exercises and maneuvers of line troops. It follows that an efficient force of signalmen should be placed at large garrisons, and held in readiness to take part in all movements and exercises.

In this regard it is authoritatively said that these signal troops must be trained with the troops of the line, and the establishment of larger maneuver posts in the United States creates an immediate demand for such organized bodies of signal troops. That this demand has been already recognized is evidenced by the recent official requests for battalions of signal troops to be provided at three of these posts. Plans and specifications have been forwarded for necessary barracks, vehicle sheds, stables for signal troops, in advance of any provision at present for a personnel to meet these demands.

In addition, as will hereafter be seen, detachments of signalmen should be stationed at the coast artillery districts, to perform many duties in connection with the coast defense. All this implies a large field of work for the signal corps in peace, but in addition there remain the staff duties of the corps which exist both in peace and war; the supply and purchase of material and maintenance of permanent telegraph lines and cable systems; and the technical training of the men themselves. The signal corps in reality, though not in law, is both a staff and a line corps and must be trained in the duties of both; but the latter training can only come through association with the line of the army with which when war comes the signalmen are bound as closely as are the three arms of the service to each other. They must be instructed and equipped accordingly.

*It has been said that recent field experiments with troops have conclusively proved that for every specially trained signal

*Report of the Chief Signal Officer of the Army, June 30, 1907.

corps soldier provided, not only is the field information service many times increased in efficiency, but for every such soldier taken from the total strength of an army at least two men are returned to the firing line who would otherwise be removed therefrom to perform the inefficient and often impossible work of the mounted orderlies of the past. Since this messenger service must be provided, either through mounted orderlies or trained signal troops, it is manifest that the provision of a minimum per cent. of the total strength for this purpose results in increasing the number of men for the firing line, instead of taking from that line. In short, it is believed that all well-informed military authorities are now in accord in advocating the development of this branch of the service to the limit of its possible usefulness.

In what has been said there is no intention on the part of the writer to magnify the signal corps, or to sing its praises. Its work must speak for it. But there is the strongest desire to emphasize here the importance of the field opened by modern science and its appliances to a corps charged with the service of information. This field corresponds closely to that covered in peace by the press, the telegraph, the telephone and, in part, by the mails; but in war it possesses the added importance of including in its extent the greatest of human events, and the control of actions as swift in occurrence and as shifting as the lightning. The field, both in peace and war, is that of mental command.

LINES OF INFORMATION IN THE FIELD

In addition to a general knowledge of the methods of transmitting military information, it appears that reasonable familiarity with the instruments and methods employed under varying circumstances must be possessed by officers who will use them in the field, and especially by those in control. It is evident, for instance, that no soldier about to assume command of an army or of an expeditionary force for service in a distant country would willingly lack information regarding the kinds of communication that should be used in the work before him and of the types of instruments necessary; nor would he care to leave the selection of his means of establishing his lines of information solely to the judgment of a subordinate, perhaps a stranger. He must know, or at least he should know, from the nature of the country and the probable scope of his future operations, the character of the lines that he will need, and the kind and amount of material that he will use, and must provide himself,

within the limits of his transportation, with everything that experience and knowledge may suggest as useful; and for that reason should know generally the amount of material to select, the type of lines of information to be established and the number and kind of men necessary to use them. The commanding officer will have a signal officer on his staff, no doubt, to whom all details should be intrusted, as he will have an ordnance officer and an engineer, or a commissary; but he should assure *himself personally* that his means of transmitting information are sufficient for the work ahead, that they conform to his plans and to the probable field of action, just as of his own knowledge he will make sure of the arms carried by his men; the type of his artillery, the amount of his ammunition, the size of his pontoon train, and the character of his ration.

This preparatory work of a commander implies some knowledge of the service of the lines of information and of the instruments used, but only knowledge of a general nature. It is after he takes the field that his capacity and experience are called fully into play. Then, indeed, in addition to his own knowledge he will require all the assistance that the most skilful of his signal officers can render in determining the kind, scope and plan of the lines of information, distribution of men and location of stations. On the march, in camp and in contact with the enemy, such dispositions must be made by him as not only to secure the best service possible for himself as commander of the troops or expedition, but as will give, also, to those in subordinate command the fullest advantage of the lines and the quickest transmission of information and intelligence.

A military force no sooner takes the field than its lines of information are determined, its methods of signaling designated, its stations located and the whole command linked together and connected with the home country or capital by these nerves of the army.

It is difficult, if not impossible, in a paper of this kind, to specify the courses and objectives of telegraph and telephone lines and the location of visual and wireless stations under the varying conditions of field service and the many phases of war. On this subject a commentator remarks:

"Every tactical problem varies in its details and the commander of each force is constantly confronted with new situations which cannot be met automatically by any set rules. Judgment must be used in applying the essential principles which gov-

ern. So with tactical lines of information, judgment must dictate when and where to lay the lines, and what methods to use. The acumen for this judgment comes only from practice and experience. The primary object is to secure and maintain constant and unfailing communications. Then economy and the powers and limitation of each distinct method as well as their adaptation to the particular problem must control."*

In general, it may be said that lines of communication will take the direction needed and be established where useful. However, a few more definite suggestions may be offered.

Lines of information in the field are of two kinds: First, *Strategical Lines*, which are defined as those behind an army, connecting its headquarters with its base or with the seat of the government; these lines will usually be the ordinary commercial telegraph lines of the country, or in their absence, may consist of permanent or semi-permanent lines built for the purpose. On these strategical lines the ordinary commercial telegraph instruments, known as the relay, the sounder and the key will usually be used, although the telephone may be employed instead.

Second, *Tactical Lines*, which are defined as those laid for the purpose of maintaining communication between different units of any army. These lines will ordinarily be field lines hastily laid on the ground; the buzzer will be the instrument ordinarily employed.

There can be no doubt that the main reliance of an army in the field will be placed upon the wire telegraph and buzzer, and upon the telephone; but visual signaling will, by no means, be neglected, for although comparatively slow and of no great range, it is an indispensable auxiliary, and at times may afford the only means of communication; and the form of the wireless, if attached to army, corps and division headquarters, and used in connection with suitable observation stations at the front or on the flanks, and with other headquarters, should also prove of great value. That a balloon train should be attached to the headquarters of the army, a corps, or an independent command seems obvious.

*This remark appears in a very excellent paper by First Lieut. W. N. Hughes, Jr., Thirteenth Infantry, now detailed with the Signal Corps, entitled "The Signal Corps in Maneuvers," prepared at the Infantry and Cavalry School at Fort Leavenworth. This paper is well worth the attention of all officers concerned with the transmission of military information.

†Signal Corp Bulletin No. 3.

The more permanent lines of information will be carried on lances; but in temporary camps, on the march, or in contact with the enemy reliance will be placed mainly upon field and buzzer lines.*

The wireless telegraph or telephone in the present stage, though important, can hardly be considered as a primary means of communication for the mobile army, for neither has yet passed, in all its phases, the experimental state for field service. In addition, on account of interference, interruption, delicacy, cost and other objections, the wireless telegraph and telephone will probably never be used over land with the certainty and frequency of wire lines. But the use of the wireless with the coast defense is altogether another matter; in this service it is assuredly of the highest importance, even in its present stage of development. However, great advances are being made in the construction of the portable wireless, as is indicated elsewhere in this paper, and when the various new types of apparatus are in use it appears that, in the opinion of wireless advocates, an army should resemble, in the field, a flock of blackbirds, so general will be the twitter of the instruments. Maybe, too, it will become as suddenly silent as the birds on the approach of the man with the heavy wireless weapon. But these anticipations must be taken soberly, for no doubt wireless signals will drown each other to a considerable extent, and but few sets will be permitted in use. However, thus far field experience, if it does not promise unlimited success, is at least very encouraging, and it has been found that communication by wireless telegraph can be maintained across considerable stretches of country under favorable conditions by expert men with the small field instruments; but it is also found that not only experience, skill and good judgment in the selection of stations are required for success but that the terrain must lend itself to the purpose. Judgment and experience as well as a high degree of skill and technical knowledge are necessary, and everything in connection with the apparatus must be in condition. In short, to be successful in wireless communication over land one may say that all conditions must be favorable.

It is believed, then, that both wireless and visual signaling, though important, may be classed as auxiliary to the main system of wire telegraph and telephone communication of an army, to

*Descriptions of the field lines and the more important instruments are given hereafter in this paper.

be used when the wire cannot be installed or is interrupted, and for communication across a country included in the enemy's theater of operations and other special cases. But whether the wireless can be used or not, visual signal appliances, at least, should always be at hand at signal stations, to be employed when needed. No doubt the most important use of all air-borne communications is in connection with boat expeditions and the navy.

FIELD LINES.

For an army composed of two or more corps in camp or on the march, or in contact with the enemy, the lines of information proper, omitting those within the smaller units, will extend to a few definite points only, and no great multiplication will be required. In general, in this case army headquarters will maintain communication with the base by lance or permanent telegraph line, and through its base with the home country or capital by commercial telegraph systems or cable. These lines will be strategic in character. From army headquarters the telegraph, using commercial lines with signal corps operators when possible, will run to corps headquarters and thence lance or field wires will extend to headquarters of divisions, of independent brigades, and of artillery, cavalry and other commands under the immediate control of the corps commander. In connecting these larger units the telegraph rather than the telephone will be used. But under no other circumstances in the field do such excellent conditions obtain for the use of the wireless of the pack, automobile, or wagon type.

An excellent example of a military telegraph system on an extended scale is furnished by the Japanese, who had, at the conclusion of the Asiatic campaign, a network of lines touching the coasts of Korea and Manchuria at every important town and inlet from Chemulpo to the Gulf of Liao Yang and beyond Mukden; the whole forming a network of telegraph lines in some localities as close together as the commercial systems of the United States. Lines of this kind follow, of course, the railroads and wagon roads of the country where they are most needed and more readily maintained.* They form a very good example of strategic lines of information.

In the United States army the division is considered the tactical unit to which are assigned all arms and auxiliary troops of the service.

*"Stragetical map of part of Korea and Manchuria," prepared by the Second Division, General Staff.

tical unit to which are assigned all arms and auxiliary troops of the service. The ordinary lines of information of a division under the three conditions of the camp, the march and contact with the enemy are therefore worth a word of consideration, although they cannot, of course, be definitely fixed. Assuming that the division is to be assembled at some suitable locality, and a more or less permanent camp is established, an officer of engineers will, no doubt, first be sent to select sites for the encampments of the various units; quartermaster and commissary officers will locate their depots; and the medical officer the field-hospitals. It will then become the duty of the chief signal officer of the division to install the lines of information. He will first establish at division headquarters a central signal station and connect this with the most convenient telegraph and telephone offices through which communication may be had with the commercial systems of the country or with the base. He will establish a camp and depot where will be stored all material needed for extended and varied service. Next he will connect by telegraph, corps or army headquarters (if such exist), and for convenience will carry telephone lines to the chief quartermaster, commissary and surgeon, as well as to the depots, hospitals and corrals. As the troops arrive at their camps telephone or buzzer lines will be run from the division central to brigade headquarters, to the camp of the engineers, the signal corps, to the cavalry and field-artillery, and to independent commands at a distance, but it is not thought to be good practice to extend electrical communication, in ordinary cases, below the brigade, as otherwise the troops are apt to have too easy and enervating service.

Within the divisional camp itself, the telephone will be the ordinary means of communication between fixed stations, the telegraph being reserved for more distant work; both lines will usually be carried by lances. In addition to these more permanent lines temporary buzzer or field wires will be laid to changing positions, such as outlying observation points, at the front or on the flanks to the outposts, and to the balloon train. In short, every important point will be connected with division headquarters and the whole command linked together and connected with the base and the larger units by wire. In a camp of this character the wireless, both portable and semi-permanent, should be of great value. In camp, then, there should be little difficulty in using fully the lines of information, since the extent

and direction of the system are known and the stations are easily found.

On the march the lines of information and the stations for a division become fewer and the latter more difficult to reach. Some general considerations may be noted. First, a division on the march must at no time lose connection by wire with its base through the last station occupied; and as the advance continues a field or buzzer line will extend forward to the commanding general, that is, to some position designated by him as his own during the day or night. This position becomes, so far as the lines of information are concerned, the headquarters. As the buzzer or field wire advances it should be followed, if practicable, by the signal train with the necessary material for a lance line to replace the field or buzzer wire, for the former is expensive and may be scarce, and if exposed is liable to injury from passing troops and transport, and resulting faults, if within the envelope, are not readily located. However, so rapid at times, with good roads and in an open country, is the advance of a lance line erected by trained men that no field cable, or very little, need be used on the march. Later, when material is at hand, the lance line may in turn be replaced by a permanent system erected by the (so-called) base line troops and the lances recovered; but this construction is necessary only when the system is to be used for a long period. On the march a buzzer wire may very well follow the general line of advance of the commander by extending from one conspicuous station to another designated by him. Of course the field line only will be used for rapid work.

The units of command should, in the advance, be kept, so far as possible, in touch with each other; but as these units frequently move by different routes, and as cross lines are impracticable except at halts, and always objectionable, field or buzzer wires must stretch from the last field station maintained at the rear to corps headquarters and to brigades and important commands, as the ribs of a fan expand. Wire communication, if possible at all between the general and detached commands, or cavalry at the flanks, will also usually be maintained in this way or by means of visual or wireless signals. Here and in flank communication is a great field for the wireless. It may be possible on the march to keep the advance guard and even the point in touch by buzzer with the headquarters station, but the problem is

not easy.* During halts, however, such lines can quickly be thrown out, but here visual signaling may be used to advantage and above all the wireless, especially of the automobile type. Communication with the flanks may also be obtained by the last two means. Probably the balloon train, if well to the front on the march (which it should never be in the presence of the enemy), will offer the greatest advantage as headquarters signal station. The balloon in air can move forward rapidly enough to maintain its place in column, certainly at a trot,† and since observations from it are telephoned down continuously they may be communicated without loss of time to the commanding general if near, or through the buzzer-line, if distant. The buzzer wire is readily controlled and carried by a balloon wagon.

The day's march over, the division eats and rests; not so the signal men. Then buzzer lines from the advance guard, from the flanks, from the corps headquarters and from the rear must be carried to division headquarters, and others laid to the outposts and reserves, and still others to detached posts, to observation stations and important points where pickets are maintained. A central station will be established and from it as many secondary lines laid to brigade headquarters, auxiliary and detached troops as the general may deem necessary, a matter which will undoubtedly depend upon proximity to the enemy and the length of time the camp will be occupied. Again the field wireless would be of enormous value.

In a retiring movement lines of information will be as few as possible, and mainly used to connect the rear guard with the general commanding. Provision should be made, however, to tie flanking parties thrown out at intersecting roads with the marching columns and to recall those troops as the rear passes. It will be important, also, to connect retreating columns moving by different roads and this can be more readily done than in the advance, since lines extending to the front of the retreating force will not ordinarily be in danger of interruption, except from a very active and overwhelming cavalry. Thus, in the retreat, central stations may be thrown out far ahead and wires led back to the marching columns like the ribs of a fan, as in the advance, to be taken up as the columns pass, if not aban-

*Great care must be taken in campaign to recover every inch of wire lest the supply be expended. Hence auxiliary means of communication should be used as far as practicable.

†The writer has seen, with the Italian army, the balloon wagon, with the balloon well in the air, follow cavalry at a trot.

done. Of course if the retreat follows the line of the advance, stations on that line that have been maintained will become the central through which various units may be reached. In the retreat a balloon train should render important service as an observation station, but it must be placed on a flank.

As the period of actual contact with the enemy approaches the most serious of the problems of the lines of information arise. Then, indeed, it becomes necessary for a commanding general not only to know what he can reasonably expect from these lines, but to weigh their chance of maintenance and the extent to which they may be usefully employed. He must know the terrain and the best means of sending messages across it; he must know his enemy and the probability of successful attempts on the latter's part to cut the wires or drown the wireless; and in difficulties he must try every means of signaling that offers a chance of success. An active and numerous hostile cavalry will, if unchecked, make communication by wire difficult, if not impossible, outside the limits of control; while on the other hand an inert cavalry need hardly be considered. It seems probable, for instance, that the Japanese owed much of the success of their communications to the lack of energy or direction of the Russian cavalry.*

However, as the division approaches the enemy the commander will make as certain as possible of his lines of information with corps and army headquarters, with supporting and reserve troops and with the rear; and before actual contact comes buzzer lines will be carried to brigades and, in some cases, to regiments. The troops engaged, buzzer wires will be carried forward to the firing line, where trained observers, perhaps officers (as was done by the Japanese), with buzzers or the field telephone, will be placed to send back important information as regards control and fire. It may be practicable at the beginning of the action to maintain touch by wire between the smaller reserves, the supports and the main bodies; but this is doubtful, as a great multiplicity of wires on the field of battle is hazardous, for all cannot probably be maintained in the face of marching troops, and untrustworthy lines may do actual harm by failing when most needed and overthrowing calculations or defeating movements, the opportuneness of which depends upon rapid transmission of orders and information. But this objection applies to all lines of information.

*See report of Major Kuhn.

Regarding lines on the field of battle the writer before quoted, says:

When the attack is once launched, little control can be had by superior commanders over the troops making the attack, but the lines of information are still of value for quick reports as to the success attained. Therefore, the lines of information, while not advancing in the actual final infantry assault, should be pushed up under cover as far as possible in order to see and report the result to the commanding general as quickly as possible. Then, again, lines of information should be used to notify the artillery when to cease firing, which should fire, however, until the infantry has advanced to its range. A quick order is needed here. Field Service Regulations should settle who is to give the order. The Japanese sent artillery-officers with telephones on the firing line to accomplish this.

At the Battle of Mukden the Third Japanese Army laid 155 miles of field-telegraph line during the battle.*

Of course, before the division is actually engaged against the enemy its commander will extend his field or buzzer lines to the positions occupied by the cavalry and artillery commands and will maintain touch with the former as long as possible, and with the latter throughout the action. The artillery will, no doubt, in addition to its other lines, establish between batteries a system of fire control to enable the chief of artillery or the division commander to concentrate or disperse the fire as needs demand. In addition to all this, and one of the most important of the measures to be taken, the commanding general will early establish lines of information by field telephone or by buzzer, by wireless and by visual signals between some fixed position (designated as his own) and the observation stations and balloon. From these should come the most timely of his information regarding the movements of friend or enemy, and notice of the changes taking place in the shifting panorama of war which no single observer can perceive.

It should be noted that in action the balloon will attract fire, and to avoid the effect of dropping shots upon reserves and other troops at the rear, it must be carried well back or to a flank.

So much for the lines of information of the larger bodies of troops; in the case of a small independent or expeditionary force, the problem is easier but not less important. If operating in an enemy's country, especially if the movements are connected with a boat expedition or with the navy, somewhat less weight must be given to wire communications and more reliance be placed upon visual signaling and (if carried) on the portable wire-

*Report Chief Signal Officer of the Army.

less of the field type. With all such expeditions a supply of day and night rockets should be carried, for they are of value as preconcerted signals or to indicate location and time. The field acetylene lantern will also be extremely useful, for its range under favorable conditions is easily twenty miles and it can be used by hand even from a boat on quiet water. But in addition buzzer and field wire in necessary amounts must be carried, and the buzzers and field telephones if practicable. The amount of material will be small, however, if pack train or light transport alone can be used, and all large wire and heavy material must be omitted. If the force is to maintain communication with its base or main body, or is placed on the coast as a support to fixed positions, lance lines should be thrown forward to meet the necessarily limited field lines, which must be used for the safety and success of the expedition as it advances. For this purpose the light wire and instruments needed to maintain touch with the advance guard, outposts and other important points will be carried. Expeditions of this kind offer an important field to wireless telegraphy.

Enough, perhaps too much, has been said regarding lines of information in the field; but the subject is interesting and vast. A commander who can profit by the service of intelligence to the full extent possesses great ability, if not genius, but there are degrees of benefit to be derived, and an ordinary man provided with these aids to success is far better armed than genius without them. The commander, then, aided by his chief signal officer, must plan and direct, but the signal officers and men under them must execute; on their energy and ability will depend the value and success of the lines of information.

One other factor of importance enters the problem, and that is familiarity on the part of those authorized to use the lines of information, not merely with their character and scope, but with their objectives, their value and location of their stations. Of what use, for instance, to an officer having important information to forward, is a network of field wires going he knows not where; or of signal stations hidden or inaccessible that he has not time to find? It follows that systems of information must not only be skilfully established, but that their scope and direction must be as well known and as familiar to those who have to use them as the mail and telegraph offices of a town to the average citizen. As a consequence the commanding general should not keep himself alone informed regarding the systems es-

tablished and the location of stations, but he should send this information through the proper channels to those in command under him, who should in turn transmit it to all who are entitled to receive it; and, in addition, he should take every opportunity, by orders or circulars, to impress upon his subordinates the importance of familiarity with the systems as established, and a knowledge of the location of stations and of the quickest way to reach them.

As a rule, then, signal stations will, as far as possible, be placed at points readily accessible and, unless exposed to the observations of the enemy, they will be as conspicuously marked as a telegraph office or a telephone booth in civil life. Often they will necessarily be placed in exposed positions, especially buzzer stations which are habitually located at the outposts or frequently with the firing line. Whenever possible stations will be sheltered, as far as practicable, from fire, in order that the attention of the operator may be wholly given to his work. Their approximate locality will be selected by the general himself, with the advice of his chief signal officer, but the exact location will be fixed by the signal officer on the ground. The main thing to be considered in the establishment of stations is proximity to localities where events are occurring, and where information is needed or at which information is obtainable; a second point is accessibility to persons authorized to use the lines.

In visual signaling the establishment of stations is more difficult than with electrical communications, since the stations must have a wider range of view and are seldom near or accessible to commanding officers. In the camp or on the march the main signal station of the division will, of course, be at headquarters or at some other point designated by the general, but the lines will reach many points, and secondary stations will become so numerous that memory cannot be relied on. It is suggested, then, that telegraph or signal maps be prepared under the direction of the chief signal officer and corrected as frequently as may be necessary. These sketch maps should show direction and character of the lines of information, the location of signal stations, possibly the roads leading to them, and but little else. They should be supplied to the proper persons, certainly to each headquarters of brigade and independent command with which lines of information are maintained, to signal officers, and most important of all, to each commanding officer within whose commands such stations are placed. Of course it is not meant

that no signal stations will be established except those forseen by the commanding general and chief signal officer and fixed by them; on the contrary, temporary stations in great numbers will be constantly established and used, especially for buzzer, wireless and visual signaling. It is meant merely to emphasize the importance of familiarity on the part of all authorized persons with the location of stations of what may be called the regular systems for the transmission of information for the army, and the best manner of securing the highest degree of usefulness from the service. If it be impracticable to frequently make the sketches suggested, though this should not be the case, as they are designed merely to show the location, lines, roads and signal stations, and can be made, no matter how roughly, by signal officers or non-commissioned officers in charge of stations, a memorandum should be sent, every day if necessary, to each officer in command at or near these stations, indicating the system and the location of stations for the day; the object being to prevent the loss of time in transmitting important intelligence, since it not infrequently happens that the value of information received from reconnaissance, from scouts, pickets, from prisoners or from chance observation is lost by delay in transmission. Signal officers and signalmen should, also, as a matter of course, inform themselves of the location of all field stations and the lines and objectives of the system.

The proper officers of the army being thus informed of the location of the signal stations should thoroughly acquaint themselves with the means of transmission of information there installed and use them to the utmost limit. To do this some little knowledge of the possibilities of transmission is necessary on their part. For instance, when these means are merely visual, flags, the heliograph, or the acetylene lantern, whose rate of speed is probably not more than three or four words per minute with the flag, and double that with the heliograph or light, it would be absurd to send from such stations long messages over short distances to points that a mounted orderly could more quickly reach than could the completed message. On the other hand, across long distances, the enemy's territory, above his head or over intervening obstacles, all messages must be sent by signal. When electrical transmission is provided and speed is desirable, the messenger, of course, should not be thought of; but often it may be the natural impulse of a commanding officer to call an orderly and send a verbal or hastily scrawled message rather than to give

the manner of transmission a thought. Care in this matter should be enjoined until familiarity with the lines of information and stations causes the use of the lines to become instinctive and the messenger to be forgotten. The subject of the *use of lines of information* requires some study and thought on the part of all soldiers.

In endeavoring to present the foregoing practical considerations the writer has, perhaps, tried the patience of such readers as may do him the honor to peruse this paper. Nevertheless, faultily as these ideas have been presented, he believes it unwise to curtail or omit them, trusting if defective in themselves they may inspire better efforts on the part of others. The demand upon all military men of the day is work, and work applied to the development of the great field offered by the service of information cannot help producing an abundant harvest. The signal corps cannot do this work alone; it needs the best assistance that the army as a whole can give, and that assistance can best be given the corps by service with the line troops.

PERSONNEL

As has been said, the signal corps of the army is now composed by law (omitting temporary assignments) of forty-six officers and one thousand two hundred and twelve enlisted men, a strength which bears the proportion of about one and three-quarters per cent. to the present authorized enlisted strength of the army at large. Before the promulgation of the recent order* increasing the army to approximately seventy thousand men, the proportion of the signalmen to the total enlisted was about two per centum, but the increase reduced this to the present proportion of about one and three-quarters per centum. It should be evident, if allowance be made for absentees, the sick, changes of details from and to the Philippines and Alaska, and other losses, that the actual number authorized is far too small to carry on properly the duties that the mobile army, the coast defense, the schools and the military authorities in Cuba, Alaska and the Philippines have a right to expect from a signal corps in peace. Should hostilities break out it would be too small to even lighten

*Number 130, of June 12, 1907—before this order, omitting the Porto Rican Provisional Regiment, and the Philippine Scouts, the army had an authorized strength of 3869 commissioned officers and 62,516 enlisted men, 1212 of whom belonged to the signal corps, a proportion of about two men to the hundred. By the order above noted, the strength of the army was increased, by direction of the President, by 6460 men, giving a total of 68,975.

the large mass of men that must be called into the service of the lines of information. In reality, the present authorized force of the signal corps is about one-half the number properly proportionate to the maximum strength of the regular army, fixed at one hundred thousand men. The army may be increased to that number by executive order at any time, but the signal corps can only be increased by legislation.

The order referred to affords an excellent illustration of the faulty working of the present law as regards the signal corps, if this should at all times have a just proportion to the total of the army as authorized by the President.

In peace the smallest ratio acknowledged to be satisfactory is two and one-half percentum of signalmen to the total enlisted; in war this must be increased. It must be exceeded, also, should the army be largely reduced in numbers, since many of the duties of the corps, such as fire control, telegraph and cable service in Alaska, do not depend directly upon the size of the army, while others do so depend. It follows that a maximum of two thousand five hundred signalmen should be authorized to correspond with a maximum of one hundred thousand men for the army at large; and that within limits the proportion of the first should vary with the last. Under the existing law, if need should arise while Congress was not in session to increase the army to one hundred thousand men the signal corps must remain at one thousand two hundred and twelve and bear a proportion of but little more than one per cent. (about $1\frac{1}{5}\%$) to the total effective; a quota ridiculously small. In addition, it may be remarked that when commands are broken into small detachments, as often happens with our army, or when expeditionary forces are dispatched, as may at any time become necessary from the needs of our peculiar situation as regards distant regions, the percentage of signal troops must be greater than required for large bodies of troops serving in garrison or operating as units in the field, since each unit, large or small, must be provided with lines of information, and since the control of cables and base line stations must be given to signalmen. *It should therefore be evident that in peace two thousand five hundred men ought to be allowed as a maximum for the service of the communications and that in war this number must be increased as the army is increased.*

In war, under modern conditions, it is the belief of the writer that the proportion of signal troops, including balloon train and

wireless, should not fall below four per cent. of the total. This would give seven hundred and twenty signalmen to a division composed of three brigades of infantry (of three regiments each), one regiment of cavalry, nine batteries of field-artillery, and the usual auxiliary troops, say eighteen thousand men in all. In other words, it would provide six companies of one hundred men each in addition to the balloon company of one hundred and twenty men. Or, if we consider the balloon train as a separate unit, outside the service of the lines of information proper, the percentage of signal troops becomes a trifle more than three. Probably about a just proportion, but not excessive, since it should be remembered that signal companies are constantly depleted by detachments assigned to commands operating independently, by others left at important positions on the flanks or at the rear, or placed at outlook stations at the front, and by still others as operators at the rear or with the field wireless telegraph.

The estimate here given is larger than that contemplated in the *provisional organization* authorized for the signal troops of a division, but a division of eighteen thousand men is greater than would ordinarily be found, except in case of an independent command complete in itself, and for which the organization and strength should probably be as stated.* It marks the limit of requirement.

The best information obtainable from officers of our own army and the practice in foreign service indicates that $2\frac{1}{2}\%$ per cent. of the force is the minimum that can safely be used for signal work. The type of service here considered for tactical lines of information is a special mounted service with highly trained personnel, which cannot be created after the declaration of war. Therefore these special troops should be provided and trained in time of peace, on the basis of our authorized army of 100,000 men, and not of the existing army of 65,000 men. In this respect signal troops are the same as field-artillery.

*See Circular No. 7, War Department, Signal Office, Washington, October 11, 1907, which states that "A company of 100 men, as enumerated above, will be considered a normal organization. However, in the field the number of enlisted men will be greater or less, as the nature of the service and existing conditions may require. The fourth company, above noted, may therefore be broken up and attached to the other three."

Considering the division as the unit the six companies above mentioned will be equipped and designated as

One base line company.
Two telegraph companies.
Two field companies.
One wireless company.
One balloon company.

Or if the wireless men are broken up into detachments and included in other companies, as indicated below, then three field companies or three telegraph companies, as the exigencies of the service require, making a total of six companies, in addition to the balloon company. Of these six, however, certain ones will be detached at corps and army headquarters.

The organization and equipment of these companies is outlined as follows:

A company will consist of

1 Captain,
3 Lieutenants,
3 Master signal electricians,
10 Sergeants, first class,
10 Sergeants,
10 Corporals,
45 Privates, first class,
20 Privates,
2 Cooks,
Total enlisted, 100.

The assignment of duties in general, the equipment and normal distribution of transportation, will be as follows:

Field company to provide lines of communication for tactical use during combat, maneuvers, rapid marches, etc. Each field company will be provided with suitable equipment to furnish communication for a division by visual signaling, wireless telegraphy, buzzer and other field telegraph and telephone lines. The amount of equipment will be sufficient for a field company to construct, operate and maintain forty miles of field lines, thirty miles of buzzer lines, three portable wireless telegraph stations having a normal radius of twenty miles, and six visual signaling stations.

Telegraph company.—To provide lines of communication for administrative purposes, such as camp telephone systems, serving staff departments, supply depots, hospitals, etc. Each telegraph company will be provided with suitable equipment to furnish communication for a division by visual signaling and lance

or semi-permanent lines for telephone and telegraph service. The amount of equipment will be sufficient for the company to construct, operate and maintain forty miles of lance lines and six visual stations.

Base line company.—To provide lines of communication from the bases of an army along the route of supply to the distribution points and connections to commercial and cable systems. Each base line company will be provided with suitable equipment to construct, operate and maintain telegraph and long distance telephone over permanent or semi-permanent lines fifty miles of three wires, and two wireless telegraph stations, 1 K. W. having a normal radius of 75 miles. Details from this company will assist in the administration of signal corps depots of supply at bases and distribution points.

Each cavalry division will have two field companies and one telegraph company, all mounted. When one company is required to provide all classes of service, viz., field, telegraph and base line, suitable equipment will be furnished accordingly.

To the headquarters of each army corps and each unit larger than an army corps, there should be assigned one additional field and one additional telegraph company to furnish communication service for such headquarters.

These companies should serve under the immediate direction of the chief signal officer of the headquarters to which they are assigned.

At present time the ballooning experiments have not been sufficiently complete to determine the most suitable equipment and transportation for a balloon company, nor the number of balloons that will be necessary, but probably a balloon company should be allotted to each army corps or expeditionary force, and placed under the immediate direction of the chief signal officer in the field.

Transportation for a field company:

90 Riding horses,	
6 Reel carts, 2 draft horses each,	} Special wagons supplied by the signal corps; to be driven by signalmen.
3 Instrument wagons, 2 mules each,	
3 Lance trucks, 6 mules each,	
2 Escort wagons (quartermaster)	} for company transportation,
4 mules each.	
9 Pack mules.	

Reel carts and instrument wagons are special vehicles supplied by the signal corps, and drivers will be enlisted men of that corps.

Transportation for a telegraph company:

- | | |
|---|--|
| 10 Riding horses, | } Wire wagons, lance trucks and instrument wagons are special vehicles supplied by the signal corps, and the drivers will be enlisted men of that corps. |
| 3 Wire wagons, 4 mules each, | |
| 4 Lance trucks, 4 mules each, | |
| 3 Instrument wagons, 2 mules each, | |
| 4 Construction wagons (escort), 4 mules each, | |
| 1 Escort wagon (general transportation, 4 mules each. | |
| Wire, | |
| The lance truck carries about 300 lances. | |

Transportation for a base line company:

- | | |
|---|--|
| 3 Instrument wagons, 2 mules each, | } Special wagons supplied by signal corps; to be driven by signal corps men. |
| 2 Wire wagons, 4 mules each, | |
| 3 Lance trucks, 4 mules each, | |
| 2 Construction wagons (quartermaster escort), 4 mules each, | |
| 1 Escort wagon, 4 mules each. | |

The preceding paragraphs, which prescribe organization and equipment of various companies, may be amended to conform to exceptional conditions of service.

Field artillery, signal equipment.—The fire control and direction of field artillery is a matter of great importance, but as it pertains incidentally to the signal corps it is only necessary to note here that the following equipment is provided for this service:

BATTERY EQUIPMENT.

- | | |
|-------------------------------------|--|
| 3 Telephones, field-artillery type, | 2 Flag kits, 2-foot, |
| 2 Pay-out handles, | 2 Megaphones, aluminium, 18-inch, |
| 2 Breast reels, | 6 Field-glasses, field-artillery type, |
| 2 Spools buzzer wire, | 1 Chest for packing battery equipment. |
| 3 Ground rods, | |
| 3 Inspector's pocket kits, | |

BATTALION EQUIPMENT.

- | | |
|-------------------------------------|---|
| 2 Telephones, field-artillery type, | 1 Field acetylene lantern, |
| 2 Ground rods, | 1 Heliograph and tripod, complete, |
| 2 Breast reels, | |
| 2 Pay-out handles, | 1 Flag kit, 4-foot, |
| 10 Spools buzzer wire, | 1 Field-glass, field-artillery type, |
| 2 Inspector's pocket kits, | 5 Miles field wire, 11-strand, |
| 2 Rolls insulating tape, | 2 Chests for packing battalion equipment. |
| 1 Pliers, 8-inch pair, | |

REGIMENTAL EQUIPMENT.

- | | |
|-------------------------------------|--|
| 2 Telephones, field-artillery type, | 1 Flag kit, 4-foot, |
| 2 Ground rods, | 1 Field-glass, field-artillery type, |
| 1 Inspector's pocket kit, | 2 Chests for packing regimental equipment. |
| 1 Field acetylene lantern, | |
| 1 Heliograph and tripod, complete, | |

One high power field-glass will be furnished to the commanding officer of each battery and to each reconnaissance officer of field artillery.

Only six field-glasses, field-artillery type, and two flag kits, 2-foot, will be furnished to each battery of mountain artillery.

No one system of lines of information will meet all conditions, therefore the signal corps will provide as great a variety of systems as practicable, and the signal corps officers in charge must determine what system to use for each particular case, to provide the most efficient service. This usually requires duplicate lines of different types and routes to prevent interruption.

The kind of lines, type of instruments or signal apparatus which ought to be carried by a signal corps detachment serving with line troops in the field should not be rigorously prescribed, but it should be left to the judgment of the senior signal officer present. The amount will usually be limited by the transportation available.

A division in camp, when the duration of the encampment warrants, should be supplied with the following telephone service by the signal corps: One telephone at each brigade headquarters, headquarters of divisional cavalry, headquarters of divisional artillery, engineer battalion, quartermaster supply depot, commissary supply depot, signal corps headquarters; two telephones at division headquarters, each field-hospital, corral of ammunition and supply train, and to each regimental headquarters when the amount of material on hand warrants.

It is believed that the organization above given will answer well the needs of the regular army, but should war come and the great army of organized militia and of volunteers be called into service, the work of organizing and equipping a corps for the service of lines of information will be no slight task. Preparation for this work has not been neglected, but space is lacking for more than a suggestion as to the numbers that will be required for this service in a great war. A fair estimate has

been made of the strength of the volunteers that will be called to the colors by an officer of the General Staff,* but even he, in the opinion of the writer, places the number of men too low for the service of lines of information. He remarks: "In any future war with any first-class power, and acting purely on the defensive, the United States will require a volunteer army of at least five hundred thousand men, in addition to the legal maximum strength of one hundred thousand men in the regular army. Of all the great nations of the earth, including even China, our country is the only one that has no system by which its forces can be rapidly placed upon a war footing.

"We have, on paper, about one hundred and twenty thousand men in our organized militia or national guard, of whom only about thirty-three per cent. would be available for service in the volunteer army. Our regular establishment can supply the necessary complement of both line and staff-officers for the maximum strength of the regular army alone, and officers, line and staff, for four hundred and sixty thousand volunteers will have to be forthcoming. It has been usual in the past to allow one and one-half per cent. of the total strength for the service of the lines of information, and for six hundred thousand men we would then require nine thousand trained technical men for such service. The proper complement of officers for such a force is, in round numbers, four hundred and fifty.†

In the opinion of the writer, this estimate should at least be doubled. For a force of six hundred thousand men no less than twelve regiments of one thousand five hundred men each should be provided for the service of the lines of information. If the estimates above made are accepted as a criterion of the needs of the armies of the United States in war in the matter of the personnel of the lines of information it appears evident that difficulty will be experienced not only in supplying the men needed, but in obtaining the officers necessary for their control and direction. Nevertheless it is believed that the men will be found and that the small nucleus of the peace establishment, aided by experienced officers of the organized militia, will sufficiently leaven the whole mass.

*Lieut.-Col. S. R. Reber, Signal Corps, in a paper read in 1906 before the Telephone Society of New York.

†Compare with estimates given in coast defense.

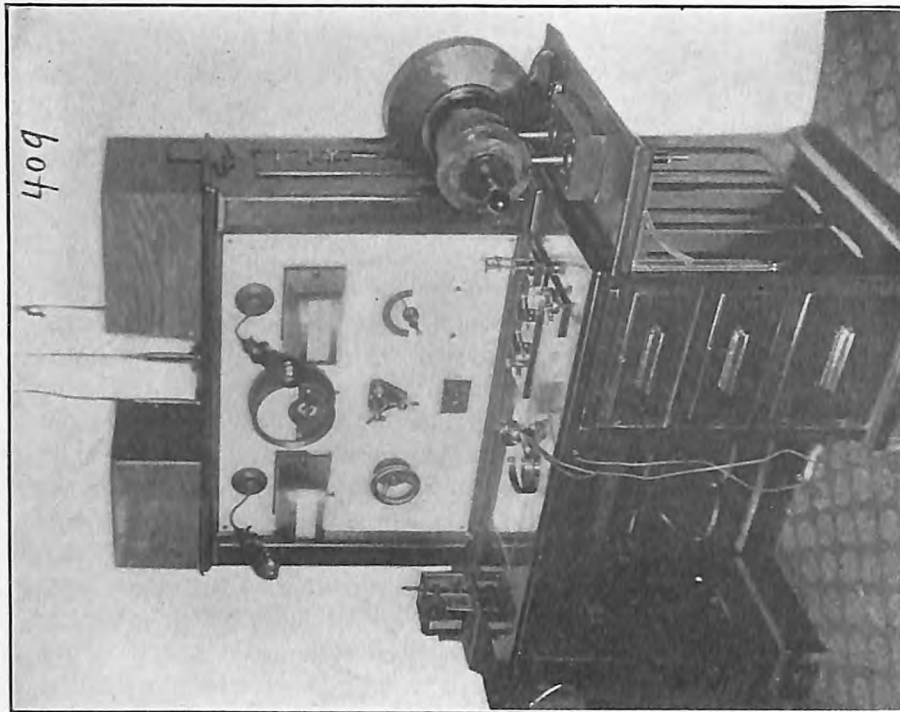
THE WIRELESS TELEGRAPH AND TELEPHONE

Though still of somewhat indeterminate value to the mobile army in extended operations in the field, the wireless telegraph has grown to such importance in peace, and is so obviously essential in certain phases of the military service, that much effort has been expended in the past few years by the signal corps to devise apparatus suitable to military needs which require, in general, portability, certainty and reasonable simplicity rather than power and range. But it is unnecessary in this place to more than touch upon the subject of wireless communications as a whole.* There can be no doubt that the most important use of the wireless made by the army has, up to this time, been the section of one hundred and seven miles across Norton Sound, established in August, 1904,† and which is reported June last to have continued to work uninterruptedly since that time—practically three years. It has maintained communications and has transmitted the entire telegraph business of Nome and Seward Peninsula, which, with the official messages, averages several thousand words daily. Every detail of operation of this system is done by enlisted men of the signal corps, and if it is remembered that the Seward Peninsula of Alaska is cut off from the world for probably eight months of the year, except for an occasional mail carried by dog-sled, it is thought that the system proves the value of wireless better, perhaps, than any other of the world; yet the apparatus by which this is done consists of a small gasoline engine and a 3-K.W. generator with their accessories. So successful has been this use of the wireless in the North, where, as it seems, the electrical conditions are favorable, that during the coming open season in Alaska the stations at Nome and St. Michaels will be so increased in power that they should be able to communicate with a central station at Fort Gibbon on the Yukon River, where a 10-K.W. permanent station will be established by the signal corps. In addition, smaller stations fitted with 1-K.W. sets and gasoline engines, will be in operation at Fairbanks and Circle City.‡

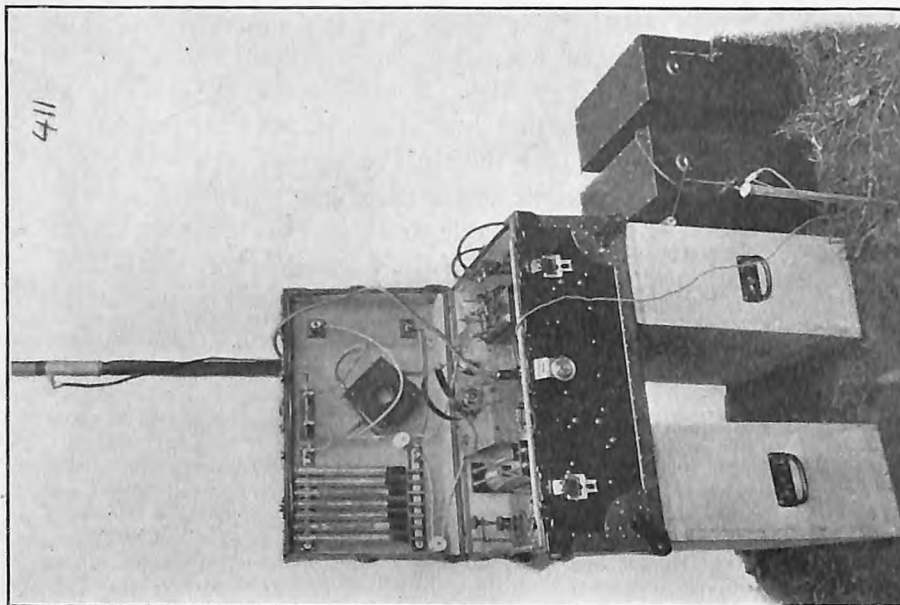
*For a more full discussion of the subject reference is suggested to the November-December, 1907, number of the *Journal of the United States Artillery*, which contains an article on land wireless telegraphy, by Major Edgar Russel, Signal Corps.

†Largely through the efforts of Capt. L. D. Wildman, signal corps, and his command. It has so continued to the present time, forty-two months after its installation.

‡Incidentally it may be remarked that the navy has established a 20-K.W. station at Sitka, and that another is proposed at Valdez, which will give a chain of wireless stations from Nome to Fort Gibbon, 400 miles; Fort Gibbon to Valdez, 350 miles; Valdez to Sitka, 500 miles; Sitka to Cape Flattery, 750 miles.



3-K.W. WIRELESS STATION SET.



FIELD WIRELESS SET.

In the Philippine Islands, also, the wireless telegraph is growing increasingly important, especially in replacing cables, often difficult to maintain among the coral reefs of the tropics, as they long ago proved among the icebergs of the shallows waters of Norton Sound. Stations have been established at Zamboanga and at Jolo which use apparatus of the same type and power as those so successfully installed by Captain Wildman in Alaska, and wireless communication will be maintained between the former place and Malabang. Interisland communication in the Philippines appears to offer a magnificent field for the wireless telegraph, for though the natural electric conditions have proved less satisfactory than in the North, the grouping of the islands is most favorable to the service.

In Cuba, the signal corps has confined the use of the wireless to the field sets later described; but it has fitted up six permanent stations* for the Provisional Government. These, in connection with the naval stations at Guantanamo and on the Isle of Pines, form a valuable system of lines of information in case of the interruption of wires and cables.

On the coast of the United States proper a signal station has been erected at Fort Wood and equipped with a 3-K.W. wireless set with harp antennæ, to be used rather for instruction purposes at the signal school there established than as a line of communication. A second station which will serve as a model for artillery districts is nearing completion at Sandy Hook, and others will be established within the artillery districts of Boston, Portland and Puget Sound when practicable. Wireless stations exist for artillery work at Fort Monroe, Fort Totten and at Fort H. G. Wright, which are equipped with the 1-K.W. set; at the latter station, however, use is still made of part of the commercial apparatus installed in 1903. In addition, there has been installed in the interior of the country, at the signal corps post at Fort Omaha, a 3-K.W. wireless set, designed for use with stations later to be established at Forts Leavenworth and Riley. The latter are intended to be of portable type, fitted with a 1-K.W. set, known as "Field Wireless Set, 1 K.W.—Wagon," which includes a gasolene engine, dynamo, a three-gallon gasolene tank and fittings, the whole to weigh about five hundred pounds and susceptible of being transported by wagon, as the name implies. But among the most useful installations that have been effected

*Pinar del Rio is (or will be) equipped with a 5-K.W. set. Havana, 20 K.W.; Santa Clara, 10 K.W.; Camaguey, 10 K.W.; Santiago, 20 K. W.; Baracoa, 10 K. W.

are those of the transports. The first of these was used in the Pacific on the *Logan*, and though of only 3 K.W. power, maintained communication between the ship and the Wake Island station for 700 miles at its first use,* and more recent reports indicate that the 3-K.W. apparatus under favorable conditions has a range of more than two thousand miles at sea.

Three types of wireless sets have been devised by the signal corps; these are, first, the 3-K.W. permanent set above mentioned, intended for transport service and for shore stations. Second, the 1-K.W. permanent and portable set for station use and for field service with wagon transportation. Third, portable field or boat sets, used on land with wagon or pack transportation.

In addition, an experimental wireless equipment is reported under construction, which will consist of an automobile of forty horse-power so built that it will transport a 1-K.W. dynamo, transformer and necessary auxiliaries and allow a portable mast to be fitted to carry the antennæ; the motor of the car will be used for driving the dynamo. Such apparatus may prove of service hereafter; but nothing has as yet been established as to the value of this ingenious contrivance. Communication while you wait is attractive, but not proven.

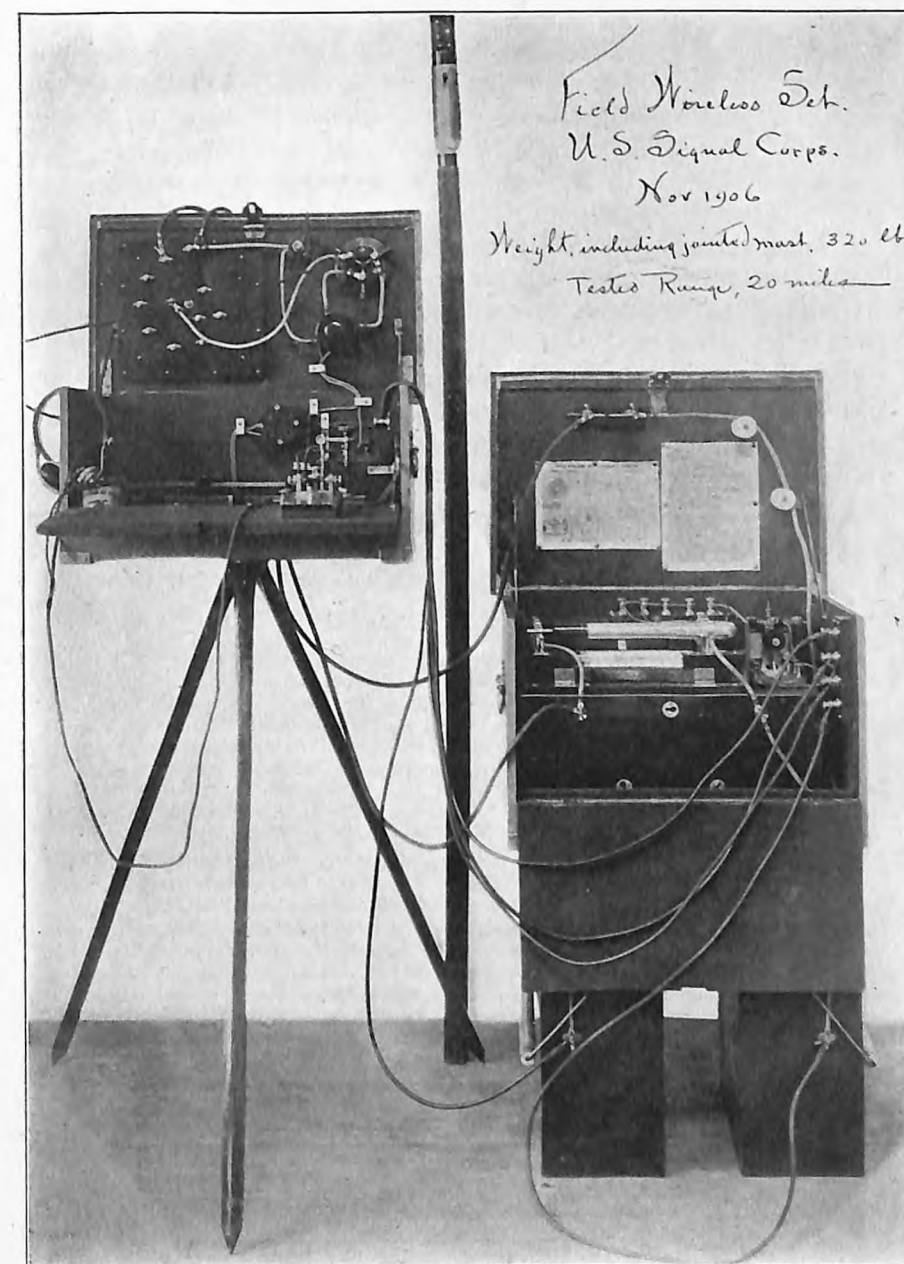
The 3-K.W. wireless sets constructed by the signal corps are usually provided with two sources of power: a gas engine and generator and a motor generator set, each furnishing alternating current at approximately 110 volts and 133 cycles, which is increased for use to 25,000 volts in an open core transformer. Receiver set, sending keys (direct and oil-break) and fan-cooled spark are mounted on a desk, at the rear of which is a panel with equipment for the distant control of the generators. A copper tube linking coil and open core transformer are installed in the operating room.

This set, though not portable, can be broken into sections weighing 800 pounds and less, and can consequently be transported by boat or wagon without difficulty and may be used with a portable jointed mast. It is believed that the radius of opera-

*The following later results are reported in Orders No. 23, War Department, Signal Office, December 16, 1907, as follows:

Some time ago the naval wireless telegraph station at Sitka reported hearing the *Sherman*, at a distance of about 2200 miles. Table Bluff station, near Eureka, reports hearing, at 10.30 P. M., November 17th, the *Thomas* calling the Farallon Islands. Table Bluff answered the call, receiving a considerable message, reporting the ship 1400 miles from San Francisco (about the same distance from Eureka), and reporting all well. Four hours later Table Bluff received a second message, giving the *Thomas's* latitude and longitude. Excellent service for this small apparatus.

FIG. 8.



tion of these sets, working with each other, will be over two hundred miles.*

The 1-K.W. sets are practically the same as the preceding, except that a motor generator only is provided and a direct break key is used and some minor changes made in the receiving apparatus, due to decreased requirements.

The range of the 1-K.W. set is indicated in the following report:†

"The tests so far conducted show that the range of this station lies somewhere between seventy-five and one hundred miles, it being possible to call any station within the range of seventy-five miles whether they have the same tune or different. This distance, slightly over ninety miles, is practically the extreme limit over which a 1-K.W. set will operate successfully. Greater distances have been covered over water, with no land intervening, but the practice among commercial stations seems to be to use about three kilowatts over distances, say from fifty to one hundred miles."

In regard to the current used with station sets, it is stated that, "The power we should use at our coast-artillery stations

*In speaking of this set Major Russel, in the article before noted, says: "The only element upon which data is lacking is the jointed steel mast, and we are confident that the one recently purchased, or one we can devise, will be capable of erection within an hour. It is certain that all other parts of the station can be made ready within the time. This may be called the division headquarters set; with it the division headquarters can be kept in touch with corps headquarters, or adjacent division headquarters probably within one hundred miles. If the automobile 1-K.W. wireless set turns out as we hope, this will be the readiest means of keeping up the division headquarters line of information."

†Made to the writer in January, 1908, by Mr. H. D. Austin, Assistant Electrical Engineer, Signal Corps, regarding the Fort H. G. Wright station, but applicable, generally, to stations of this power. The report adds: "All things considered, the variety in equipment and variations in voltage experienced on the post circuit, this station gave splendid results; results that are comparable with any wireless station around New York."

"It is not simply a matter of distance to which a station will send, but it is a question of how far the station will successfully operate with interference, because at the present time interference is a thing that must be reckoned with. Your attention is invited to the power used by the following stations:

"New York, DeForest station, 3 K.W.
 "Bridgeport, Conn., DeForest station, 3 K.W.
 "Atlantic City, N. J., station, 5 K.W.
 "Gallilee, N. J., DeForest station, 3 K.W.
 "Wilson's Point, Massie station, 3 K.W.
 "Fire Island, N. Y., Navy station, 5 K.W.
 "Brooklyn, N. Y., Navy station, 15 K.W."

"Commercial stations have recognized this fact and have designed their stations accordingly, increasing the power so that there is no question but at any time during night and day they can establish communication."

"Ninety miles is too great a distance to operate over under all conditions with a 1-K.W. set, as there is no time during the day when there is not either some station working at New York, or some boat working at Fort Wright, which would cause interference enough to prevent a message from one station to another being properly received."

should not be very much greater than that required in target work in order to prevent any interference with the neighboring naval stations. If, as appears, a range of seventy-five miles can be attained with our 1-K.W. sets, this would give all that would be needed not only for target practice, but also for any possible scout boat work in time of war. Coastwise wireless in general, in intercommunication from station to station, at present appears to be a matter that pertains to the navy and not to the army.*

The permanent stations supplied with both types of apparatus mentioned will use generally the umbrella antenna as shown in the cut. Experience with the umbrella aerial has been very satisfactory.†

It is evident that permanent wireless military stations are not only of great value even at the present time, but that the scope of their usefulness is steadily and rapidly increasing and that they have become a permanent factor in coast defense. However, the control of the field of operations of the wireless has not yet been defined. Not merely are the army and navy co-workers in it, but it has already been so largely occupied by commercial companies that much confusion results and more is to be expected in the future unless means are taken to establish by law necessary restrictions.‡

The position of the field wireless is not so well assured as is that of permanent stations. Somewhat recently, however, in our own service field wireless sets have been brought to a promising

*The Chief Signal Officer of the army in a communication to the writer, dated January 31, 1908.

†Regarding this form of antennæ, Mr. Austin, before quoted, says: "This aerial contains considerably more capacity than the plain four-wire aerial, and is a much better radiator, as well as absorber of electrical waves. The aerial at Fort Wright was found to work best using a wave length of about 600 meters and a 30-per cent. coupling. This gave the maximum reading on the hot-wire ammeter, which was 2.2. Wilson's Point received us a great deal louder using an umbrella aerial than using the four-wire loop, showing that the range of the station was considerably increased by the umbrella aerial. Stations of this capacity already installed indicate that they have an effective range of seventy-five miles, which is ample for coast artillery purposes."

‡The Honorable Secretary of the Navy, in a letter transmitted to Congress by a special message of the President, January, 1908, recommends that a law be passed which should make it a punishable offense "To originate or transmit a false message purporting to be official."

"To break in and interfere with any wireless station while it is transmitting an official message."

"To refuse to cease, or fail to cease, sending a private wireless message when called upon to do so by an operator having an official message to be sent."

"It will be noted that the enactment of law of the nature proposed would never seriously interfere with the legitimate workings of commercial wireless installations. The restrictions suggested are intended to apply particularly to times of peace. During war it is contemplated that much more extensive prohibitions would be exercised to put into effect in the absence of legislation by executive proclamation as a belligerent right."

degree of perfection, and good, practical work has resulted from their use with small craft in artillery target practice and with the army in Cuba. The portable apparatus devised by the signal corps is called the "Field Wireless Set—Pack." They are promising and very pretty instruments, intended primarily for service with the mobile army and to accompany rapidly moving troops in the field; but they are also very serviceable with scout boats and other floating auxiliaries of the fixed defenses, at lighthouses and advanced observation stations of the coast, since they carry their power with them.* In the field the portable wireless is trans-

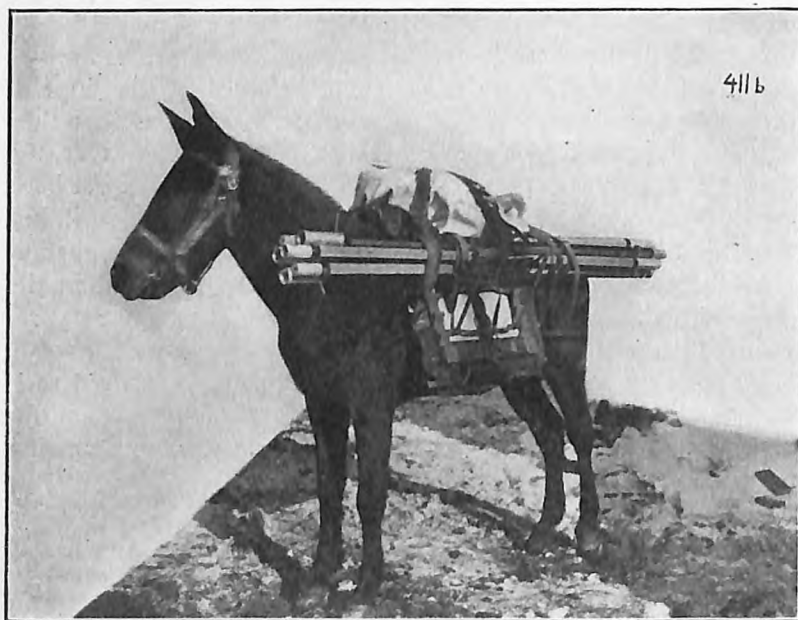


FIG. 11.—FIELD WIRELESS SET PACKED.

ported by pack, as shown, three animals being necessary for each wireless set complete; that is, one each for the sending and receiving apparatus, the antennæ and jointed mast and the storage batteries. The operating chest when packed weighs 150 pounds; the jointed mast, guys and antennæ, packed, weigh 200 pounds; the latest form of storage batteries, charged and packed, weigh

*The Artillery Board of Fort Monroe are apparently taking exceptions to the small portable sets for use on the tugs, and are taking steps to ask for $\frac{1}{2}$ K.W., or larger, for use on those boats. In view of this, the whole matter has been brought up to the Chief of Artillery to settle definitely the kind of wireless sets that we are to issue to the artillery.

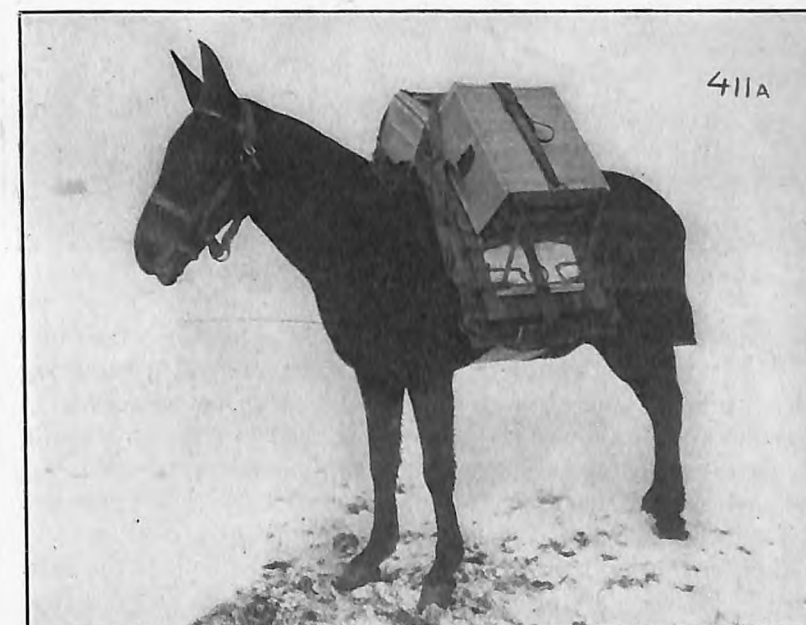
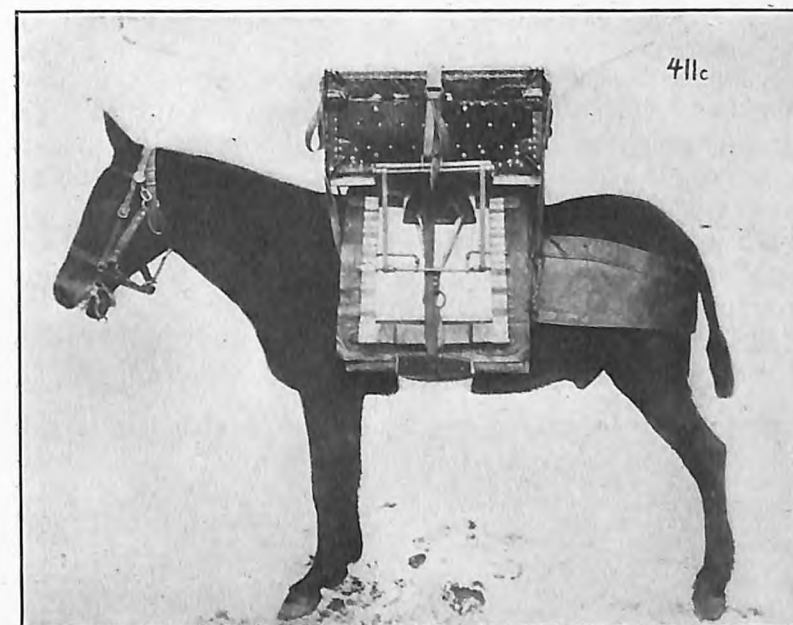


FIG. 12.—WIRELESS OUTFIT PACKED FOR TRANSPORTATION.

130 pounds; the battery cases are so constructed as to be practically free from leak, no matter how the load is turned. The aggregate weight of one set is therefore 480 pounds, so that the two sets can be readily carried in a wagon or cart. Divided into three packs the load carried by each animal is light.

The jointed mast is of wood. It consists of ten sections, each six feet long, and when erected is maintained by guys, some of which support also an umbrella aerial.

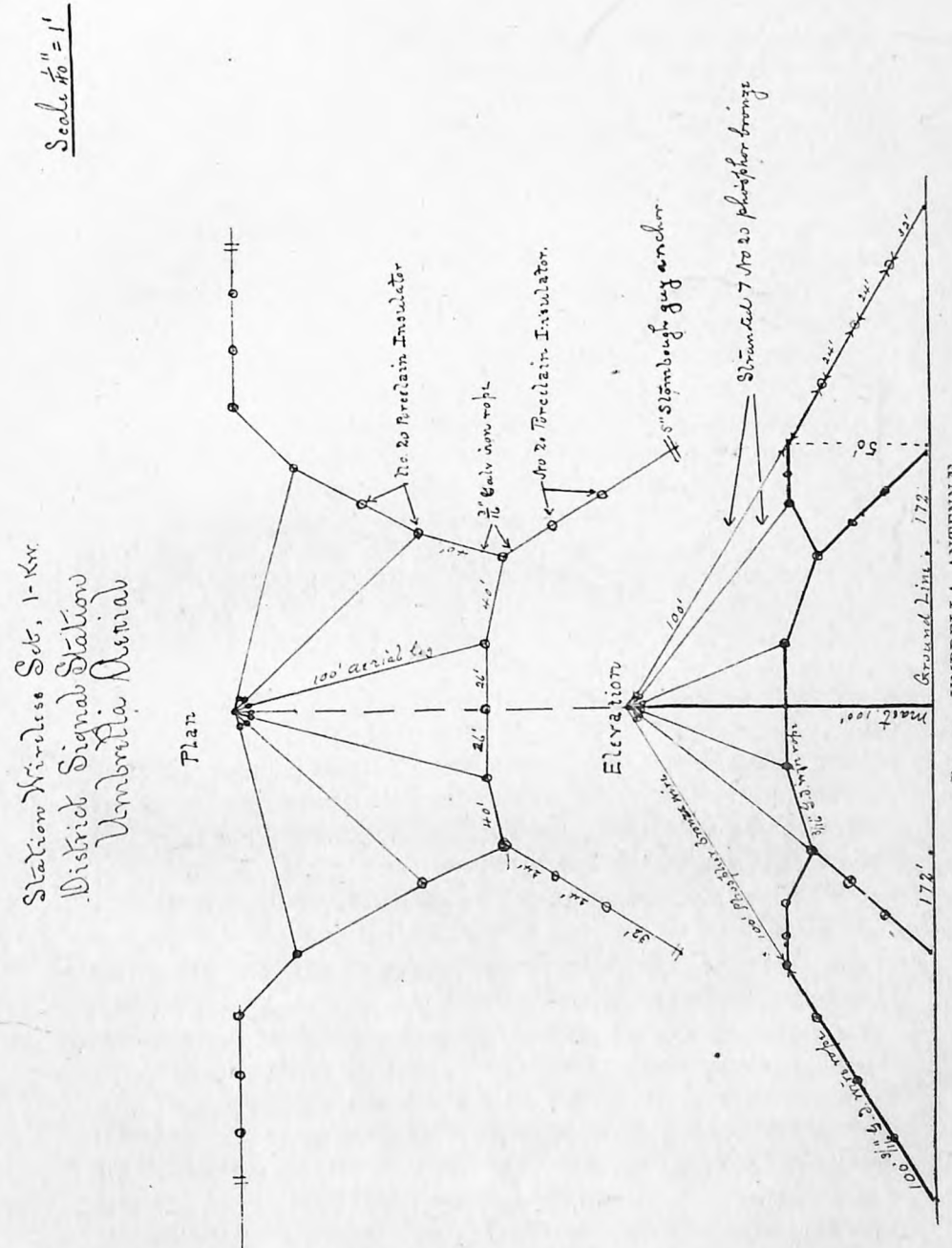
The antenna connected with the mast consists of eight phosphor bronze wires, each fifty feet long, radiating from the top



FIG. 9.—WIRELESS STATION AND KITE.

and connecting with the copper strip which extends up the sides of the sections. At the bottom of the mast there is a radiating set of insulated wires fifty feet long and about seven feet from the ground. This lower set of wires is used instead of ground, the wireless set being connected between these so-called "counterpoise" wires and the upper or antennæ wires. This mast and aerial have been erected in fifteen minutes.

Another means of raising the antenna in the field is the kite, of which two sizes are used, one six, the other seven and one-half feet high; the kite is held by a phosphor bronze wire which weighs about twelve pounds to the thousand feet. It is said that



"The kite antenna has shown great adaptability for receiving long distances; although for sending it does not appear quite so efficient as the mast and umbrella antenna."

Power is furnished the field sets usually by eight cells of storage battery (sixteen volts, eight amperes), which will run the set about ten hours continuously; but there is also used a small dynamo driven by hand. Two men can give the necessary power, namely, one hundred and twenty-eight watts. The apparatus when packed weighs one hundred and thirty pounds.

Another form of dynamo employed is a foot-driven machine operated somewhat like a bicycle, but it is not ordinarily sufficiently powerful for the field sets. A small gasoline charging set of one-half kilowatt may also be used.

From Cuba, where the field wireless has been most extensively used, it is reported that continuous operations with various kinds of sets contributed much valuable data to the subject. From experimental work with the signal corps apparatus it seems probable that communication over twenty miles of land distance can, as a rule, be relied upon with them and that they are capable of sending messages that can be read by permanent sets one hundred miles away, or of receiving communications from a distance of seventy-five miles.

Furthermore, it is reported that "When working with stations equipped with large masts, such as the naval station at Key West, one of the small sets at Camp Columbia, near Havana, communicates easily with Key West, a distance of 110 miles; or across Cuba with the large wireless station (of the navy) at Neuva Gerona, on the Isle of Pines."*

In Germany, of course, the development of the wireless for use both in peace and war is a matter of the keenest interest. Extensive tests have been continuously conducted since they were begun by the balloon battalion in 1897. In 1904 a wireless telegraph division was established, equipped with three portable stations and composed of four officers, four non-commissioned officers and twenty-seven men, in connection with the balloon battalion. This division was sent to Southwest Africa, where it rendered valuable service. On account of the nature of the country the ordinary signal apparatus could not be used. Seeing the importance of this work, a second division, established in 1905, was sent out. This was equipped with three additional

*Army and Navy Register.

portable stations and was composed of four officers, nine non-commissioned officers and seventy-nine men.

The German field wireless apparatus is mounted in carts, and is stated to have a range under ordinary conditions of about one hundred and ninety miles. The wireless detachment consists of eight officers, five non-commissioned officers and eighty-three men.

In the Russo-Japanese War the wireless was but little used over land; the field wireless apparently not at all. England has a portable form of wireless for field use. From Italy comes reports of the extensive use of the field wireless during the maneuvers of last summer. It appears that wireless stations were established at intervals of twenty miles and that "There was never a time when the whole line of the attacking army was not in instant communication with its commander."* From the stations automobiles were used to deliver the wireless messages.

Such is a summary of the status of the wireless in military affairs. There can be no doubt of its importance in coast defense, at sea and at permanent land stations during the leisure of peace; but of its real value in the field during the operations of war, who can judge? The charm of its theoretical use is obvious, and its enormous importance, if practicable under certain conditions, as, for instance, the lateral lines of information of an advancing army, or communication with an invested position, is clear; but it should seem that the time to place full reliance upon communication by wireless telegraph or telephone has not yet come. There is this, however, to be said in regard to its use. The wireless can be interrupted only by itself, and it follows that the wireless of the enemy must be met by that of his adversary; consequently, the wireless telegraph must be given a place in military affairs.

THE WIRELESS TELEPHONE.

The wireless telegraph can no longer be disregarded, and it may be that the day of the wireless telephone is also approaching, but this day has not yet arrived. Much is, of course, claimed for this form of communication, and our fleet now on its way to California is equipped with this telephone. Astounding reports also of its use over a distance of two or three hundred miles are re-

*Major Edgar Russel, who quotes the statement from a newspaper.

ceived from abroad,* but at present the wireless telephone has no great value in military affairs, though it may later become an important means of communication. It has recently been tested by the signal corps at Fort Monroe. In all the systems tried a sustained current of high frequency is transferred directly to the antenna circuit in which the telephone transmitter is connected and by which is superimposed the wave frequency of the human voice.

*The *Times*, of New York, December 20, 1907, states:

"Yesterday's London cable dispatches to the *Times* reported that Professor Poulson had been transmitting wireless telephonic messages with clearness and accuracy from his station near Copenhagen to Berlin, distant 240 miles. A German company is also reported to be sending oral messages through the air from Nauen to points fifty and sixty miles away."

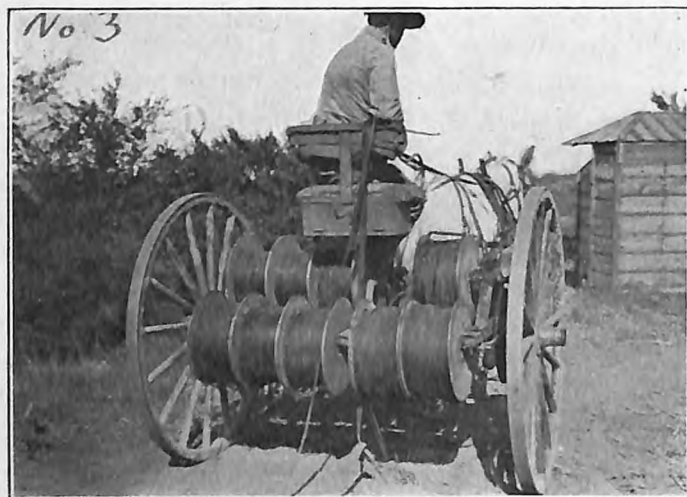


FIG. 13.—AUTOMATIC WIRE SPOOL-CART.
(United States Signal School, Fort Leavenworth.)

PART III.

THE SIGNAL CORPS AND THE MOBILE ARMY.

ELECTRICAL AND VISUAL LINES OF INFORMATION.

Let us now turn from the personnel of the corps charged with the service of the lines of information to a brief consideration of the methods employed and of the instruments used. Before entering upon details, however, it is important to remark that, in accordance with the practice at the magnificent training school of the mobile army at Fort Leavenworth, the military lines of information are divided, as before noted, into tactical lines and strategical lines, of which it is said that "it is the former only which seriously concerns the signal officer at present, since in a very great war, conducted in a territory inhabited by civilized people, the problem of constructing permanent or semi-permanent lines to follow the larger units of a moving army is one which would be met by utilizing and adopting commercial lines already at hand through the service of either regular or volunteer signal troops." The obvious comment in regard to this conclusion of Leavenworth authority is that much, perhaps most, of the work of the signal troops of our army will be done in connection with expeditionary forces in countries where commercial lines either do not exist or have been destroyed by the enemy or his people—as was the case in the China campaign—and that strategic lines, their construction and their material—bulky though it may be—are by no means to be neglected in considering broadly the duties of signal men.* However, there can be no doubt that tactical lines are the more important, and of these the authority quoted goes on to say: "Tactical lines of information refer to lines constructed and operated in the presence of the enemy. Here is the task to which the signal officer must devote his closest attention. In the construction of tactical lines of information the prime requisites are certainty of operation and extreme mobility"; and he adds very forcibly, "If we are to succeed in war, the signal

*The writer of the present article repeats that he is now only referring to the transmission of intelligence or information, and that the collection of information is a duty of the army itself; it depends, at times, almost wholly upon the line, and especially upon the cavalry in the field, and upon the coast patrol and floating auxiliaries in coast defense.

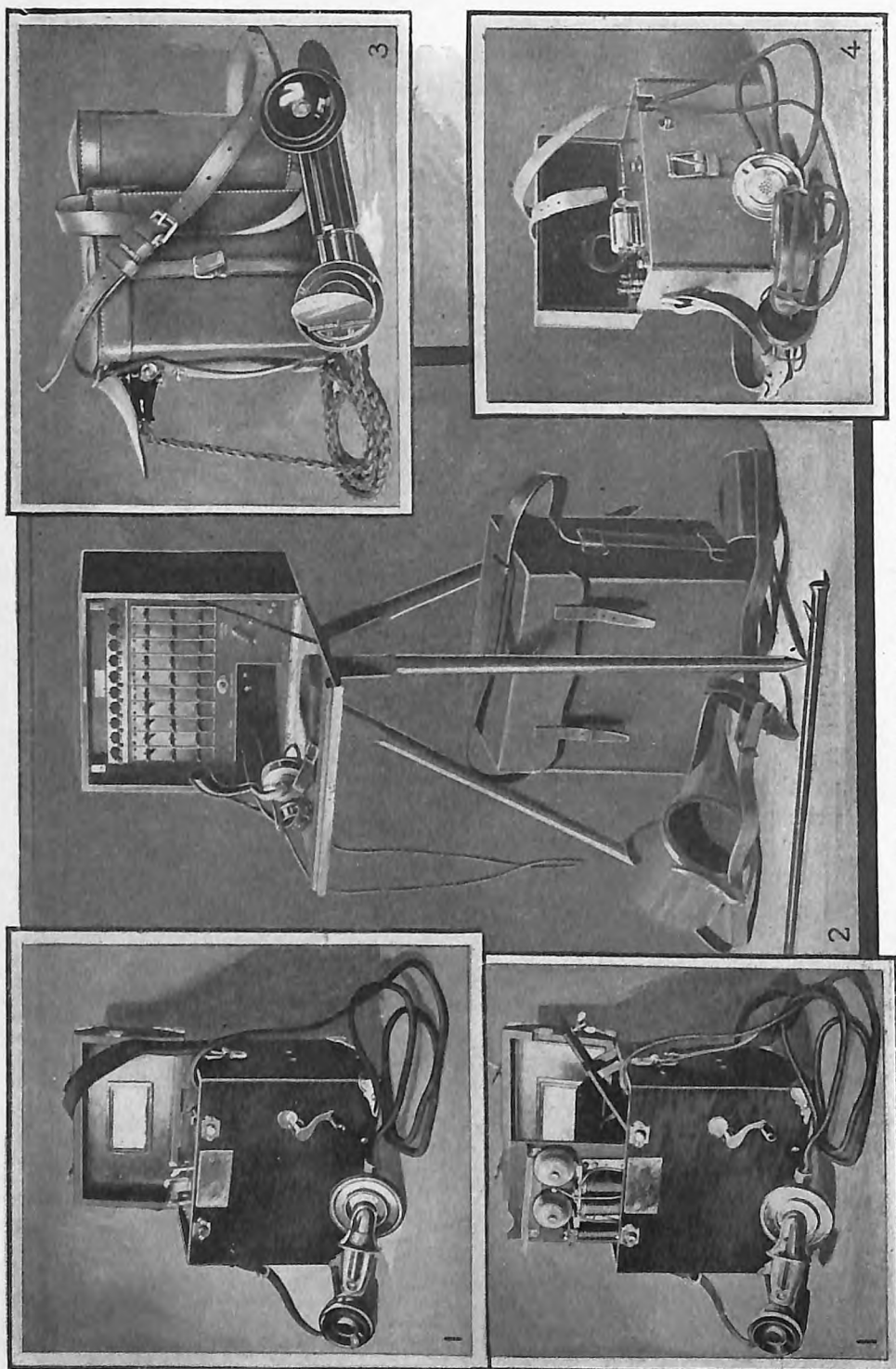


FIG. 14.—SIGNAL SERVICE TELEPHONE EQUIPMENT.

troops must construct field lines of information which are so reliable and certain in action as to inspire and insure the complete confidence of the mobile army which is to depend upon them. The equipment must also be so mobile as to provide a field telegraph station by the side of the commander wherever he may be required to go in the exercise of his duties."*

"This means that for tactical lines, as defined above, we must abandon the present lance trucks and use a pliable, well-insulated wire of great tensile strength, paid out directly on the ground."

Although the writer is by no means disposed to advocate the discarding in the field of the heavier equipment of the strategic lines, he agrees thoroughly with the idea that in the transmission of information, during operations in the presence of an enemy, the main reliance will be placed upon the insulated wire and the buzzer; these are of first importance. But to return to the broad subject of military methods of transmitting information, these may be classified as: first, ELECTRICAL.—The wire telegraph; the wire telephone; the wireless telegraph; the wireless telephone. Second, VISUAL AND SOUND.—The flag; heliograph; semaphore; International code; the Ardois; search-lights, acetylene (and other) lanterns; the torch; fires; rockets, bombs and other pyrotechnics; balloons or kites, by illumination or with other signals; sound signals.

PERSONAL.—Mounted or dismounted messengers; cyclists; automobilists; possibly aeronauts.

MISCELLANEOUS.—Carrier pigeons; dogs; chronosemic signals.

Of these four groups it may be said that the first is by far the most important, but that its use implies the aid of many of the methods of the second and third groups.

The wire telegraph and telephone are the main reliance of an army; the wireless telegraph promises well, and the possibilities of wireless telephony are recognized but not proven.

Although the visual groups cannot be considered as primary,

*The practical conclusion reached is fortified by analogy.

"Professor Morse originally elevated his wires on poles because commercial insulated wire had not been then invented, and because he used for the operation of his instruments a low-potential battery.

"From an engineering standpoint, this problem of delivering at the extremity of a transmission line, of any length required in war, the minute fraction of a horse-power of electrical energy necessary to operate the present field-buzzer is not difficult. In fact, hundreds of horse-power are transmitted daily in the operation of electric street railways by insulated trolley wires placed even beneath the surface of the earth. A few years ago these trolley wires were also elevated on poles. It is simply a matter of relative insulation and potential."

yet visual signaling, both day and night, is so important that it can never be safely omitted. The very increase in value of electrical signaling adds to the importance of the visual since the latter is often the only substitute in case of failure.* Visual apparatus, therefore, must always be supplied at signal stations to supplement the electrical communications. In addition, visual signaling is (in the absence of the wireless) often the only means of communication available or possible with invested positions, across impassable stretches of country, or over the heads of the enemy. The objections to visual signaling in general are slowness, shortness of range and dependence on atmospheric conditions; but its value, especially between the smaller units of command, is of growing rather than of diminishing importance, and it is believed that there exists too great a tendency to neglect it.

The third and fourth classes of methods of transmitting information will be considered in their place, but the attention of the reader is invited to a brief survey of the material and instruments used by the signal corps of the army at the present time. The more important of the instruments are, of course, those employed in electrical and visual signaling, and these vary from the light field telephone and buzzer carried by a mounted man in service with the cavalry, advanced infantry, or forward with the firing line, to the ponderous special equipment of the fire control and the intelligence communications of the sea-coast defenses in all their many forms—cables of a dozen types, heavy dynamos, visual apparatus from the wig-wag to the Ardois, and in addition many types of the wireless telegraph, both field and station.

In the field a small and rapidly moving command, with pack transport, carries, of course, only light electrical apparatus, and such visual appliances as may be serviceable. The heliograph, flags, smoke rockets for use by day, the acetylene lantern and sequence rockets by night, and the instruments, staffs and batteries of the field wireless telegraph. But when a corps or an army are mobilized the lines of information require an amount of heavy material and equipment that needs for transportation a number of wagons, lance trucks and signal carts; and probably in addition balloon trains and field dynamos for use with search-lights and wireless, the whole composing a little army of itself. Of all this material it is intended here merely to note the most important, stopping for a moment by the way to remark that as

*See page 16, the note of Gen. Sir Ian Hamilton.

a primary duty of signalmen is with the mobile army, and as they are called upon to accompany troops of all arms and to move as rapidly as do any; when held in readiness for service with mobile troops the men of the corps are equipped as cavalry and in the field are usually mounted. As to weapons, the chief reliance is the pistol; but the new rifle is provided for use in exposed situations. The saber is omitted, but its place supplied sometimes in the tropics by a heavy knife or machete.*

Let us now turn briefly to a consideration of the instruments in use in the United States service for the transmission of information by wire; for these instruments the writer has no hesitation in claiming the highest degree of merit. Some, but by no means all, have been designed, or improved, by officers of the signal corps of the army; others have been adopted or adapted from civil life; one, the cavalry buzzer, came originally from Sweden, but is now manufactured in this country; all, it is believed, are the best for their purpose that have thus far been devised.

First to be considered are the instruments used with the wire telegraph, as this has the widest range of certainty and usefulness and as its instruments are the simplest of the electrical appliances employed in the field.

The Military Telegraph and Induction Kit.—As everyone knows, the ordinary telegraph apparatus is composed of three essential parts, namely, the key, the relay and the sounder, found in every telegraph office. In the field these instruments are, on occasion, modified to suit service conditions; as, for instance, the substitution of a main line sounder to obviate the need of a local battery, for the ordinary instrument. Besides this certain details of manufacture are changed in order that the service instruments may better meet the requirements of hard usage in all climates. It happens, also, that these simple instruments are supplemented when necessary by more complex adjuncts, such as repeaters for long distance work, duplex instruments, and many complicated machines which need no description here, and in fact are

*The arms and equipments of master signal electricians and first-class sergeants are: 1 non-commissioned officer's sword, 1 revolver and holster, 1 revolver cartridge belt, 1 canteen, 1 set blanket roll straps, 1 shelter tent pole, 1 waist belt, garrison, service, 1 cartridge box, 1 first-aid packet, 1 haversack (with field-kit), 1 shelter tent, half, 5 shelter tent pins.

For sergeants, corporals and privates: 1 rifle, caliber .30, 1 gun sling, 1 pair rifle cartridge belt suspenders, 1 revolver cartridge box and lanyard, 1 canteen, 2 spurs and straps, 1 shelter tent pole, 1 revolver and holster, 1 rifle cartridge belt, 1 first-aid packet, 1 cartridge box, 1 haversack (with field-kit), 1 set blanket roll straps, 1 rifle scabbard, 1 shelter tent half, 5 shelter tent pins.

used only under settled conditions. These instruments are installed with some form of battery, usually the ordinary gravity cell, storage battery or dynamo current; but not with the dry cell (except for a short time in emergencies), since these cells are quickly exhausted on the closed circuits usually employed in this country; the open circuit key is, however, coming into use to some extent with the dry cell. It may be said, in passing, that in the army the American Morse code is used, whereas all the other great nations and their armies employ the continental code,



FIG. 15.—VISUAL STATION.
(United States Signal School, Fort Wood.)

which, by convention, we also are compelled to use with the wireless telegraph.*

This fact imposes upon the signalmen of the army familiarity with three codes, the last two mentioned for telegraphic service and the wig-wag code for visual signaling. However, in emergency any officer or enlisted man familiar with the useful wig-wag only may communicate by the telegraph key and be understood by a skilled reader at the other end of the line, who will soon perceive the meaning of the dots.

In connection with the simple telegraph apparatus noted, it

*Agreement of the Berlin Conference. The multiplication of signal codes is a serious question that needs consideration.

may be well to mention here a new signal corps instrument that will probably prove useful in the hands of highly skilled men in the field. This is called the

Field Induction Telegraph Kit.—It is made up of an oak case containing a very delicate polarized relay, an open circuit key, a sounder, a switch and a proportional induction coil. The battery circuit is local and the relay is actuated by impulses sent out over the line from the secondary of the induction coil. This instrument can be carried over the shoulder; it was tried in recent maneuvers, and a few are now with the army in Cuba.

*Tests that have been made with this set indicate that with three dry cells for main battery, as provided in the case of the instrument, signals can be sent through about fifty thousand ohms dead resistance, and that the set will work with certainty through about thirty-five thousand ohms. Through a resistance equivalent to one hundred miles of No. 9 G. I. wire (2000 ohms), the set has been made to work through a distributed leak of about ninety-five per cent. The above conditions are nearly limiting ones, and quite careful adjustment of the relay tongue is required. It must be set with a small play, and care should be taken that it falls with equal ease to either back or front contact when no current is sent.

These induction telegraph sets would therefore appear to be useful in working field lines, and may be considered as an intermediate type of instrument between the establishment of the line as a permanent one and the discontinuance of the use of the buzzer. The above-named qualities appear to fit it particularly well for use over lines which must occasionally be worked over bad leaks or high resistance.

The Military Telephone.—Of this it is said that it is† “the basic instrument of all short distance systems of communication”; but until the Spanish-American War it had not been used extensively and its military value was considered doubtful. With that war, however, the necessity for a type of telephone for the general military service became apparent, and certain signal corps instruments were evolved. The special telephones and kindred instruments used in the military service are of two classes. First, those intended for the use of the troops in general, in garrison, in camp and in the field. Second, those intended for permanent positions such as the coast defenses. With both, of

*Signal Corps Bulletin No. 8, March, 1908.

†Manual No. 8, United States Signal Corps.

course, commercial instruments are employed when useful,* but of these no further mention need be made beyond noting the fact that they are not suited to service in war, since in general they are not safely portable and, so far as known to the writer, none are sufficiently strong for field use.

The first of the military telephones to be considered is the *Service Telephone*.—This is a bridging instrument with magneto box that has the induction coil fastened in the top and a transmitter of the solid arm type fastened on the bottom. Two cells of dry battery are screwed into the lower half of the box; the latter, when closed, serves as its own case for transportation by wagon or pack; the transmitter being removable and held by a clip within the case, no protuberances remain and the instrument has the form of a strong rectangular wooden box. When opened it may be suspended from a tent pole or tree.

A lighter and more portable instrument, fitted with a strap for the shoulder for field use, is the

Field Telephone.—The kit of this instrument is contained in a strong wooden box, holding the magneto, call bell, combined receiver and transmitter and dry battery. The magneto handle (or call), when in use, passes through a hole in the side of the box and screws on to the driving axle; when not in use the handle is slipped into a wooden block in the top of the box. The transmitter and receiver are connected by a hollow handle of aluminum that forms no part of the circuit.† This is a very useful instrument and can be carried anywhere in the field, since it weighs only about twenty-two pounds with battery. It is readily seen that a man provided with this telephone at the outposts, or at some well chosen observation station may communicate information gathered by himself and others without betraying his position as a visual signaller must do—a most important consideration in modern warfare, since the signaller may betray to the enemy much more than his own position. In addition to the two types of telephones mentioned, two other instruments are provided for special use, these are the:

*This is an important consideration, since, in the event of war, thousands of instruments must be obtained from private manufacturers for the use of the army, and all must be made in the short preparatory period preceding the actual outbreak of hostilities. Indeed, they will be used previous to this at the formation of the first camp of instruction.

†In the illustration these are shown at a and b on the front of the box.

Cut-In Telephone.—This is an instrument designed for operation over short distances on telegraph lines and may at times be useful in the field in the hands of a skilled man. It weighs, with battery, ten pounds and thirteen ounces.

A new telephone designed for base-line work of the light artillery has just been devised. It is called the

Field-Artillery Telephone.—This instrument is intended for use by the field-artillery in communicating over base lines. It consists of a transmitter with a battery key, induction coil and battery, and head telephone with flexible bands. It is not a calling instrument. The various parts are mounted in a fiber case contained in one of leather, and is intended to be carried on the side or back when not in use and to be thrown to the front and employed as a breast transmitter in action.‡

As has been said, in addition to the telephones of military type above mentioned, there are used in permanent garrisons and camps telephones of the ordinary wall and desk types, which need no description.

Switchboards.—In connection with both telegraph and telephone two kinds of switchboards are used, the first of ordinary type, the second of somewhat special design. The field telephone switchboard is an important instrument, as it makes practicable the extended systems of lines of information demanded by troops.

For posts and permanent camps there is provided an ordinary magneto switchboard with usual cords, cams and drops, which is in the form of a cabinet. It may be supplied with an equipment of one hundred lines, but is too delicate and heavy for field use.

The coast artillery posts are now being equipped with common battery switchboards and telephones in accordance with the latest commercial practices. Other telephone switchboards are still used, but they are of past types. The switchboards above mentioned as being employed in the military service are

*The adaptation of this instrument to military purposes is due to Major Edgar Russel, Signal Corps, U. S. Army, whose name it usually bears.

‡During the past year the Chief Signal Officer of the Army has co-operated with the Chief of Artillery in determining upon a suitable equipment for visual and electrical communications for use of field-batteries, battalions and regiments.

In accordance with the recommendation of the Chief of Artillery, and following in general the plan outlined by the Field-Artillery Board at Fort Riley, Kans., a series of equipments in chests for battery, battalion and regiment have been issued, comprising in the electrical equipment field-buzzers, which are used as telephones, with the necessary accessory material. Two kinds of wire are issued for the flying lines which are used, the first being a fine insulated buzzer wire on half-mile spools, which can be paid out and taken up by means of a hand-reel. The other wire is very strong insulated wire, weighing about seventy pounds per mile. This equipment has proven satisfactory. (Annual Report of the Chief Signal Officer of the Army for the fiscal year 1907.)

merely adaptations of those commonly used in civil work, with the exception of this:

Field Telephone Switchboard.—It is intended for use in camp and consists of a strong oak box with leather carrying case and ground rod; the box contains ten line drops with the necessary ringing, listening and connecting cams to enable four sets of connections to be established simultaneously. The operator is provided with breast set and single head receiver. This switchboard is readily installed in a tent and is capable of being set up and providing the necessary ground for protectors and ground lines under any condition of field service. The board is supported upon a tripod, which is of ash, and is provided with a carrying sling.

There remains, however, one instrument whose use is probably only military. It is called the *Buzzer*.—This instrument plays so important a part in the transmission of military intelligence that something more than a mere mention seems desirable. The reason for this importance is that it frequently is the only instrument capable of working over hastily constructed military lines, the insulation of which is often imperfect. Indeed, the importance of the buzzer in field operations has grown so great and become so well recognized in modern field operations as to lead a well-known officer of the Leavenworth School to remark recently to the writer, both wittily and truly:

The most important enlisted man in the forty-mile fighting line of to-day is not the man behind the gun, but the man behind the buzzer; because upon the integrity of his service may rest the movements of the grand divisions of the army, involving thousands of officers and men, and the success of a campaign.

The principles upon which the buzzer operates depend upon the comparatively high voltage developed at the terminals of an electromagnet when the battery current through it is suddenly interrupted, and upon the sensitiveness of the telephone as a receiving instrument for feeble momentary currents, especially when they are of the sharply accentuated character produced in the manner just described. An automatic make and break vibrator gives a buzzing* sound in the telephone receiver, which, by short or long contacts of the key, produces the dot or dash of the Morse alphabet. This buzzing sound gives the instrument its name.

*Quoted from Signal Corps Manual No. 3. Most of the above remarks regarding instruments are taken from this and other manuals, which contain rather full descriptions of the instruments now issued.

The first prominent mention of the use of the buzzer in military telegraphy is that by Major Cardew, R. E., in 1881. Its utility in working through a poorly insulated line where the ordinary Morse was impracticable was mentioned in the account of the expedition of the English up the Nile in the attempt to relieve Gordon at Khartoum in 1884. Some use of it was made also in the French Army; but it remained for Colonel (now General) James Allen, Chief Signal Officer of the Army, to so perfect this instrument in form and manner of working as to make it an indispensable adjunct to an army operating in the field.

The buzzer, undoubtedly, is the most valuable of all the instruments employed for communicating intelligence in the field, and the American army in the Philippines and China made a most extensive and continuous use of it as a means of maintaining communication between the army and its base and as an habitual means of telegraphing over hastily constructed lines where the insulation was too imperfect for Morse working.

An instance may be mentioned.* In General Lawton's advance through central Luzon in November, 1899, communication was almost continuously maintained by this means for a week between Cabanatuan and the head of navigation on the Rio Grande, and San Jose, thirty miles north. About ten miles of this was imperfectly insulated line and twenty was bare wire of various kinds laid on the earth, trees and bushes. During part of the time heavy rain prevailed, and flooded rivers would have prevented messengers from going back. In spite of these apparently prohibitive conditions, the buzzer continued to operate. Of course it was very faint and the utmost attention and complete quiet were required. Such proofs of its utility under trying conditions show plainly its rôle in military telegraphy for field lines and other temporary connections.

Two kinds of buzzers are now used in the United States service; they are, first,

The Field Buzzer.—This instrument is mounted in a wooden case covered with leather; it weighs, with battery, eleven pounds and five ounces, and is easily carried by a mounted man by a sling over the shoulder.

It consists of a rubber plate, upon which is mounted an enclosed iron shell buzzer with a telegraph key and a small con-

*Quoted from Signal Corps Manual No. 3. Probably the experience of Major Russel.

denser and coil for absorbing the spark. In addition to the telegraph part, the buzzer is provided with an approximately waterproof telephone transmitter with a push-button key. When a buzzer line is in good condition fairly satisfactory results can be obtained with the telephone. When the telephone ceases to be effective the buzzer line will, in nearly all cases, be found workable. Normally, five cells of battery are used with the buzzer. Second.

The Cavalry Buzzer.—This valuable instrument is originally of Swedish design, but is now manufactured in this country. It is contained in a fiber case covered by leather, and is intended for use with the mounted service. It is very compact in form and in principle is similar to the field buzzer. The speaking part, which consists of a collapsible micro-telephone with a switch in the handle, is carried in a circular leather pouch attached to the buzzer case. The telegraph key of this buzzer is built like a push-button and is capable of being worked through the leather case. A flap is also provided for the connection of the micro-telephone with its jack on the buzzer.

The instrument weighs, with battery, five pounds and twelve ounces, and requires but two cells of dry battery, which are contained in a single case. It is capable of being used both on its own line and on a line employing the telegraph. It is a most valuable instrument of very recent design and probably destined to have an extended use.*

Such, briefly, are the instruments employed by the army in the electrical transmission of information by wire in the field. A full description is given in the various manuals. With the instruments thus briefly described are used three kinds of telegraph or telephone lines: FIRST.—*Permanent Lines*, which, as the name implies, are employed to connect camps or permanent positions with the telegraph or telephone systems of the country or with the base, and to replace field or temporary lines as the army advances. These systems will ordinarily extend to the rear of the army and will be constructed and maintained by the "base line troops," in whose charge, of course, most of the heavier signal material will be placed. They are in general strategic, rather than tactical lines; and are constructed with wooden or iron poles, glass insulators, and bear a galvanized iron wire, number nine or fourteen size. The speed

*The type "D" and type "E" kits and old styles of buzzers may still be seen in use, but they are obsolete and but few remain in service.

with which these lines can be built depends, of course, upon the number of men and transportation available. Frequently in a wooded country with tree insulators they are run with considerable rapidity, but the maintenance of tree lines is difficult and costly. SECOND. *Semi-permanent Lines.*—These are of more hasty construction, the ordinary iron or copper wire, being carried on temporary supports or on light poles of cypress, red fir or similar wood, thirteen feet and eleven inches in length and two inches in diameter at butt; into it is screwed a pigtail insulator made of a composition of mica and shellac, which carries the wire suspended from a hook or pigtail. The wire is usually number fourteen, though, of course, a lighter copper wire may be employed. In China the modern lance was replaced by bamboo which, capped by a pony insulator, served admirably. Lance lines accompany troops on the march, and with well-trained signalmen and ample transportation may arrive each night at the camp of the troops. The lances are carried by a special truck and the wire is unreel from a cart, or a hand reel carried by two men; batteries, instruments and office supplies are carried by another cart or wagon, which may be used as a field station. These lance lines, though strategical rather than tactical, are among the most useful of the communications; they are raised above injury from passing troops; are sufficiently permanent to remain standing for months with a little care, unless destroyed by storms, and they follow the field lines of insulated (or sometimes bare) wire used for rapid movements in the field and for shifting commands. THIRD. *Field Lines.*—These are the most important of the lines of information, and it is probably due to the introduction of some form of the field wire and the buzzer that modern lines owe their importance. The buzzer and field wire were unknown in the Civil War, and though the military telegraph was used, the wires were necessarily raised on lances and the ponderous lance trucks and wire wagons of those days added to the transportation of the army. Nevertheless, magnificent work was done, but the telegraph lines then were in general strategical rather than tactical, and the tactical lines were chiefly visual.

Field lines are of two classes known as field wire lines and buzzer wire lines. As has been said, heavy transportation of the signal corps, such as the lance trucks and the wire wagons, remain in the service and have their use, but this is no longer found on the theater of operations in contact with the enemy,

with mounted commands, in reconnaissance, in connecting momentarily changing positions, or, in short, in establishing those systems of information by which alone the commanding general can control the units of his army. These have by modern fire been caused to extend perhaps over fifty miles of front. It is not too much to say that power of individual control over this widely deployed army is due to the modern field wire and the buzzer. Field lines, therefore, are tactical lines.

The best field wire now authorized for use by the signal corps is an eleven strand wire, later described. It is very flexible and enormously strong, two qualities which give the power to follow marching troops or the changing movements of a commanding general; and to provide certainty of communication, since the danger of interruption is small. The wire, thrown upon the ground, lies close to the earth and is not liable to injury from passing troops; in addition, its strength is so great that there is small risk of interruption to lines of information.* The most approved way of transporting and laying this field wire is with the new type of wire cart.† Field wire may be laid at a trot or gallop from wire carts with large reels which hold about eight miles of wire and which are drawn by two mules. These carts can be used in automatically reeling up the wire if circumstances permit of its recovery. In laying the wire, a mounted man rides behind the cart. The man is equipped with a light wooden lance on the end of which is a special hook. By means of this lance the wire is picked up and thrown out of the road from under the feet of passing troops and vehicles.

Field wire will ordinarily be used on tactical lines, but in special cases, when lines must be laid very rapidly, or when they must be laid on ground over which two-wheeled carts cannot well be taken, buzzer wire is used.

The field wire is made up of ten steel and one copper wires, weighs eighty pounds to the mile and costs about seventy-five dollars. The breaking strain of this is two hundred and fifty pounds and the conductor resistance about one hundred and ten ohms per mile.

As is seen this wire is expensive, but of course no question of expense should limit its use in time of actual need, but

*A most valuable and essential quality from the larger point of view of security for the lines of information; but a source of annoyance and danger to mounted commands and transport when the wire does not hug the ground closely or is not buried.

†Photograph.

when used under ordinary field conditions and to the extent of, perhaps, fifty or more miles per day, the questions of cost, transport and supply become vital—in war it is by no means certain that the necessary quantities can be obtained. Hence, this wire must be recovered when practicable, but recovery is a slow and tiresome proceeding in the field, and when no emergency exists, this cable must be replaced by a lighter and less costly line.

The buzzer wire is built up of two very fine steel wires surrounding a core of copper, the whole insulated by a cotton wrapper. It weighs four pounds and a quarter to a reel of one-half mile (not including the weight of the reel or spool) and in diameter is about the size of the lead of an ordinary pencil. It is a most excellent cable and can be laid upon the ground in rain and heavy dew and even through water; it is wound on a spool ordinarily mounted on a breast reel fastened to a mounted man and uncoiled as he advances. This is done at so considerable a rate of speed that the wire can readily follow the usual movements of the cavalry or field-artillery.* It costs only about ten dollars per mile, and consequently may at need be abandoned without great pecuniary loss, and as it is very strong, it is reasonably secure against interruption.

In addition to the two special cables described, there will frequently be used—when certainty of communication is not

*A very interesting paper appeared in the July number of the *Journal of the U. S. Cavalry Association* in which the writer, First Lieut. A. C. Knowles, Thirteenth Infantry, describes a method of using the cavalry buzzer and breast reel from a horse. Lieutenant Knowles says, in part:

"Heretofore, when a mounted operator, so equipped, wished to communicate with the base station from which he was sent out, it was necessary for him to dismount and establish his own station by connecting his buzzer to wire which he was reeling out and to complete the circuit by driving a metallic pin into the ground.

"By the method described by Lieutenant Knowles, if used it appears when a mounted operator is sent out from a column for the purpose of accompanying a reconnoitering patrol, a flanking detachment, or any body of troops whose duty will take them far enough from the column to make electrical communication both practical and desirable, constant electrical connection may be had with him. It is no longer necessary for him to dismount and cut in his instrument. He may be called at any time, even while moving. He is ready to transmit messages to base whenever necessary, and he doesn't have to stop to do it. The commanding officer of the body to which the operator is attached may move alongside of his moving telegraph office and receive the message word by word as the operator receives it; or he may dictate his own message to the base in a similar manner. Should he desire to communicate by telephone, the operator hands him the combined receiver and transmitter, and without dismounting he may talk with the base.

"The only way to accomplish what is described above was to ground through the horse. This is done by placing a small piece of copper (properly connected to the instrument) against the animal's body, and as the horse always has one or more feet on the ground while moving at any gait, except possibly the gallop, which would seldom be resorted to, it is seen that the ground connection is completed through one or more hoofs. Of the several horses used in these experiments, only a few showed any dis-

absolutely vital, or in unfrequented localities where interruption is not probable—a still cheaper wire; this is a bare strand of copper about number twenty in size. Its weight is greater than that of the buzzer wire, but as its cost is only about two and one half dollars per mile it is not worth the trouble of recovering unless needed elsewhere. Small wires have the disadvantage of being nearly invisible on the ground, and are lines difficult to find and repair or to avoid. In regard to field lines it should be noted that the ingenuity of the signaller is frequently called into play. A tree, a convenient fence-post or building may be made to answer for a lance, the neck of a bottle or an old cup may be used as an insulator, and the wire of a fence may save many a mile of construction.

In establishing wire communication existing telegraph lines will, of course, be used when possible. Creeks and small rivers will be crossed, when no bridge is near to carry the wire, by suspending it from convenient trees or from lances spliced together. When too wide for this a light river cable may be employed, armored for use in rapid currents over stones. The field wire and even the buzzer wire may be made to answer for a time. With all field lines the telegraph, telephone and buzzer are used.

A very good illustration of the character of hastily constructed field lines was afforded during the China campaign. Of these it has been said.* The field line constructed by the signal corps in China during the Boxer troubles extended from Taku at the mouth of the Pei-Ho (North River) to Peking, about 120 miles distant. The first section of this line, from Taku to Tien Tsin, a distance of nearly thirty miles, was built of various sizes and kinds of wire, from nine iron to twenty-two copper, and was supported by the poles of the old railroad telegraph, which had escaped confiscation and burning when the road was destroyed, and by pieces of board, bushes, anything, in fact, that would keep the wire from the ground. Where a stretch of insulated wire was to be had it was left on the ground. The line thus constructed was worked by buzzers.

comfiture, and those that were affected by the current were soon quieted. They appeared to exhibit surprise, rather than pain at something unusual, to which they quickly became accustomed.

"These tests were made over all kinds of ground—very wet, muddy, moist, perfectly dry and dusty roads and fields, with results of practical value.

"With two mounted operators similarly equipped, and separated by five miles of wire, conversation was carried on without difficulty, the horses standing in grass. The buzzer was loud enough to be heard several feet from the instrument."

*By Mr. Hastings, of the Signal Corps, then a lieutenant of volunteers, with the writer in China.

From Tien Tsin a similar line was continued to Peking, but the latter section, about ninety miles, was constructed of material not quite so diversified as the other, as more complete supplies had been received, which made it practicable to construct a better field line.

The allied forces left Tien Tsin August 4th on the march to Peking. An effort was made to bring the telegraph into camp each night. This required hard continuous labor from early morning until late at night; but each evening, until held back by want of material (at Matao, some sixty miles from Tien Tsin), the click of the telegraph instrument, unless interrupted, soon after camp was established announced that the signal corps had done its work.*

As soon as possible after the legations had been relieved (August 14, 1900) efforts were made to erect a lance line in place of the field cable and other wire first used. This construction, however, was not completed, owing to lack of material; but wherever practicable the lance line was erected and the field cable recovered. Much assistance in the building of this line was found in the use of fir poles from small villages along the trail. Constant patrolling was necessary to keep the line intact, owing to the great amount of traffic and passage of columns of troops. Often the wire was deliberately cut by troops (not our own) who found it in their way, and occasionally it was stolen. In putting up the lance poles efforts were made to straighten the line, to shorten the route and to avoid angles and sharp turns, but owing to the nature of the country it was often impracticable to run a straight line for any great distance. This second line, partly taking the place of the field cable, was in use for, perhaps, a month, until poles, wires and insulators were collected for the erection of a permanent line. In building this line it was intended that it should be strong enough to withstand the winds and storms of the winter in North China. After its completion the permanent line required little repair during the period from October to May, when the American troops left China.

These three methods of providing and maintaining lines of communication, although constructed and kept in repair under great difficulty, owing to shortage of men and material, illustrate the work of the signalmen in the field as far as the telegraph and telephone are concerned.

*Under charge of Lieutenant (now Captain) Stamford, Signal Corps.

It was desired

First.—To maintain communication between the base and the moving column, having the lines available for messages each evening.

Second.—To replace the field cable as soon as practicable with a lance line, which might be kept in operation for weeks, if necessary, by careful patrolling and repair, and could be recovered quickly when no longer needed.

Third.—It was intended to erect a line that would stand for several years, in other words, a permanent line, should the occupation of the district for an indefinite period be contemplated.

TRANSPORTATION.

The transportation used by the signal corps for construction in the field is both wheel and pack. Special types of wagons and carts are authorized, and one or two new types are now being tried. First of these meriting a word of description is the

Instrument Wagon.—This is a special spring vehicle intended for the transport of instruments and general technical supplies in the field. It is drawn by four animals. The gears,* axles, brakes, seat and general construction conform to those of the army ambulance. The body consists of a box without upper panel and top; there is a seat immediately in rear of the driver's and seats at the sides provided with wings. A canvas cover may be used. Like all army transportation of the present time it is painted an olive drab color and has on a panel at each side the insignia of the signal corps in black, white and red.

Lance Truck.—This vehicle, as its name implies, is designed for the transport of lances for field lines. It is drawn by six animals, and although conforming nearly to the specifications of the army escort wagon in its running gear, the gears are longer and raised, so that in turning, the front wheels cut under. The body is thirteen and one-half feet long, three feet four inches wide and four feet high. There is a tool box at the sides eight feet long, six inches wide and eight to twelve inches high, which carries digging bars, tools and insulators; a driver's box at the front and three rings on each side provided with ropes to bind the load.

Wire Wagon.—The old type of wire wagon will be replaced by some form of reel cart, one type of which (experimental) is

*Signal Corps specifications.

an adaptation of the fire hose cart, but its value has not yet been tested in field work. It should prove excellent over rough country and bad roads. Another experimental wire wagon is of the pintle type. This wagon consists of a reel truck and limber, the former of standard type; the first is designed to carry two reels of field wire, the second one. When in use the limber and truck are attached.

A third type of vehicle for use chiefly with the field cable is the new cart. The form shown* is experimental and will be modified, but it is probable that this type will be adopted permanently. It is designed to carry, pay out and pick up eleven strand field wire on spools. This cart will hold fourteen spools of wire. The wheels are the same as, and interchangeable with, the wheels of the quartermaster standard army ambulance. The winding-up device is thrown out or in gear by a foot lever.

For pack transportation there are used chests which resemble an ordinary trunk, very strongly braced and fitted with lock and clamps. These chests are of leatheroid and are about thirty inches long, nineteen broad and fifteen high.

It may not be out of place here to invite attention to the importance of special transportation for the signal corps of the army. Not only are wagons of special design more convenient and conducive to the saving of time and expense, but they even make possible lines which could not otherwise be erected. They have a far greater value in that they cannot readily be used for other purposes than that for which they are built and on expeditions where transportation is lacking are not so readily subject to seizure by a person in power, who has very likely failed at the proper time to provide transportation in sufficient quantity for other purposes and later in the field seizes everything available, leaving the signal officer to get on as best he may with nothing except what can be commandeered or hired from the natives, and this in spite of the fact that the signal officer may have used all possible foresight in providing the transportation needed for his work. This has happened within the experience of the writer, and similar incidents have occurred not unfrequently in recent years. Of course it is natural for a commanding general to supply transport first for his ammunition, his rations and probably for his medical supplies, but after that should come the service of the lines of information. With special transport the signal officer is measurably free from the loss of such important ve-

*Frontispiece, Part II.

hicles as wire carts, lance trucks and instrument wagons, since they would be of little value (except perhaps the last) for other purposes than those for which they are intended, and once provided should remain under control of the signal troops. The signal corps should have its own transportation.

As has been said, modern ideas are tending toward simplicity in field-line construction and much of the older and more cumbersome material and transportation are passing from use in the actual theater of operations to the base line troops. Experience is proving that to the essentials of speed and certainty flexibility must be added. As a consequence field trials at Leavenworth have suggested a tactical field wire train of a capacity of sixty miles of wire. This train is composed of four sections of fifteen miles each, one day's march of a division.

Each section consists of but one wire wagon, with equipment for four buzzer stations complete; total capacity of train, sixteen buzzer stations. Personnel of each section, twelve men. Of these all are mounted but two, who ride on the wagon. Total personnel of train, fifty men; each individual, although permanently assigned to a section and having certain definite duties and responsibilities therein, is trained to fill any position in his section.

The above field wire equipment is supplemented by a buzzer wire and visual equipment for each section, for use when required with lines subsidiary to the main lines, that may be easily paid out or reeled up by a mounted man at a trot.*

Mounted field buzzer squads are organized as follows:

Five mounted men, equipped with special hand pikes on pack mules, carrying two standard squad boxes, each containing one heliograph complete, one flag kit, one signal lantern, two cavalry buzzers and a supply of wire in half-mile coils; each of these squads is equipped to follow the cavalry screen or light artillery at a trot and establish field lines joining with and subsidiary to the main field lines laid by the field wire train above described.

"From a military standpoint the immense advantage to be gained in dispensing with the material and personnel for pole construction of whatever sort must be apparent. In fact, the commanding officer unconsciously pictures to himself, when considering field lines, the comparatively complicated equipment

*By Major George O. Squier, Signal Corps. The above was published in the report of the commandant of the Infantry and Cavalry School, Signal School and Staff College for the year ending August 31, 1906, a copy of which was very kindly furnished the writer by Major Squier, and is in part reproduced here.

which was used in the Civil War and known as the 'flying field telegraph train.' When he learns that one single, substantial field wire wagon, which automatically pays out and reels up a strong, insulated steel wire at any gait up to a fast trot, and which is operated by a personnel every man of whom is mounted either on a horse or on a wagon, and which furnished him with reliable telegraphic or telephonic communications wherever he wished to go with his command, he will positively demand this service for all of his field operations.

"He learns that his field wire is automatically maintained without specific orders, on the same principle that a railroad is maintained by the use of section bosses. He learns that the wire trailing behind his command is placed in a concealed position by mounted men, equipped with light pikes for this work, who also keep up with his command. In fact, he learns that the enemy's raiding cavalry attempting to cut his lines no longer finds them conspicuously on poles inviting destruction."

"The field equipment of a company of signal troops recognized at Fort Leavenworth is as follows:

COMBAT TRANSPORTATION.

Automatic field wire wagons, pintle type.
Automatic wire wagons, tandem type.
Instrument wagons.
Standard pack chests and standard squad chests (for pack transportation).
Lance trucks and supply wagons.

WIRE.

Field wire, 11 and 19 strand.
Buzzer wire, five pounds per one-half mile (partially insulated; varnish finish).

INSTRUMENTS.

Field buzzer, latest type.
Cavalry buzzer.
Field telephone.

VISUAL SIGNALING LIST.

"To properly handle this wire for tactical lines of information every man must be mounted, either on a horse or on a wagon. At the present moment, from the best information obtainable from all sources, it is considered that about seventy-five per centum of the men should be mounted on horses.

"The mounted sections of each field company for tactical lines of information lay, recover and patrol the wire mounted. The mounted signalman must be an expert horseman; the horse must

be specially trained and this is no less important than in the cavalry arm.* The wire is handled almost exclusively by a short hand pike, fitted with a special hook at the end and carried in a small boot in the right stirrup with the hand. These pikes are about six and one-half feet long, provided with a good grip at the end and with an arm sling, used when at increased gaits. The facility with which this field wire can be handled and recovered is hard to be realized until seen in the hands of expert men. Experience has proven that at least six months of the hardest kind of labor are necessary to train signalmen for this special field service, even after they are fully instructed in the duties of the soldier, horsemanship, etc. These men are armed simply with the revolver; arms are provided for their use when employed on strategic work."

VISUAL SIGNALING.

It is the intention here in connection with this important branch of the subject to merely outline the methods of visual signaling in use by the army and to describe briefly the instruments employed.†

In visual, perhaps even more than in electrical signaling, a reasonable familiarity with instruments and their capabilities is essential to those who depend upon them for the transmission of intelligence, therefore, the following very sensible remarks are quoted.‡

The limitations under which all visual signaling must be conducted should be well understood. Because a signaler may be given a message of hundreds of words to transmit to a station five or six miles distant, the sending of which visually will consume an hour or more, the system should not be held worthless because of the failure of the responsible officer to understand that the message could be delivered at its destination by a mounted orderly in less than half the time required to send it by the flag, heliograph or lantern. Quite as bad judgment would be shown by sending a mounted courier over a like distance with a message of ten words that a flagman could send to its destination in the time needed to saddle and bridle the orderly's horse. The correct and economical use of visual signaling is pre-eminently one of good judgment, and the efficient signal officer will always use the means available for the most expeditious delivery of information or messages, the transmission of which he is charged.

*An intelligent horse properly trained for this work takes as keen an interest in following the field wire as a good polo pony does in following the ball.

†For a full discussion of the subject, reference is suggested to the Manual of Visual Signaling, U. S. Signal Corps, 1905, by Capt. D. J. Carr, Signal Corps.

‡From the excellent introduction by Captain Carr.

Flags.—In visual signaling, as now understood in the army, the Myer or wig-wig code is used, and the simplest means of communication is with the flag. Signal flags are of two sizes, viz., two feet square and three feet nine inches square. The smaller flags are white with red center, the larger white with red center and red with white center.* The four by four flag can be read with the average field-glass at a distance of six or seven miles. The maximum rate of sending with this flag is about four words per minute, and with the two-foot flag seven or eight per minute, but much depends upon wind and distance. The flags are carried in signal kits each containing two flags and two staffs, three joints each.

The Heliograph.—The next most commonly used instrument for visual signaling by day is the heliograph. The form employed in the United States service consists of two (or one) mirrors mounted on a tripod, and a shutter and key mounted on a second tripod to prevent the vibration of the key from displacing the flash, which remains fixed on the object. This system differs from that used abroad in that with the latter the mirror itself moves and throws its flash on and off the observing station. The range for the heliograph, depending upon position as well as atmosphere, is varied, but it has been used in the southwestern part of the United States a distance of one hundred and eighty-six miles. In ordinary climate and under favorable conditions the heliograph can be well used over a distance of thirty or forty miles; its rate of transmission may be taken as from eight to twelve words per minute. The advantages of the heliograph for visual signaling are its portability, range and comparative rapidity. In reading long messages the eyes are subject to considerable strain, which is somewhat relieved by smoked or colored spectacles. At night or on dark days the heliograph may be used for short distances with artificial light, but experiments in this direction have not, so far as known, been extensively carried on in this country, though in Germany a powerful instrument for use with artificial light by night and sun by day has been devised.

The Lantern.—Next in importance to the heliograph comes the acetylene lantern, which is perhaps the best field night-light yet devised; it is small and easily carried by pack. It consists of a signal lantern with a cartridge generator. The lamp is furnished

*The old black flag with a white center has been done away with. The six-foot flag is no longer issued.

with a special aplanatic lens mirror, five inches in diameter and about three inches focus. The lamp is fitted with a telegraph key and so arranged that when the key is up the flame is almost extinguished, but by depressing the key the gas is turned on full, making a flash. The lamp may be used with the heliograph tripod or by hand; the generator either attached to the lamp or suspended from the tripod. When used as hand lantern, the flame is turned on full by depressing the key and locking with the latch above the key, which keeps the key open. One charge will burn about an hour with the light turned on full, or for approximately three hours while signaling. The range under favorable conditions, and with field-glasses, is about fifteen miles.

The new high power, or station lantern, which replaces the old station type,* has one burner which consumes three-fourths cubic foot of gas per hour and uses the same generator and carbide cartridge as the field lantern. It is the same in construction as the field lantern with the exception that it is fitted with an aplanatic lens mirror eight inches in diameter instead of five. The body of the lamp is larger than the field type. Its range is from thirty to forty miles, but its efficiency is reduced by brilliant moonlight, especially when the moon is low, and also by shore or range lights. Indeed, the writer has seen the acetylene lantern rendered almost useless by the fires of fishing boats, very numerous at times, on the coasts of certain islands of the Philippines. The rate of transmission by field lantern is about the same as that of the heliograph, but the lantern has the great advantage over the heliograph that it may almost always be used by night whereas the heliograph is often useless by day.

A common lantern or torch may, of course, be used for signaling at need, but the useful old turpentine torch, with its foot torch as reference and the flying torch waved as a signal, is now unfortunately obsolete in the regular service, though still employed to some extent by the organized militia.

The Ardois.—A system of signaling of value, especially at coast fortifications where power plants exist, is the Ardois. This consists essentially of a keyboard provided with a dial, on which are recorded letters and other characters with their corresponding signals in combination of red and white colors. Across this dial moves an operating handle, which carries the signal to the mast head or staff. The remaining parts of the apparatus are the electrical cables running to the keyboard, the cable that supports

*The old station type described in Manual No. 6 is still in use, but to be replaced.

the lights and the lamps, of which there are four. These are covered one-half with red, the other with white glass, and have an electric bulb in each part so that either a red or a white light is shown by a proper movement of the key. In this way a hoist of alternating red and white lights, indicating the Myer signals, is displayed.

Though of considerable value when installed and susceptible of operation by any one who can read the alphabet, the Ardois is complicated, mechanically and electrically, and very expensive. Its range, too, is limited, and in foggy or rainy weather its lights have very little penetrating power.

The Search-Light.—Another light, and one of great power, which finds its principal use at sea or on the coast, though it may prove of importance in the field, is the search-light. This is of great potential value and its range is enormous; it is used by the navy as a flashlight and signals are made with the Myer code, a short flash indicating one, two short flashes in quick succession two, and a long steady flash three.* But the search-light may be used as a wig-wag signal to the right, left and front. Search-lights in the field are, theoretically, of considerable importance, but the writer has seen no trial of their practical use or value. When needed they are not at hand.

The Semaphore.—An old but still excellent system of signaling, especially between ships and shore, coast artillery stations, at permanent camps or invested positions, is by semaphore. Semaphores are innumerable in design, but one of the best for permanent use is made with three arms attached to an upright and having an all-around motion in a vertical plane.† Above is a disk or governing sign and below a fixed horizontal arm called an indicator; reading dials may be attached if wanted. With this semaphore the International code may be used. A similar semaphore is employed in both the British and French navies, in the latter for communicating between shore stations and passing ships; but no doubt the wireless will eventually replace this service. In addition there is used in European countries a simple method of semaphoring with hand flags; by change of position the flags, one in each hand, are made to indicate the letters of

*This is at variance with the instructions issued to the army in which signals with flag, torch, hand lantern, or beam of search-light are described as made with the flag, that is, to the right or left of the sender. It is evident that either method can be used and readily understood.

†A description is given in the "International Code Dictionary."

the alphabet. Probably the speed of transmission is greater, when used by experts, than our own wig-wag, but the range is less.

A most curious semaphore was observed by the writer in Panay during the Philippine insurrection. It consisted merely of a tree high upon a mountain top, trimmed to resemble a flag streaming in the wind; but it, no doubt, carried some message many miles over land and sea, though the meaning of the message was never known. Often, to construct a semaphore, only a few planks or a few saplings are necessary, and to these, for night use, lanterns may be attached, forming a useful system of signals. It is said that a semaphore arm six feet long may suffice for stations six miles apart, though it may be well to add a little to this. Signaling by semaphore is, of course, slow.

The International Code.—The most important of fixed signals, however, is the International code. This consists of twenty-six flags—one for each letter of the alphabet—and a code pennant. All are used in connection with a dictionary. There is no occasion to describe this method of signaling here; but it should be familiar to the army, and the flags and dictionary provided at every coast station.

Fixed distance signals, useful in coast communication, are given in the code dictionary; they are made by combinations of certain forms, a ball, a cylinder and a cone. A little consideration will show the value of this code, since it gives, in addition to its primary use, what is probably the best system of semaphore signaling in existence. When the simplicity and use of the semaphore are understood, its value in communicating over short distances between island posts and the main shore, isolated garrisons separated by obstacles and under similar conditions must be recognized.

Bombs, Rockets and Lights.—Signaling with bombs and rockets may at times have great importance; usually they are employed in connection with a preconcerted code, or simply used to call attention, give an alarm, or indicate the location of the sender, as, for instance, a picket or outpost. They are valuable in seacoast defense, where they are readily observed. Their use in conveying long messages is small on account of the number required; nevertheless, with the sequence rockets and combinations of colors in connection with a preconcerted code, extended information or instructions may be conveyed. Rockets for signaling are of two general classes, smoke rockets for day use, and

for night use light, sound and sequence rockets.* It should be remembered in reading rockets, as in reading Ardois, or indeed any color signal, that the sequence of the colors in the national flag (that is, red, white and blue) is taken, red reading one, white two and blue, if shown, three.

The light and sound rocket is used to indicate a position or give a preconcerted signal; it explodes with a loud report and emits a shower of white sparks. The smoke rocket is employed as a day signal usually by arrangement; on bursting it throws out a heavy cloud of yellow-brown smoke. It may be well used to mark the movements of a column, or locate an outpost or signal station. Rockets on dark nights may be seen and read for five or six miles if no fog exists; the range of smoke rockets, however, is probably considerably less than this, in fact, unless watched for, this signal frequently passes unnoticed.

Bombs are pasteboard shells, charged with stars and fitted with a fuse. Generally they are fired from cast-iron pipes called mortars and attain an altitude of some five hundred feet. There are two reports, one at discharge, the other at the bursting of the shell; these serve to call attention to the signal. They are used in day and night signaling.

In connection with night signaling it may be well here to mention the Very† system, found serviceable in seacoast signaling to announce the arrival of a scout boat or beginning of an action. The system employs red and green stars, which are shot from a large caliber pistol of special construction. It may be used in connection with the navy signal book. In addition there are the Coston signals, which are slow burning lights, showing red, white and green, and are sometimes valuable. They may be used either with the International code or wig-wag; a red light indicating one, a white light two.

Signaling by balloon or kite may sometimes be of practical value. A small captive balloon or kite, such as that used for the wireless, and carrying a light wire, may very well show a light like that used with the Ardois. So, too, the portable mast of the field or station wireless, by attaching an electric bulb, may be made to show the dots and dashes of the Morse code or the one, two, three of the wig-wag; and possibly a search-light thrown on a captive balloon may give a signal that could be read at long distances.

*All are fully described in the "Manual of Visual Signaling."

†Invented by former Lieutenant Very of the navy.

In addition to the methods that have been mentioned there are, of course, innumerable other means of transmitting information by visual signals, but most of these are unnecessary to mention; a dense white smoke made with dampened hay or straw or with rotten wood by day, and by night a fire screened intermittently are examples. To this class belong the Cossack signals of the Russians, heretofore noticed.

Personal Lines of Information.—Of the third group, which comprises what is called the personal method of conveying information in the field, little need here be said. It appears that in certain services, notably the British and Russian, the mounted and dismounted orderly is included in this service, but the system is open to the objections pointed out in the remarks previously quoted in this article. In the United States service the mistake of providing a special corps of orderlies for field messenger service is not made. When needed, orderlies and messengers are used, of course, by the signal corps, just as they may be used by all officers, but the men are detailed when available and merely used for the delivery of messages from near-by stations.

The question of using automobiles and bicycles, however, presents a somewhat different phase from that of the orderly, since thus far no special corps of this class has been organized to be weakened by detachments detailed with the signal corps, and it is not probable that such special organizations will be provided. Both motor-cars and bicycles will, in service, form a part of the equipment of the signal corps, as they will of the quartermaster department, the medical department, the engineers, or any other arm to which they may be useful. Consequently, both motor-car and bicycle men must be trained for the service of the lines of information. The numbers of men and machines assigned to signal units will depend upon the character of the country and the service required of them.

Like the last class of special men and special appliances which may be used in the service of information, balloons, and particularly dirigible balloons are, as yet, very uncertain factors in warfare, but their importance is rapidly increasing and from France, Germany and England considerable activity is reported.* The signal corps is taking great interest in the subject; three "heavier than air" machines are now being made by contract. It seems not improbable that already the air-ship must be counted as

*See appendix.

a factor in warfare, and that at no very distant day some form of aeroplane will make good. Even at present such advance has been made in telephotography that the value of the dirigible and captive balloon in reconnaissance and observation service promises to be very great in the future if properly employed.*

Miscellaneous Communications.—The fourth group, or miscellaneous methods of communication, has little practical value in general, although at times and under unusual conditions some may prove useful if at hand. As a rule, however, they are not available when wanted. What, for instance, would be the use of training dogs or maintaining flocks of homing pigeons for service no one knows where or when? Under this class has been included, however, one system which may have a practical value to the soldier; that is the chronosemic or time interval signal; the most common and best understood of which is, of course, the minute gun. Chronosemic signals may be used under conditions where it would not be practicable to employ other methods, as, for instance, where it is possible only to raise a flag or disk over an embankment, sun flash from a hand mirror, or by using bombs and rockets.

Sound Signals.—Of sound signals little need be said; their value is obvious, and their use, under the more common forms, is constant. They are of more importance to seamen, however, than to soldiers, but a system of signaling by the blast of a horn or whistle and the sound of the bell or bugle is recognized by the general service code.

General.—There is no occasion here to describe such special systems of signals as those used for storm warnings, time signals, or of the life-saving service, for special codes are numberless. But it seems advisable in conclusion to endeavor to emphasize the importance to all soldiers of some knowledge of visual signaling. It was used with great advantage during the Civil War, but in recent years has been, if not positively neglected, at least laid aside for the more satisfactory methods of electricity. The importance of visual signaling, however, is again increasing; improvements in the instruments for its service and the growth in the importance of all lines of information require that visual methods must be given their full value and place in warfare.

*It is stated by the press that the French War Office has decided to create a balloon corps of twenty airships, to be attached to various military fortresses. Furthermore, that a considerable number of officers and men are to be trained for this work.

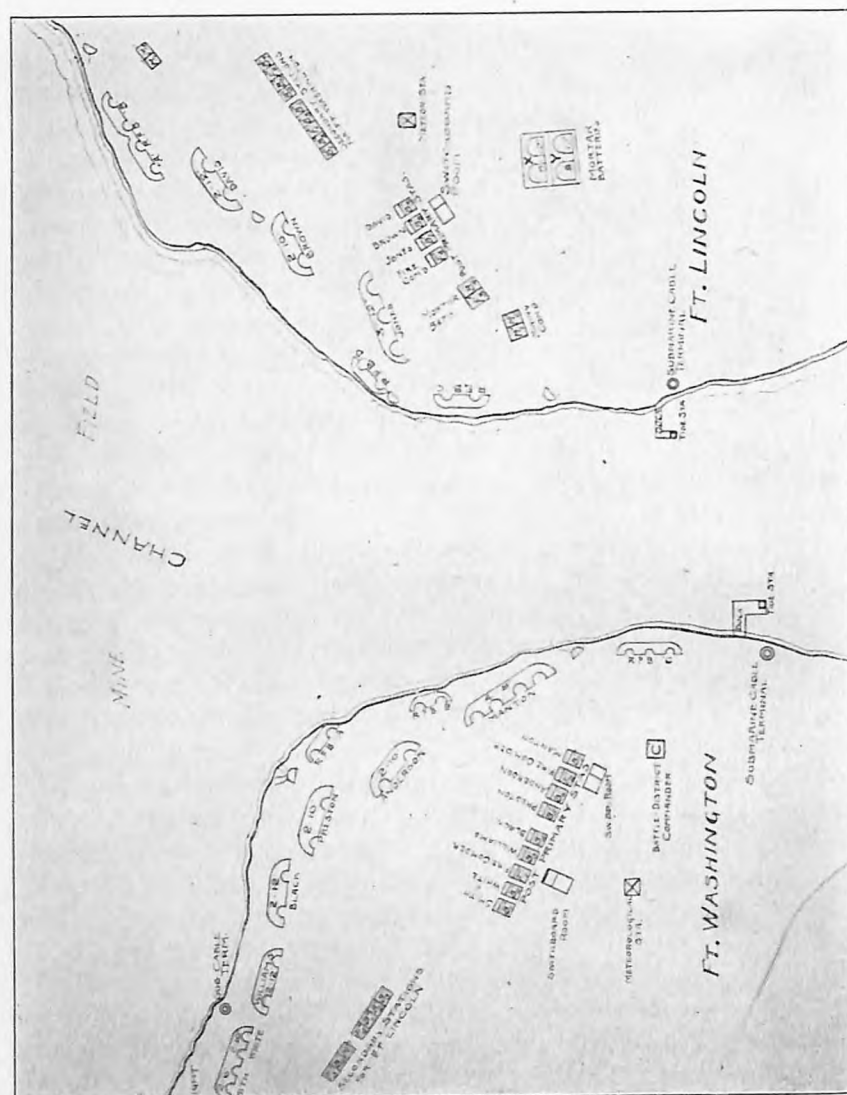


FIG. 16.—IDEAL PORT AND HARBOR.
(Showing defenses, observation stations and lines of communication.)

PART IV.

THE SIGNAL CORPS AND THE COAST DEFENSE.

THE MOBILE ARMY OF COAST DEFENSE; THE COAST PATROL.

THE RELATION OF THE SIGNAL CORPS TO THE COAST ARTILLERY.

In the following outline of the duties of a signal corps in coast defense, duties which are made possible chiefly by modern lines of military information, much attention is given to the land defense by mobile troops and to the coast patrol. These subjects are interesting in themselves and new in their present aspects, and a comprehensive survey of them is at least helpful, if not necessary, in estimating the scope and value of systems of intelligence communication in coast defense.

The United States, unlike others of the great nations of the world, has never established, and may never need to establish, permanent fortifications on the land frontiers, since the real frontiers are the seas. But even without the obligation of defense against neighbors to the north and south, the vast extent of the coast imposes upon the country a duty which can but grow greater as population and wealth advance and as the speed and fighting powers of navies increase. Size of ships, the turbine and new types of motors are bringing alien shores yearly into more intimate relations and are making sea attack more easy, more swift and, perhaps, more probable, while the weight of floating batteries, the number, capacity and speed of merchant vessels and their great transporting power, swarms of rapid and dependable auxiliaries, and, possibly, the dirigible airship, leave all but strongly and permanently protected coasts without the hope of adequate defense in war, except by a navy whose duty at the outset may call it into distant seas. Indeed, the probability of the absence of the navy at the very moment when coast defense becomes most necessary is so strong as to amount to a certainty with a powerful and aggressive fleet; a fact that is well pointed out in a passage of the President's last message to Congress. In this he says:

Parrying never yet won a fight. It can only be won by hard hitting, and an aggressive sea-going navy alone can do this hard hitting of the offensive type. But the forts and the like are necessary so that the

navy may be foot loose. In time of war there is sure to be demand, under pressure of fright, for the ships to be scattered so as to defend all kinds of ports. Under penalty of terrible disaster this demand must be refused. The ships must be kept together and their objective made the enemies' fleet. If fortifications are sufficiently strong no modern navy will venture to attack them so long as the foe has in existence a hostile navy of anything like the same size or efficiency. But unless there exists such a navy, then the fortifications are powerless by themselves to secure the victory.

The plea is here primarily for the navy, but it stands as well for efficient coast defenses, and since the key-stone of the defense is the fixed artillery position, it will be well for the country to remember that these and their accessories require in the building as long, perhaps a longer time, than the battle-ship itself. It follows that dispositions for the national defense cannot be delayed until hostilities begin, or even until the cloud of war no bigger than a man's hand appears upon the horizon. The plans must have been perfected long ere this, the fixed defenses completed and the lines of information made ready. All this must be done during the leisure of peace, and the work must cover all zones of danger, since no man knows where the blow will fall. If the work of general defense is stupendous—as it must be in order to be effective—this fact is but one more, and the most cogent, of all reasons for its timely undertaking.

It is not, however, the object of this paper to enter upon a full discussion of the great question of national coast defense—which must be left to abler writers—but rather, it is the purpose to consider it in such detail only as may serve to point out its relation to the nerves of the system, that is, to the lines of signal communication or the lines of information. A general survey of the field seems necessary before the value of these lines and of the work of the signal corps of the army in connection with the defense can be estimated and understood.

Regarding the defense of the seaboard of the United States, it appears clear in retrospect that the inertia which for years followed the close of the Civil War and prevented the making by the nation of any serious effort to protect the country from foreign attack began to give away, a quarter of a century ago, to the demand for an efficient navy. The growth of the navy in turn emphasized the need of protected harbors and of permanent defenses, and as the fortifications required soldiers to man them, attention was directed more and more strongly to the personnel of the defense. Finally the coast artillery was given a working, if still skeleton, organization, an efficient armament and satis-

factory equipment were added, systems of fire control and direction were devised and at least partial lines of information installed. There remained to be organized, however, two important factors of the defense, namely, the coast patrol, which, as will be later seen, has been systematically taken up by the navy, and second, the vast and important factor of defense by the mobile army.

For convenience in considering what follows, it is assumed that in war the coast defense, which **"Combines the military and naval dispositions and operations necessary to resist a naval attack on any part of the coast line"*† may be divided into five factors, each related to the other in operation and all dependent upon co-ordination of action for the full assessment of their value. These are, first, the fixed and floating defenses of the artillery, consisting of the armaments, submarine defenses and material, coast defense and scout ships, torpedo, submarine, patrol and picket boats; the personnel, including all troops assigned to duty in connection with the fixed defenses.

Second, the general defense troops of the Regular or Volunteer Army, or of the organized militia, not including the supports of fixed positions. Third, the coast patrol. Fourth, the lines of information. Fifth, the navy, placed last as having little to do with the subject of this paper.

Although each of these factors supplements the others, it is evident that the one which binds them all into a working whole, and without which the other four will have rather less cohesion and connection than so many reeds shaken by the wind, is that of the lines of information.

To arrive at a proper understanding, however, of the extent and character of the lines of information necessary to keep in brain touch the elements of the defense of a great seaboard like our own, it will be well to first outline the general scope of the defense and to indicate the part that will be played by the other factors in war so far as the writer may be able to do so. The first of the factors of defense to be considered is that of the fortified positions.

*Drill regulations for coast artillery (provisional).

†The writer submits the following plan and estimates with diffidence, for he has not seen those of the General Staff, and what follows merely gives what is believed to be a probable plan of defense and estimate of numbers based on the admitted requirements of a position of the first class.

THE FORTIFIED POSITIONS.

It may be said, in general terms, that the permanent defense of a coast consists in the adequate protection of a number of distinct positions which from their importance to the country or value to the enemy must be guarded against injury, occupation or capture. Such positions are either actually or potentially guarded permanently by a number of fixed defenses, the fighting or tactical units of which constitute a chain of command whose units are the artillery district; the battle command, the fire command and the battery. The artillery defense, as a whole, is thus made up of a series of tactical areas or districts, each measurably complete and independent in itself, but separated usually by considerable distances from the others, and the whole kept in touch by lines of information, which form a chain encircling the country.

On the coasts of the United States there are seventy-eight separate forts where modern defenses are installed or are in process of installation. These forts, or artillery posts, usually comprise several batteries; and when the defenses are completed, in accordance with adopted plans, the number of officers required to serve them will be one thousand nine hundred and eighty-five, and of men forty-seven thousand seven hundred and nine* for one relief alone, a personnel of, approximately, fifty-thousand troops, merely to man the fixed defenses and work the guns, without allowance for relief or absentees. It is evident, therefore, that in the event of a serious war the fixed defenses alone will require a force of artillerymen considerably greater than the total strength of the Regular Army as now authorized by law.

The positions referred to are grouped, on the Atlantic seaboard, into the artillery districts of Portland, Portsmouth, Boston, Narragansett, New London, Eastern New York, Southern New York, Delaware, Baltimore, Potomac, Chesapeake, Cape Fear River, Charleston and Savannah; on the Gulf into those of Key West, Tampa, Pensacola, Mobile, New Orleans and Galveston; and on the Pacific Coast into those of San Diego, San Francisco, Columbia and Puget Sound. Twenty-four in all, without taking account of future requirements of the Philippine and Hawaiian Islands or other territory of the United States. It is evident that, for purposes of control as well as of defense,

*See "Proposed Distribution of Coast Artillery," &c. Government Printing Office, 1907, September.

these districts must be kept in communication not only with great centers of population and with the capital, but with each other, and that under certain probable conditions of war the chain of defense from Portland (Maine) to Galveston, from San Diego to Puget Sound, or even from Quoddy Head to the Straits of Fuca, must be kept in constant and immediate touch by telegraph.

But before entering upon consideration of the lines of information necessary to keep in correspondence the strategic and tactical positions of this vast extent of seaboard, it becomes advisable first to consider the second factor of coast defense, which may be called

THE MOBILE ARMY OF COAST DEFENSE; OR GENERAL DEFENSE TROOPS.

It is probably evident that the most necessary factor of the land defense of the coast, after the artillery, is the mobile army, and it will be unnecessary here to insist upon its importance, since without it there can be no real and substantial protection, except at those positions which have been selected beforehand for fortification. But even if the fixed defenses could stand alone, which, of course, they cannot do, they will of necessity form but a partial and interrupted protection to any extended seaboard and leave open to attack many important towns and serviceable harbors that may be used by an enemy as a base or as coaling and supply stations. It is obvious, moreover, that a country offering to attack some five thousand seven hundred miles of coast line,* indented with innumerable minor harbors and anchorages and dotted with important towns that invite destruction, cannot protect all its vulnerable points by costly and extensive armaments and as a consequence that the minor positions must be otherwise defended or left to shift for themselves. While the navy remains within reasonable distance of the coast these minor positions will be free from danger, but, as has been said, a navy, if efficient, will not remain at home; and it follows that in a serious war protection for the less important positions must fall to the care of such of the floating defenses as may be withheld from dis-

*The Atlantic seaboard from Quoddy Head, Me., to Cape Florida is 2043 statute miles; the Gulf coast from Cape Florida to the Rio Grande is 1852 miles; the Pacific coast line from the Mexican Boundary to the Straits of Fuca is 1810 miles. But if we include the indentations of the coast to the head of tide water the lengths are, for the Atlantic coast, 36,607 statute miles; for the Gulf coast, 19,293 miles. The figures for the Pacific coast are not at hand, but for Alaska they are 26,376 miles.

tant seas and to the troops of the mobile army, aided by such batteries as can be hastily constructed and armed. Such partial defenses may not prevent attack and local injury, but they can, at least, prevent destruction and an occupation that may provide the enemy with a naval base and perhaps threaten invasion of the country at large.

The need of a mobile army in coast defense is not, however, confined to the protection of the lesser positions and harbors unprovided with effective fortifications and armament, for it is to be remembered that coast fortifications of to-day, unlike the permanent works of an earlier time, look only toward the sea, and of themselves are helpless against land attack; hence they must be protected at flank and rear from approach by hostile troops and landing parties.* Indeed, it is perhaps not too much to say that in these days any coast attack, beyond a mere demonstration or bombardment, the damage from which is usually overrated, will not be made by ships alone. The lessons of recent wars tend to show that naval attack only, though it may cause considerable damage, can produce but little effect upon the ultimate result of a war, unless combined with land operations, by means of which the defense can be overwhelmed and the objective destroyed or occupied, together with the surrounding regions.† It appears, then, that in war the country must be prepared to prevent the seizure and occupation of any one of many important points, both fortified and unfortified, of our long seaboard. This implies the existence of a large mobile force so placed as to insure on the one hand the safety of exposed positions by proper dispositions of troops immediately needed, and on the other by concentration of the major part of the mobile troops in reserve at strategic positions of the coast or possibly of the other frontiers.

*An officer of the Austrian general staff in an article translated for the JOURNAL OF THE MILITARY SERVICE INSTITUTION and printed in July, 1907, remarks regarding our coast defense: "Fortifications are to be found in the vicinity of the larger cities or good harbors, but these provide for a bombardment seaward. Should a hostile fleet once obtain a landing of troops at an unprotected point, and such points are numerous along the extensive coast line, the coast fortifications could be easily attacked from the rear, and would, in a short time, be at the mercy of the enemy. Any war-vessels seeking the protection of these fortifications would doubtless also be lost. * * *

"Even though the Pacific coast line is, to a large extent, composed of high, steep cliffs, rendering a landing impossible, there are many unprotected harbors; for instance, Gray Harbor, Monterey Bay and Port Harford. To repel an invasion of an army at such points a numerous land force would be needed."

†In this connection the remarks of Capt. Clint C. Hearn in an article on "Fire Control and Direction for Coast Artillery," published by the Department of Signal Engineering, United States Signal School, Fort Leavenworth, 1907, are well worth attention.

In the defense by a mobile army the plan adopted may well be somewhat as follows: The Atlantic, the Gulf and the Pacific seaboard will be divided into defensive areas that may here be called defensive zones, the extent and boundaries of which will depend upon strategic, geographical and economic conditions. These zones will not, as a rule, be coextensive with military departments, since they depend upon different conditions and lie mainly along the sea; nor will they be under the orders of department commanders, but will be controlled by their own general officers, acting presumably under one chief. In each zone there will be organized in war a mobile force adequate not only for zone defense proper—that is, for land defense of fixed positions, unprotected harbors and other vulnerable points within the zone itself—but for service with other troops who, upon the certainty of hostilities, will be mobilized and held as a general reserve. Within defensive zones there will be placed before the outbreak of war a sufficient number of men of the Regular Army and of the organized militia to form a nucleus of the force that will be required.

It should be evident that of this force the men most needed in the preliminary work of the defense will not be coast artillerymen alone, but engineers, and especially signal troops, since the first step in mobilization will be the establishment of lines of information.

No doubt the men of the organized militia, especially those mobilized in seacoast states, will, when needed, be partially trained as regards the defense of fixed position, since it is probable that in the future, as during the past year, the organized militia will have taken part annually in exercises and maneuvers of the coast artillery. Moreover, the militia, under the new law, will be able to take the field as United States troops within a few days after being called out by the President for service during the nine months authorized by law, and will be ready at once for service on the coast. It is, therefore, believed that if the peace training of the militia is to fit it for coast-defense work in its several forms; this training should be widened in scope to embrace not only the lines of information, but to include the duties of signal troops in campaign, in the collection and transmission of intelligence by all of the many methods that are employed by the signal corps in the field.

It is certain that if so trained the small quotas of state troops, since they will be among the first sent into the field, will be of the

utmost value to the defense at a time when the lines of information will be urgently needed in the organization, disposition and control of newly organized levies. The state troops, now become national troops, together with the signalmen of the Regular Army, will undertake the organization of additional signal troops from the volunteers.

It is not probable, however, that the total force of militia thus mobilized for national defense will exceed the authorized strength of the Regular Army; and the two combined will doubtless constitute a force far too small for ultimate defense in a serious war. It follows that recourse will be had, as always in this country, to the volunteers, who will then be drawn not merely from the threatened states within defense zones, but from the almost inexhaustible supply of men of the interior states, which have no frontier to defend. If a great struggle threatens and it becomes necessary to put forth the strength of the country by calling to the colors the larger part of the mighty reserve available for national defense, it is certain that the total number of men of the ultimate levy will be so enormous that occasion for mobilization of the whole can hardly arise. But be this as it may, it is evident at least that, though the *levé en masse* need never be resorted to in this country, the force that will be called to the national defense in a great war will be no small thing, and the work of turning it into an efficient army and of supplying it with an adequate force of technical troops properly equipped for the field will require the best efforts of every trained man of the service. *It is, however, impracticable to calculate beforehand and until the probable magnitude of the war is known, the number of men who will be needed for national defense, but the following estimate is suggested in the event of a war of the first magnitude in which two powerful maritime powers combine to attack the country on both the Atlantic and Pacific seaboard; or to so threaten the coasts as to compel an adequate force of general defense troops to be called to the colors on the seaboard of both oceans.*

In making this estimate it is assumed that for the protection by land of a single strategic position of the first class—needless to say which one—it is presumed that an army corps composed of three divisions will be necessary; that is, a force of some forty-five thousand or fifty thousand effectives of all arms of the service. Probably but two, or less, of these three divisions will be tied to the defense of the position proper, and the remainder

held as a reserve for the protection of any threatened part of the coast or other frontier.

Turning now to the military conditions that surround the twenty-four artillery districts into which the seaboard is divided, it appears that the number of these that will be considered positions of the first class and require the support of the large force indicated above, and the number of those in subordinate classes that need a smaller force for their land defense will readily be seen. Without entering, however, into a detailed calculation of the strength of the force necessary for any particular one, it will suffice to say that the fourteen districts of the Atlantic coast will, in the opinion of the writer, require an *average* of twenty thousand mobile troops for security against an enemy, ten thousand of whom may be regarded as zone troops and supports of the fixed positions of the district proper, and ten thousand as a reserve of the mobile army and to be concentrated at such place either within or without the zone as may be best suited strategically to the defense of any threatened part of the frontiers, either land or water. By this it is not meant that twenty thousand men will be actually mobilized in every zone for each artillery district within the zone, but merely that this number be considered the normal allotment of general defense troops, for mobilization and use where necessary. This average is less than half the force that will be called to the colors in a defense zone which embraces a position of the first class, and if it is a criterion of the number of men needed, means that the mobile army of the Atlantic seaboard should have a strength of some two hundred and eighty thousand men. Similarly, that the Gulf coast, with its six artillery districts, should be expected to send to the colors at least one hundred thousand men—probably more than will ever be necessary for this coast alone, but giving to both the Atlantic and Gulf a maximum of three hundred and eighty thousand men of the mobile defense, which is not thought to be excessive. Similarly, the Pacific coast with its four districts would supply by averages about eighty thousand troops, a force far too small in such a war as has been supposed, and which, considering the remoteness of the Pacific from the great centers of population, the non-existence of the Panama Canal for several years to come, and the difficulty of transporting troops and war material across the continent, should be increased to at least two hundred thousand men to secure the safety of the shores of the western ocean.

In making this estimate it is, of course, understood that there are several districts, such as Savannah, Key West and Galveston, which on account of the terrain will need little or no immediate mobile defense; but, on the other hand, there are many important positions requiring protection that are not included within artillery districts; Cape Cod and the lower Delaware Bay as examples, and it is thought that for both zone and reserve defense the estimate is moderate. In addition, not one but several localities will require the full number of men allotted to positions of the first class.

If the above estimates are approximately correct it appears that in a great foreign war the United States will be forced to mobilize some five to six hundred thousand men for the general defense, half of whom will be massed along the coasts at such positions as may be best suited for concentration and protection, and the remainder held within the zones;* but this total is the maximum of probable war requirement, for it is hardly conceivable that any considerable additional force will be necessary within the country itself; and if a mobile army is needed on either the northern or southern land frontier, it may be secured by a proper disposition of the general defense troops thus mobilized. Although the full strength estimated may be never called out, if a great war should come, in which the United States (on land) is forced to serious defense, it is believed that a force of at least five hundred thousand men, in addition to one hundred thousand regular troops, must be mobilized.†

It is needless to say that of this total force the Regular Army and the organized militia can form but a small part; and that the militia organizations within the threatened zones cannot be expected to supply more than one artillery relief, supports of fixed positions and perhaps the first or emergency line of the zone defense. But if the enlisted force of the coast artillery is increased to reasonable strength it may be that the regular troops and the militia called to the colors will be all

*It seems that these defense zones of the Atlantic coast will require, roughly speaking, 50,000 men each; two will need 30,000, and from the Chesapeake south 60,000 at least should be estimated. A total of 270,000 for the Atlantic. On the Gulf, east of the Mississippi, probably 30,000 will suffice, and west of that river 20,000 men, a total of 50,000 for the Gulf. On the Pacific, for the reasons stated here, not less than 200,000 should be estimated for defense. A total of 520,000 men in all, sufficiently near the estimate above reached.

†In this estimate the needs of the country alone are considered, no account is taken of the necessities of the foreign possessions.

that are necessary for the protection of the country at the outbreak of war, and possibly for some time thereafter; perhaps even until the end of the struggle, should our fleets be successful, for it must be remembered that but a small part of the mobile troops will be actively required until the fleets are swept from the seas; unless, indeed, the navy is allowed to become so weak in ships that a division on two oceans becomes impracticable. In that event, if threatened by allied fleets on both the eastern and western coasts, the weight of the resources of the country will be demanded, though the full strength of men for the general defense will not even then be called to the colors. At present the coast artillery is given a strength only about one-third sufficient for one relief at the guns; the effective of that part of the organized militia of coast States, trained in artillery work, is only sufficient to bring the artillery men to the strength of one relief; and as to the signal troops, those of the army are so overburdened with their present work that it is hopeless to expect them to perform successfully new duties, and those of the organized militia are too few and ill-supplied to form an efficient reserve. It seems that the true interests of the country require that these conditions be changed.

To return now to the army corps mobilized for the defense of a position of the first class. This, it has been assumed, will be made up of three divisions: the first of these divisions, and perhaps the second, will be composed of the organized militia of the state or states of the zone requiring defense; and in those states in which the organized militia is numerous and efficient, it is believed that the first two divisions can be easily and quickly mobilized;* but the third division will require more effort and much longer time for its organization since it will be composed mainly, if not entirely of volunteers. A considerable period, however, may be very well conceded to this work, since the first two divisions, if capable of taking the field immediately, will be ample for early needs; and when mobilized will be assigned to the zone defense proper, and not required to move far from base or rendezvous. It is evident that these divisions will require ample strength in engineer and signal troops, field and horse-artillery, and a due proportion of cavalry to erect and defend the field-works on the land fronts of fixed positions, to establish and maintain lines of information, to check sudden

*Within twenty-four hours, it has been estimated. A high authority has placed mobilization at forty-eight hours.

attempts at coast landing, and to perform the duties of mounted troops in the field.

There can be little doubt, however, that the general levies will at first be weak in these very arms, since they are of necessity almost non-existent with the organized militia of many of the states in ordinary times; and, therefore, that the main reliance will be upon the infantry of the organized militia. These, too, in the early days of a struggle will be weak in transport, staff, quartermaster, ordnance and commissary departments, and lack the assistance of technical troops, a condition that will hamper the defense, give to the zone troops little mobility, and compel them to remain tied to their base or semipermanent camps. But this condition will doubtless be corrected as time goes on, though its existence at first will multiply the lines of information and the duties of signal troops. It is certain, therefore, that the communications by which both zone troops and reserves will be linked together and to the artillery should from the first efforts at concentration be ample and effective and so continue, for without them the whole army of the defense will become a mere aggregation of inert units.

As has been said, a large proportion of the mobile troops of the coast defense, probably more than half of the total, will be formed into reserves and held at concentration camps or at positions strategically important, ready to move to any threatened point. Of these armies there will be (say) four on the Atlantic, one on the Gulf, and three on the Pacific coast. In other words, the mobile troops will be prepared in war to act both offensively and defensively, and at least half of the total will be ready to move from its own to any threatened zone and co-operate with the zone troops in the general defense. Further, it is believed that, except when employed as supports to fixed positions, whether confined to their own zones or placed in concentration camps as general reserves, the mobile troops of the general defense will remain under the control of their own officers, either of the artillery assigned to the command of zones or of the army at large. *In this estimate the needs of the country within its own boundaries alone are considered; no account is taken of the necessities of the foreign possessions.*

A third class of troops will be organized who, if not large in number, are at least of vital importance in coast defense; they are the supports of artillery positions proper. These men, placed at stations suitable to the defense of fixed positions against land

attack, will act in concert with the coast artillery, and be under the immediate command of artillery-officers, presumably of posts or districts, since it is evident that they must be kept as directly in touch with the officers fighting the positions as are the marines aboard ship. The supports, no doubt, will be drawn from the zone troops proper and be composed of the first and best men called to the general defense, that is, of such troops of the Regular Army as can be assigned to the duty, and of the flower of the organized militia. They will be made up almost entirely of infantry and field-artillery, with as many machine-gun batteries as may be available, and to these there should be added a far larger proportion of signal men than is usually considered necessary for an army in the field; since upon these men will fall the service of information, not merely with other elements of artillery defense, but with the fixed positions, the zone troops, coast patrol, and with the navy.

As to the strength of the artillery supports, little need be said here, but it is evident that the number of men assigned to each post and fixed position will be governed by local conditions and mainly dependent upon the terrain. Larger and more exposed positions will require as supports proper at least one regiment, perhaps even one brigade of general defense troops, who will be placed under the control of the district or of the battle commander in action; and the smaller posts a battalion each under the senior artillery-officer present. It is evident that the strength of the supports will depend also upon the position occupied by the defense troops of the zone. The lines of information of these troops will be those of the field army, and mainly dependent upon the buzzer, field telegraph or telephone, and visual signaling.

From all that has been said it should appear that the mobile troops of the three groups above indicated will stretch over many miles of country, and operate under widely varying conditions. It follows that even more than for a well-organized army the lines of information for the, at first, somewhat unorganized forces of the general defense must be ample and widely extended. Indeed, except in emergencies, these lines will be more necessary in the early days of the defense than later when the machine moves smoothly, but at all times the mobile troops, without an adequate service of information, will have rather less direction and mobility than a collection of tortoises. Properly laid, the lines of information will not only form a net-

work throughout the defense zone, but will tie each zone to the others and provide the entire army with the lines heretofore shown to be essential in the field. Headquarters of the defense and those of zone troops will be fixed at the places best suited tactically for the purpose, and as it is reasonably certain that these positions will lie at centers of commercial activity, they will be distant from the camps of divisions and brigades and still farther separated from the smaller commands and detachments, from the artillery district headquarters and from observation stations, the outposts of coast defense; yet with all these must commanding officers of the mobile forces be kept in constant and immediate touch, as well as with the military commanders of departments, should the latter not be in command of the general defense—and with Washington. In turn, division and brigade headquarters must be kept in communication with dependent and outlying commands; these with the observation stations and coast patrol; and the latter given the power to communicate readily with the floating defenses, with artillery districts and with ships.

From all that has been said it appears that for the mobile coast army there will be needed systems of information even more extensive and varied than considered necessary for a field army in campaign; and it follows that the proportion of signal troops to line soldiers in coast defense should be increased. But even assuming that not more than the admitted proportion of two and one-half signal men to each one hundred can be provided, it appears that in a great war there will be organized and equipped at least thirteen signal regiments of one thousand men each for the service of the lines of information alone, and in addition a considerable number of balloon troops. Certainly not less than fifteen thousand men in all in addition to the signal corps of the army, which should, of course, maintain the ratio of two and one-half per centum to regular troops of the line.

It is hopeless to suppose that the signal corps of the regular establishment can ever supply more than a leaven for this great mass; or even that the militia possessing signal troops of approved efficiency can provide more than the framework of the organizations that will be required; and it follows that the signal troops mobilized for war must be filled in by volunteers, and therefore by men drawn direct from civil life. But excellent and abundant as the material for these troops undoubtedly is among the men engaged in the electrical and mechanical pur-

suits of the country, these men before they can be of any real value must be made into soldiers. To accomplish this purpose there must exist in peace a sufficient number of signal troops in the Regular Army and in the organized militia to leaven and instruct the whole body of volunteer signalmen; but the signal corps of the army will never have the numbers or the opportunity when war comes to take upon itself alone the training of those volunteers; the assistance of the organized militia must be asked and given; but this training must be quick and effective, and therefore be performed by men who have themselves been drilled in peace in the methods of the signal corps of the army. Unfortunately the trained militiamen are at present few and confined to the signal organizations of a small number of states, and even where signal organizations exist, they are not always given, be it said without disparagement of the troops themselves, the strength in numbers, the equipment, nor, up to now, the training that will make them immediately valuable in coast defense on the outbreak of war. This condition should be changed, for it needs no argument to prove the plain fact that in war the lines of information, both military and commercial, in so far as the latter relate to the general defense, must be controlled and operated by soldiers, and that the number of men needed for the purpose will be far larger than can be supplied by any probable increase of the regular establishment. It follows that the military authorities of the states, especially those chiefly concerned in coast defense, should be asked not merely to do more than they have done to increase or create signal corps that will be of real service in war, but to encourage these troops to take each year their full share of instruction in the service of the lines of information of the coast defense.

*The third factor of the coast defense, and that one which depends for its value, if possible, even more closely upon the lines of information than others, is the coast patrol.

*The Austrian writer, before quoted, draws the following interesting, if somewhat amusing, picture of a descent upon the Pacific coast, its consequences and preventives:

"The enemy could, in all probability, make the first landing with a division, and for permanent occupation of the country would have available a relatively larger force, which could follow without difficulty. There is no doubt, however, that as soon as the enemy had made a successful landing and the Americans had come to a realization of their danger, the whole nation would rise as one man to expel the intruder. Whether it would be possible to raise millions of fighters from their population is questionable. In the absence of arms and equipment for such a force, many months would elapse in its preparation, probably a whole year. This army would be undoubtedly far inferior to the trained and disciplined veterans.

"To prosecute a war against the enemy's forces with American volunteers would be all

COAST PATROL.

It will perhaps appear to a student of the present condition of our defense that the important subject of coast observation, or coast guard, to go back to an expression of the early years of the last century, has not received from the army the attention it deserves. It is true that designs for wireless and signal stations have been drawn up by the signal corps, and, in one or two instances, the structures have been erected within artillery districts; but great stretches of coast, often containing good harbors and magnificent lookout stations, occupied by the executive branches of the Government, at which valuable information of friend or enemy at sea may be gathered, remain not only unprovided with signal stations, but remain generally unprepared for use in war, which is a condition that should be changed. Of course it is assumed that when needed these outposts will be given necessary equipment; but for this no provision has yet been made by the army. This state of unpreparedness in regard to an important factor of the defense is believed to be passing away, however, and its existence at present should not be attributed to lack of foresight or to negligence on the part of the army, but considered due, first, to the fact that coast defense has not yet been taken up seriously as a whole, and second, to lack of means and multiplicity of duties imposed upon the small signal corps of the army by whom the systems of coast patrol should be planned and lines of information be installed and operated, when authorized. But if the army has not yet considered in earnest the formation of a coast patrol, the navy is giving careful attention to it, and regulations have recently been promulgated by which an apparently thorough and efficient service will be created. The matter is important, and as the steps taken by the navy are probably not yet entirely familiar

the more difficult, for the reason that the former, having made a landing with comparative ease, could select its terrain for further movements. The three Pacific coast States are bordered by the great mountain chain of the Sierra Nevada, and to the east of these mountains lies desert, or partly desert, land, the Cordillera Basin and the Colorado tableland, stretching for a distance of two (?) kilometers. The intervening territory between mountain and sea constitutes a genuine fortress in which the invaders could feel as much at home as on their native land, and which offers all the means for subsistence.

"If the army were followed by a swarm of laborers the force could soon be independent of reinforcement from abroad. To wrest this land from such a foe would be a difficult matter for the militia, and it could only be accomplished by a preponderating force. The cost of such an army to the Americans could not be measured; the figures would be staggering when compared with the figures of former wars. * * * It is the serious duty of America to lose no time in perfecting her defense and guarding against a surprise.

to the army, a few partial extracts, which should be of interest, are quoted from the regulations regarding the naval coast patrol.

FIRST. By these regulations the coast is, for observation purposes, divided into naval districts under command of an officer; these districts are required to "Provide means of obtaining and forwarding information to and from the coast and of communicating with vessels of our own navy," and in time of war they are "to obtain and forward information relative to the movements of vessels off the coasts" and "to promote intercommunication of orders and information between the coast and vessels at sea."

The composition of the force of each district will be such as the Navy Department may direct, depending upon the existing resources at the outbreak of war. For this purpose the department will receive the necessary control of personnel and of the naval material of the various States, the revenue cutter and the lighthouse services, the coast and geodetic survey, and Bureau of Fisheries and the co-operation of the Army Signal Corps, the life saving and marine hospital service and the Weather Bureau.

The naval patrol stations will comprise a line of signal and lookout stations along the coast, and will be made up of:

- (a) Stations established by the Navy Department and manned by the navy.
- (b) Co-operation stations, belonging to other executive departments and manned by employees thereof, such as those of the lighthouse, life-saving, Weather Bureau and army signal services.

Certain designated ones of these stations will be provided with the means of communicating with vessels by signal, being in some cases equipped with wireless telegraphy. So far as practicable, all stations will be connected with the headquarters of the naval district by telegraph or telephone.

The personnel of any naval district will be largely made up by the assignment of officers and men appointed or enlisted from naval militia or volunteers who are residents of that district and have acquaintance with the locality in which they are to be employed, and of officers and men of other executive departments than that of the navy who may be either appointed or enlisted in the navy or whose services may be placed at the disposal of the Navy Department by order of proper authority.

Forwarding Information.—The commandant shall cause all information received from any source at headquarters, which bears directly or indirectly upon the progress of military operations or the conduct of the war, to be transmitted to the office of naval intelligence at Washington. So much of the same information as relates in any degree to the army shall likewise be forwarded to the commander of each artillery district of the army included within the limits of the naval district; and such as affects a neighboring naval district shall be forwarded to the commandant of that district.

Co-operation with Neighboring Commands.—The commandant shall enter a hearty co-operation with officers of both army and navy, holding neighboring commands, with the object of promoting the success of such military operations as may be in progress; and he may expect a like co-operation on the part of those officers.

Co-operation with Army and Navy.—Officers of the navy shall co-operate freely with one another, and with the officers of the army, in all matters affecting the military interests of the United States. In the interchange of information they shall take the most direct means of communication without regard to what, under other circumstances, would constitute the official channels. They may expect a like co-operation on the part of the officers of the army.

Systems of Communication.—The means of communication between the various units of the military force of the United States in the neighborhood of the coast shall be:

- (a) International code of signals; (b) Army and navy code of signals; (c) Wireless telegraphy; (d) Telegraph or telephones; (e) Recognition of signals; (f) Local signals.

International Code.—All vessels attached to a naval district shall be provided with means for making and reading signals by the International Code, excepting such as are so small as not to afford proper facilities for making the hoists; such naval patrol stations as may be designated shall also be so provided. At each defensive sea area there will be at least one army signal station under the control of the artillery district commander, likewise prepared to use the International Code. In the absence of instructions to the contrary, the plain code will be used without ciphers or additions.

Army and Navy Signal Code.—All vessels belonging to a naval district, and such naval patrol stations as may be designated, shall be provided with an adequate force of signalmen, trained in the use of the army and navy signal code, and with proper means for making signals by that code, including large and small wigwag flags for day use, and either torches, colored or "winker" lights, Ardois, or some other efficient system for night signaling. All signal stations of the army will likewise be prepared to use that code.

Wireless Telegraphy.—The policy as to wireless telegraphy in the vicinity of the United States coast shall be that, in order that it may be most efficiently employed when needed, the use of this method of communication shall be reduced to a minimum. Naval vessels and shore stations shall, therefore, abstain from the use of wireless telegraphy, except for important messages and for such tests of apparatus as may be ordered by the commandant. Should there be several wireless telegraph stations on shore in any vicinity, such station as may be designated by the commandant of the naval district shall be charged with the duty of doing all sending; but all stations should constantly "listen in" with a view to insuring greater certainty in the reception of messages and to establishing communication where the designated station does not respond; army stations shall always have the right to send messages upon official business pertaining to the War Department, when of such importance as to warrant transmission by this method. Should it be required at any time, the commandant of a naval district or senior naval officer present shall apply to the artillery district commander, who will authorize the use of an army wireless station under his charge for promoting the efficiency of naval district work.

The telegraph or telephone will afford the principal means of communication between headquarters and the respective shore stations. Government lines shall be employed when practicable. The commandant of the naval district shall furnish promptly by wire to the artillery district commander all information he may receive from any source which is of

interest to any degree to the latter, and may expect to be similarly furnished with any information obtained through sources pertaining to the army.

Recognition Signals.—The Navy Department will prepare a code of private recognition signals, which, at the outbreak of war, will be made known confidentially to the commanding officers of all naval vessels and shore stations, as well as to the army officers commanding sea-coast defenses.

Local Signals.—Where doubt exists as to the efficacy of the patrol of the limits of any defensive sea area, the senior officer of the harbor entrance patrol shall arrange with the army officer commanding the harbor defenses for a system of signals by which to indicate that a vessel has authority to be within the area; the employment of such signals should, however, be avoided unless essential.

Repeating Signals.—In order to secure greater certainty as to reading of visual signals, and to provide for repetition to all forces in the neighborhood of a defensive sea area, every International Code signal conveying information of general interest, such as reports of hostile or suspicious vessels or the suspension of navigation, shall be repeated by each vessel or station; the repeating signal, which shall take the place of the answering pennant, shall be kept flying until repeated by every other vessel or station in sight, and then hauled down. Signals intended for single vessels or stations shall be answered with the answering pennant only. The senior officer of the harbor defense patrol, acting in co-operation with the army officer commanding the shore defenses, shall make such rules regarding the repetition of wigwag and night signals as local conditions require, to insure their transmission to all vessels and stations in the neighborhood of a defensive sea area.

Signals Denoting Enemy.—The approach of an enemy shall be communicated by the most expeditious method available, using wireless or other signals.

Opening Fire.—Should a public vessel or shore station open fire with projectiles upon any vessel, it will be sufficient warrant for any other armed force within range to open fire and render all possible aid in capturing or destroying the vessel fired upon. While it is proper for the commanding officer of any armed force discovering an enemy to communicate the fact, with details, as promptly as practicable, to the senior officer of his service present and the commanding officers of other armed forces in the neighborhood, the most essential requirement is that the efforts of the whole available force be directed immediately to the capture or destruction of the enemy. The fire with projectiles is equivalent to a signal that an enemy has been discovered, and further signaling may be deferred until a favorable opportunity presents itself.

Suspicious Vessels.—The presence of a suspicious vessel or vessels should always be reported by wireless or visual signal, with all available details.

Friendly Vessels.—The presence of public vessels of the United States shall always be signaled by wireless or visual methods unless such vessels are themselves already in communication. Neutral vessels or United States merchant vessels need not be reported unless there is special reason for so doing.

Merchant Ships.—When they seem to offer a possible source of military information, shall be communicated with and questioned. In-

quiries made by them may be answered if such action does not involve important information of a confidential nature, but under no circumstances shall any information be given, which, if communicated to an enemy, could possibly be of aid to him.

Night Passage Across Area.—When it is contemplated to permit the passage of public vessels across a defensive sea area at night, the army officer commanding the land defenses shall, if practicable, be previously notified of the fact; when previous notice cannot be given, care will be taken that the vessels display the recognition signal a sufficient time in advance to make known their friendly character to the fortifications, and they should, when practicable, await the "response" of the fortification before attempting the passage.

Suspense of Navigation.—The commander of the land defenses included within any defensive sea area has the right, upon notifying the senior officer of the harbor entrance patrol, to suspend navigation of all vessels other than the armed vessels of the navy within the whole or a part of the defensive sea area for the time necessary to perfect or repair the submarine defenses. When such suspension is necessary, the artillery district commander may be expected to give notice of the fact to the senior officer of the harbor entrance patrol, at least twenty-four hours in advance; but when the necessity for such suspension arises without having been foreseen, it may be signified by the display of the appropriate International Code signals from the army signal station; when such signal is seen by the respective guard boats, or repeated to them in case they are beyond direct signal distance, the prohibition shall be put into effect immediately, the first opportunity being taken to report the facts to the senior officer of the patrol.

* * * * *

Thus it appears that a patrol of the coast has been excellently well planned by the navy, who have included in this service officers and men drawn from the various executive departments of the government, from the naval militia and from the volunteers, all of whom will be under the control of the Navy Department in war; it cannot be doubted that the navy patrol thus organized will form a most valuable auxiliary to the coast defense. A glance at these regulations, however, will show, if any doubt can exist on the subject, how closely the services afloat and ashore are interwoven in the duties of this patrol; yet in the system outlined, doubtless for the reason that the army has thus far taken no steps toward the organization of a patrol, the co-operation of the land forces appears merely incidental. It seems, however, that the army should, without delay, change its attitude in regard to the coast patrol and become something more than a mere auxiliary in this factor of defense, and through a properly organized patrol of its own creation, ally itself fully with the navy in this important work. In fact, without the full co-operation of the signal corps and the participation of troops trained in the service of lines of information, and in

establishment of signal stations and in the use of flying telegraph and buzzer lines, the telephone and field wireless cables, visual apparatus, and perhaps the balloon, it is hard to see not merely how the best methods of gathering intelligence in war can be employed by a coast patrol, but how, when so gathered, this intelligence can be transmitted to the centers of control, to artillery fixed positions and their auxiliaries, and to the mobile army, from distant observation stations, coast islands and light-houses, or from the floating auxiliaries and passing ships, with

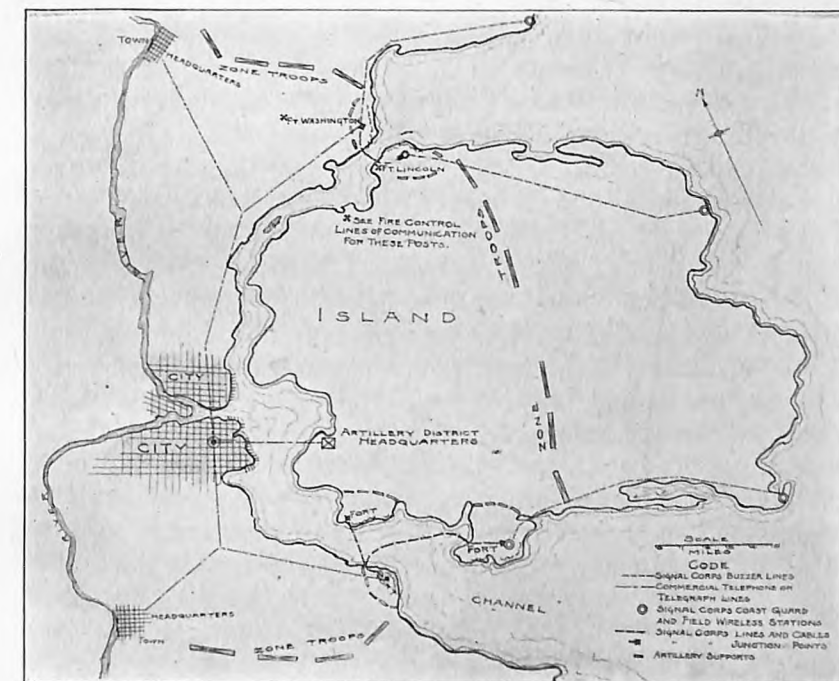


FIG. 17 (Supplemental to Fig. 16).—SHOWING FIRE CONTROL STATIONS FOR TWO COAST DEFENSE POSITIONS.

the speed and certainty which alone make such information valuable.

The service of security and information in coast defense, as in the field, implies, first, the collection of military information or intelligence; second, its transmission; and third, its correlation and use. In regard to the first of these elements it may be said that the collection of information is primarily the duty of the coast patrol and of the military services; but in war it will become as well the duty of every man of the government service,

both civil and military, and, indeed, of all of the people of the country. But although important information will come from many sources, and no matter what the source, must be transmitted to proper authority; yet incidental intelligence, like incidental soldiering, is merely auxiliary to the organized service, as the continued value of this service will depend upon a properly organized corps of men who will transmit the reports of trained observers, from the service, signal and observation stations, from light-houses and other government establishments, from the floating auxiliaries and ships as well as from chance sources of information, and from the thousand watchers of the coast, that intelligence upon which depends in war the attitude of the defense. But both judgment and experience in regard to the information transmitted will be needed by officers and men in charge of this service if a constant condition of unrest and excitement is to be avoided at inshore terminals. Who can doubt, for example, that information received at the centers of control will determine the attitude of the army of the defense in threatened zones; and perhaps its ability to prevent surprise or repel attack; that news or no news, often equally important, from the coast will govern the preparedness and vigilance of the zone troops and supports and keep the artillery men at the guns or give them release; that, in short, a well-organized service provided with trained men skilled in the use and maintenance of lines of information will relieve the defense of the greater part of its strain in the absence of the enemy; multiply many times its efficiency in his presence; and permit the smaller force to do the work of the larger. While, on the other hand, an insufficient service of information, handicapped by slow, inaccurate or faulty transmission, will plague and worry the defense with useless anxieties and alarms, if it does not even lead on to disaster. It follows that the transmission of intelligence, which is the second element of the service of security and information, is a duty of vital importance which should be intrusted only to trained men under military control supplied with the best known appliances for this service, and should never be left to the chance efforts of any irresponsible person who can use a key or a wireless instrument. In other words, that the section of the coast patrol to which the *duty of transmission of information is intrusted should be composed of men trained in naval and military signaling and in the methods of the signal corps of the army*. In addition, it is presumed that sig-

nal men of the army and of the militia will be detailed aboard scout ships, patrol and picket boats and other floating auxiliaries, for duty as wireless and visual signal men, but this is a detail that need not be considered here.

With the use that will be made of the information when received, which is the third element of the service of security and information, the coast patrol has no concern, since this will depend upon commanding generals, and the reception and correlation of reports upon staff-officers at headquarters, presumably signal officers, whose duty it should be to formulate and weigh the information transmitted.

From what has been said it appears that the coast patrol will become in future one of the strongest arms of that service of security and information upon which so much dependence is necessarily placed in modern war, and in consequence that this patrol when organized will be thoroughly efficient in numbers, personnel, organization and equipment, and that its men, who are frequently placed at lonely stations and required to act upon their own initiative, will be not only steady, well-disciplined soldiers, but in addition will be intelligent, keen and watchful men, skilled as observers and trained in the use of the telegraph and of mechanical appliances; and above all, that they will possess that judgment which seldom blunders in its work. Fortunately for the country men of this character are many in civil life, and will be found in abundance among the volunteers called out in war. As to the organization of a patrol, it should appear that none better can be found than that approved by the experience of the signal corps of the army whose duties are similar if not identical with those of the coast patrol, though more widely extended. The equipment, too, should be that of the regular service. In short, it is believed that the coast patrol of the army should be organized, trained and equipped by the signal corps, and that the collection of information, so far as it relates to this service and its transmission in coast defense, should, as with the army in the field, be placed under the charge of the chief signal officer of the army, acting through a subordinate officer in immediate control at the front. The men of this organization cannot, and need not, be actually present during peace, except those of the executive departments of the government (already bespoken by the Navy) and hence the actual enrolment of the personnel may be left to a later period; but plans of organization should be undertaken without delay. These

will look to the formation in each military zone of a patrol of the necessary strength, made up in peace from the organized militia of the zone, who shall receive each year as much training as practicable in coast signal work, in connection with the signal troops of the regular establishment. This training of the patrol will include the installation and use of signal equipment of all kinds; the operation of field and station wireless; the establishment of observation stations, the service and maintenance of lines of field telegraph and buzzer; and, in general, in the collection and transmission of military information by all approved methods. There seems no reason why this instruction should not be given to the signal organizations of the militia, as is now done for the artillery and infantry of the state troops in connection with the yearly exercises or maneuvers of the coast artillery of the army. To do this would simply mean the extension of the present valuable training of the militia, to include instruction in the service of a coast patrol within certain prescribed limits and would give to the signal men of the militia training in a branch of signal corps work of great importance to them, especially in those states which border the sea. Furthermore, it is believed that the plans for an organized coast patrol will provide that in war the signal men of the militia be formed into companies and regiments with the signal troops of the Regular Army and with the necessary number of technical men of the volunteers taken from telegraph operators and telephone men of civil life in such proportion that the whole shall form an effective service.

The number of signal men required in war for coast patrols, however, will be governed by the character of the coast they are called upon to guard and cannot be stated generally. But probably at least one-half of the total patrol should be trained as signal troops.

As a further step in preparation for defense it is suggested that the signal corps of the army be authorized to provide at government reservations, such as light-houses, marine hospitals and life-saving stations, and those of other executive departments, suitable as lookout stations, magazines of material of the less perishable sort which will furnish part of the means of establishing observation stations at the outbreak of war. In addition, island stations and light-ships should be connected by cable—out of use in peace and with the ends prepared for

periodic testing to insure their perfect condition—with interior or mainland stations whence the military field telegraph could rapidly be extended at need to commercial offices. In this way many permanent and important lookout stations of the civil departments of the government which are always on duty, Point Judith as an instance, will, when needed for coast-guard service, be ready for almost immediate use. At mainland stations of the government should be placed signal stores of a bulky character, telegraph or telephone material, wire, lance poles, supplies for electrical batteries, flags and other apparatus for the use of the communications both visual and electrical in war.

These preparations should not be put off to the day of stress sure to precede hostilities, for if the stations and material needed are ready, the men necessary to use the equipment and construct lines of field telegraph and buzzer can be quickly placed on duty in an emergency. It is probable that most of the valuable observation points of the coast are now occupied by government stations of one service or another and could safely be provided with necessary material; but others are so circumstanced that nothing should be done by way of preparation until hostilities threaten, since, if not owned by the government, magazines cannot wisely be established at them; such points can, however, and should, be carefully marked, their character made known and, possibly in the case of very important localities, material for their conversion into signal stations be stored at the nearest artillery post.

It appears then that without the limits of the artillery districts it will be sufficient in peace for the signal corps to establish magazines and lay or store cable at stations of the executive departments important to the coast patrol. But within the limits of artillery districts not only should such magazines be established, but each of the twenty-four districts should be given signal and wireless stations of the types authorized—a matter that will later be considered. As to the dependence that will be placed by the coast patrol upon the balloon, either captive or dirigible, so little is really known of their practical value, especially of the latter, that not much can be said; but it should certainly appear that if ever the captive balloon proves useful, it will be at coast signal stations within artillery districts where everything lends itself to this service.

Enough, perhaps too much, space has been given to the coast patrol, but the subject is new and interesting and suffi-

It remains to consider the relations of the service of the lines of information to the fixed defenses themselves; and the importance of these lines to the coast artillery; that is,

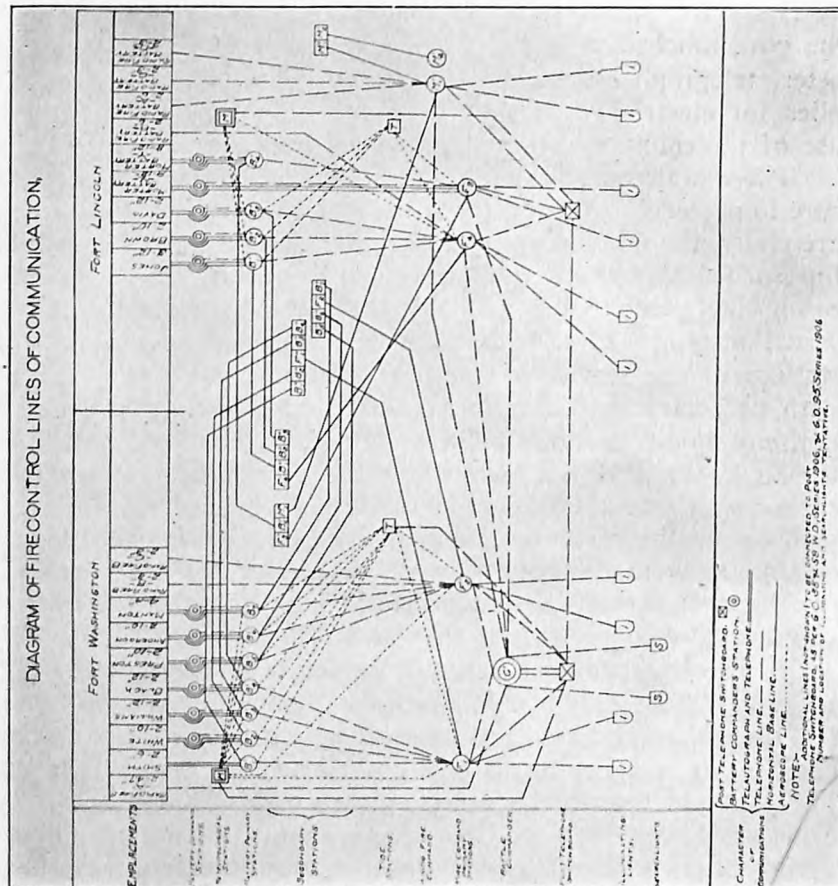
ARTILLERY.

The term fire control as here used is not only technical but conventional, it therefore seems well to premise that the expression is defined by its limitations as including the "Exercise of all such technical and tactical functions of command, supervision, control and direction, as may be necessary to insure an efficient defense." *

*See Signal Corps Manual No. 8; and Fire Control and Direction, by Captain Hearn, Artillery Corps.

†Drill Regulations for Coast Artillery (Provisional).

FIG. 18.



area within which a naval attack may be expected and over which one man may exercise efficient control of the artillery fire action that may take place therein, together with all the material accessory to the service of the armament, the personnel assigned thereto, and the submarine defense connected therewith." "A fire command consists of two or more batteries, not in general exceeding four, so located that their fire covers the same or contiguous water areas and that they can be readily commanded in action by one man." "A mine command consists of such portion of the submarine defense and rapid-fire guns for the protection thereof as may be efficiently controlled by one man." "A battery is a group of guns or mortars of the same caliber and power, with the position-finder stations provided therefor and with the personnel assigned thereto. Under exceptional circumstances a single isolated gun, with its station and personnel, may constitute a battery."

It is unnecessary here to enter into a consideration of the part played by signal-corps installations in the defense of fixed positions or to attempt to describe in detail the instruments, often highly complicated, that have been devised for the service of fire control. Suffice it to say that what follows applies only to fire-control systems that are permanent in character, which from their extent and importance can only be properly installed during the leisure of peace.

Turning now to the duties imposed upon the service of lines of information, by the foregoing definitions and their requirements, it appears, that, in ordinary language, fire-control requirements demand: First, that the battle commander's station shall be so equipped as to communicate electrically with district, fire and mining commanders, and with the searchlights assigned to the station; that the fire commander's station shall be so equipped as to communicate with the battle commander and with each primary battery of his command; with his secondary station (if existent), when the fire command is a mortar battery communication shall be provided with his battery commander and with the booths, and (if existent) with the other mortar primary station; that the mining commander's station shall be so equipped as to communicate with the battle commander, the secondary station, mining casemates, loading room, and with the rapid-fire batteries and illuminating lights assigned to the mining command; that the primary stations shall be so equipped as to communicate with the fire

commander, battery commander, each battery emplacement and secondary station (where primaries exist for six-inch batteries, without base line, communication with each emplacement, battery commander and fire commander only, is provided); that secondary stations shall be so equipped as to communicate with their primary stations only. Mortar batteries are usually provided with more than one base line to cover different portions of the range zones, and special apparatus must be installed so that the different stations can be connected as demanded by the progress of the action.

A post-telephone exchange similar to small commercial offices is provided as a part of the fire-control system installed by the signal corps. This exchange connects not only such stations as are necessary in post administration, but such fire-control stations as the tide and meteorological, battle, fire and mining commands, power-houses, and others needed in service.*

In addition, the writer is of the opinion that the district commander's station and that of each battle commander within the district should be connected by telegraph with each other and with the outer world. Of course, as will be seen later, the district will be provided with wireless and signal stations, which may at times be used in fire control, and will be connected by direct telephone service with the district commander's station, or with the battle commander's station.

To establish the communications above noted, the signal corps provides telephones of special types, the telautograph, the telegraph; electrical appliances for indicating time intervals; for the collection of meteorological and tide data, range zones; and, necessarily, a network of wire and cables of many types, which in larger installations extend into intricate systems requiring the best efforts of highly trained electricians to construct. These multiply with their distances from centers of control; they are not run haphazard between stations but follow the tactical organization of the defense itself.† The key of the system is the switchboard room, but the details of this need not be discussed here, nor an attempt be made to consider the instruments and equipment furnished. The instruments have

*See sketch of an imaginary coast position prepared to resist attack.

†For the more technical electrical details of these and some of the other electrical work involved in fire-control installations, attention is invited to appendix, for which the writer desires to express his thanks to Mr. L. R. Krumm, Assistant Electrical Engineer, Signal Corps, to whose well-known ability and detailed knowledge of the electrical installation much credit is due.

been devised, first, with regard to reliability in operation, and second, with regard to strength and durability, and are believed to be excellent of their kind. In service, the most important is the telephone, which is to fire control what the buzzer is to field communications; that is, the main reliance of the system. However, the telephone is far less reliable in coast defense than is the little field instrument in campaign; and in the excitement and din of heavy artillery fire it seems probable that officers and men near the guns will have difficulty in hearing, and can seldom be certain of what they do catch of the messages conveyed by telephone. Still, nothing now known can take its place. The telegraph—best and most certain of all signaling, is too slow—and nothing else is worth considering except the telautograph, which, though promising, has, as now constructed, faults of its own that make it far from satisfactory as a principal instrument of the communications. Telautograph lines are, however, established between primary stations of batteries and the guns for the transmission of ranges, azimuths and information. An advantage of the telautograph is that it not only records to the eye, and unmistakably, the message as sent, but also gives a permanent record. The telephone does neither unless all advantage of speed is lost by recording and repeating the message. It is to be hoped, however, that a system of light signals, like those now used in connection with the mortar zones, or perhaps some form of recording telegraph, a new type of which is now made and understood to promise well commercially, may yet be devised that shall give the speed and certainty needed in fire-control service. Tide and meteorological data are conveyed by the aeroscope, though this gives in its present form a somewhat unnecessary amount of detail; and to synchronize observations of the target and gun fire, time intervals are marked by electric bells placed in the circuits of master clocks. These complete all that need be said in a general survey of instruments used in the fire-control system installed by the signal corps. The system is not perfect, but it is believed to be the best and most efficient method yet devised by any country for fighting the guns of fixed positions.

In regard to the importance of lines of information in fire control it will be sufficient to point out that,* "Under the present state of development the battle commander conducts the fight of the defense, while technically under the orders of the district

*From the valuable pamphlet of Captain Hearn already referred to.

commander. He issues his orders to his fire commanders and his mine commanders * * * from information furnished by the district commander, from reports of his scouts and outposts, and from his own personal observation he decides as to what part of his command he will employ." Again it is said, "The fire commander, having received orders from the battle commander to open fire on vessels designated, issues his orders, in accordance therewith, to his battery commanders, directing what batteries are to fire and indicating the target for each battery * * * He controls the beginning and the ending of the firing, and the number of shots fired by each battery. He distributes or concentrates the fire according to the demands of the action. * * * He may decide to concentrate all batteries on the same target, or certain batteries on two or more targets. He must decide, according to the progress of the action, as to the manner of employing the units of his command."

"The mine commander is normally at his primary station and fights his command from this station, which is equipped with the usual instruments of communication."

Brief and seemingly simple as this appears, it should nevertheless be remembered that the information upon which the fighting methods are based must be collected from many scattered sources and be transmitted instantly over land and sea to centers of control; and that the orders governing the action must be sent over wide areas which only signals can traverse in time. It follows that when fighting his position the battle commander and his subordinates are at least as dependent upon lines of information as is a general commanding in the field, for without the telegraph and telephone, the cable and electrical appliances, not only is concert of action lost in coast defense, but at times also the power to find and stop the enemy.

The work of installing the fire control is now performed by the signal corps of the army, and many of the types of instruments used have been designed or adapted by the corps. When completed, fire-control systems are turned over to the artillery arm, by whom, it is now understood, they will be maintained. But the systems are extensive and complicated and maintenance will be an important and expensive affair requiring the efforts of a considerable body of trained and expert electricians, who can be obtained only at salaries far above those given to enlisted men of the army. A little consideration of the ideal sketch sub-

mitted will serve to illustrate further the lines of information now employed in coast defense.

It remains now to consider the systems of communication that are properly

LINES OF INFORMATION OF ARTILLERY DISTRICTS.

In addition to the fire-control systems there must exist both within and without artillery districts certain lines of information, whether electrical or visual, by means of which artillery headquarters are kept in touch with the interior of the country and with centers of control; and the factors and elements of the defense are brought into co-ordination; fixed positions connected; and the district bound into a whole under control of its commander, as an army in the field is linked together and maneuvered by its general. These systems form the lines of information proper of artillery districts; but between them and those of the fire control it is evident, from what has gone before, that no sharp line of demarkation can be drawn, since each may be used in both capacities.

It will be remembered that the artillery districts scattered along the coasts of the United States are twenty-four in number. They are, as a rule, separated from each other by considerable distances, and each headquarters is kept in touch with the others electrically mainly through the commercial systems of the country; but the commercial systems are, of necessity, frequently supplemented by military lines which extend them to artillery headquarters. Within artillery districts, the various posts may, or may not, be reached by commercial systems, and, indeed, even district headquarters, when placed on coast islands or at other isolated and scantily peopled localities, from which the money returns would be small and the expense of installation and maintenance of land lines and cables would be great, are dependent at all times upon military lines of information for communication with the outer world as well as with the fixed positions themselves. Even in peace it is not probable that these conditions will change in regard to isolated posts; unless, indeed, the government is prepared to alter its present wise policy and offer a bonus to private companies for the construction and operation of electric communications, a plan that would be expensive in peace and inefficient in war, since lines of information important to and near by military positions must certainly in

war be under the control of soldiers alone. As to interpostal lines it is neither desirable nor practicable that they should be under civil control at any time.

In general, artillery lines of fire control and of information will, in peace, be permanent in type (except the field lines necessary in maneuvers); but in war to permanent lines will be added a network of temporary systems as flexible and extensive as need be, and in character resembling those of an army in campaign; more limited in extent, perhaps, but based on more stable conditions and consequently easier to install and maintain against interruption by an enemy except in the case of the wireless; and if interrupted more easy to repair, since the material for repair should always be at hand at the fixed positions. But as with lines of information in the field those of the coast defense, both permanent and temporary, must be certain and speedy. They will be more complicated and varied than is possible with the former, since they imply, in addition to land lines, systems of information extending both under and over the sea, and include in their scope every known method of transmitting intelligence from the wink of the Ardois, the flash of the search-light, the tick of the telegraph key or call of the buzzer; to the writing of the telautograph and the message of the long distance wireless and the wireless telephone.

With the permanently laid lines of the coast defense transmission should, of course, be as efficient and satisfactory as in civil life if the systems are properly installed and skilfully operated in practice; but in order to secure these results it is evident that the ponderous permanent systems of the fixed defenses, both fire control and information, cannot be thrown out in an hour like the wires of a marching army, but must be carefully planned and constructed in advance during the leisure of peace as the defenses themselves are planned; must progress to completion with them, and when in place must be proof against reasonable probability of interruption.

When installed the permanent systems of coast defense must be kept in serviceable condition, which means constant work and incessant renewal of material, and will demand a yearly expenditure estimated at eight to ten per centum of the original cost. In addition to this cost, however, an allowance must be made for annual depreciation of probably ten per centum, thus making the total cost of maintenance and depreciation not less than eigh-

teen percentum of original cost for the satisfactory operation and maintenance of fire-control installations.

The permanent systems of artillery districts consist of wire and cable lines, and station for the transmission of aerial messages. These lines will center in general at the station of the district commander and radiate therefrom to each post commander's station within the district; that is, they will terminate at the battle or fire commander's station of the various posts. In addition wire or cable lines (or both) will extend from the district commander's station to the most convenient points of commercial systems through which may be reached the headquarters of other artillery districts; and, when established, of the zone defense of the mobile army; of the coast patrol; of the general commanding and other important centers.

Temporary lines will, of course, be installed only when demanded by the exercises and maneuvers of peace or by the exigencies of war; nevertheless, the means of providing them should be at hand within each artillery district; so that when needed field telegraph and buzzer lines may be laid easily, quickly and without confusion from district headquarters to the supports, zone troops, and to headquarters and observation stations of the coast patrol; the telegraph and telephone wireless sets and visual appliances will be in readiness for use in the exchange of signals between the fixed positions and coast-defense ships, patrol, picket boats, and scout ships; as well as with torpedo planters and the cable-ship when necessary; and with the Navy. The field telephone should be ready to tell its story from observation stations and captive balloons to district headquarters and centers of defense; and possibly the dirigible air-ship should be at hand to write, by flag or light, against the sky its message from over land and sea. Thus the temporary lines of artillery districts will include many aerial systems, and even the permanent communications will not be electrical alone. Both will depend largely upon the auxiliary, but still very important, class of visual and aural signals, which before the introduction of the wireless telegraph were the only means known of exchanging ideas without material connection. Visual signaling is probably more important in coast defense than with the army in the field and is vital when communication is needed between ships and shore and the wireless is silent. Whether or not all the signal apparatus above outlined will be used by the defense is another matter; still the possibility exists,

and the fact remains, that opportunity should be given those who have control for the use of every method of transmitting information that may prove reasonably valuable. To do this it is necessary that signal appliances of all useful kinds be stored in depots within artillery districts, in addition to the material required for the emergency repair of permanent systems.

In war the headquarters of each artillery district, even more than coast patrol stations, will become a nucleus of intelligence regarding events at sea, and therefore the service of information in and from these districts should be as perfect as it can be made. The means of transmission should be the best known, and the men who use and maintain the lines the most efficient that can be selected for this special work. It seems, therefore, not too much to say that the men entrusted with the transmission of information of the coast defense should be soldiers trained in the work of the signal corps of the army, and familiar with its instruments and methods.

Many further details concerning lines of information of the coast defense might be discussed here, but space forbids, and it remains merely to note that the acknowledged importance to the defense of the wireless telegraph and perhaps of the wireless telephone, and the possible value of the dirigible air-ship, are leading to much effort and experiment on the part of the signal corps. In connection with the wireless excellent practical results have been reached, which have been noted in this paper; and as a consequence, it is hoped that there will soon be on hand a supply of portable wireless sets suitable for small coast stations and for boat service, and other sets of greater power for shore signal stations to be established within artillery districts. The structures planned in connection with these instruments are of two types, called

DISTRICT AND POST SIGNAL STATIONS.*

The district signal station is intended as permanent, and will be complete in itself. One such is to be established in each artillery district at that post best suited for its use a condition largely dependent upon outlook, suitability for wireless work, and reasonable protection against capture or destruction.

*See frontispiece, signal station, Fort Wood. A 1 K.W. is practically completed at Fort Hancock, which differs from that at Fort Wood chiefly in the fact that an existing structure is to be used as a signal station.

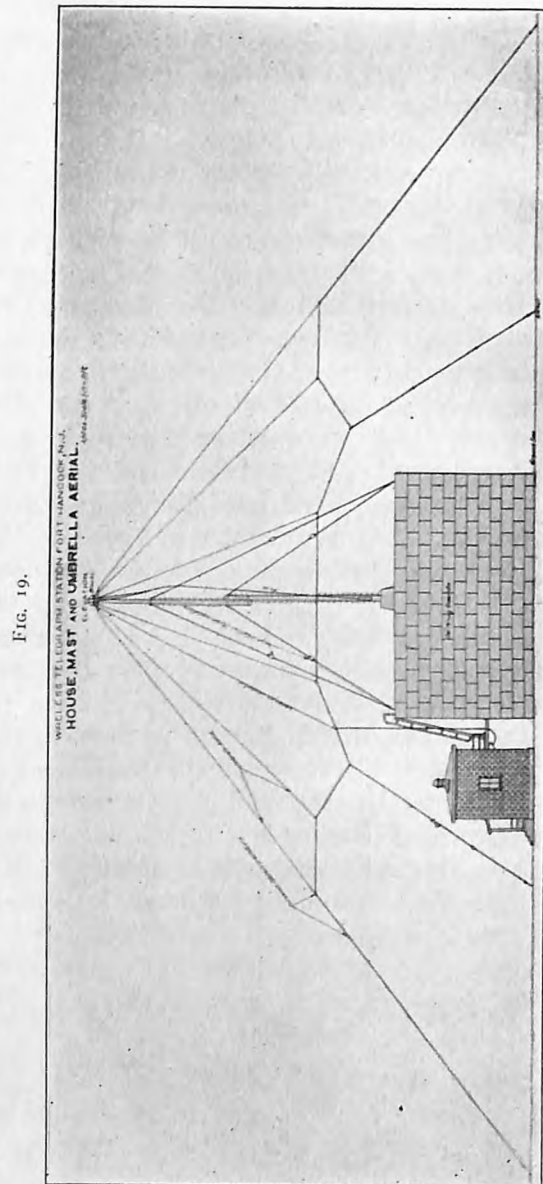


FIG. 19.

The district structure is intended to contain one 1-K.W. wireless set with the necessary power plant, pole and antenna, giving a practical range of, say, ninety miles; to this will be added telephone connection with the post exchange through which all points of the district may be reached. The pole is so arranged that from it the Ardois signals and International code flags may be displayed and from an elevated platform night signals, winker lights, the wigwag and visual signaling of all kinds used. In addition, the wireless telephone will probably be installed, and telegraph communications may be provided to military headquarters and commercial systems. A substantial house, constructed by the corps of engineers, provides the necessary office, lockers for flags and quarters for a signal detachment of six men, or more when necessary.

Post signal stations are similar to those of the district but smaller and with less range; they will be placed at one or more of the posts within artillery districts, and be provided with the necessary apparatus for interpostal communication; but will ordinarily use only small portable wireless sets. Both types will be signal stations proper, manned by a sufficient number of signalmen to form two reliefs; and there seems no reason why a balloon plant and its accessories should not be established and maintained in war at each artillery district near the signal stations and a proper force of signalmen detailed for this service.

One other auxiliary of the signal corps remains to be mentioned in connection with the defense of artillery positions, and that is the cable-ship, without which, both in peace and war, it will be impracticable to maintain the cable communications, either of the fire control or of information.

In conclusion it may be said that to properly serve and maintain the lines of information alone of artillery positions without taking into consideration the fire-control service, will require both in peace and war the attention of a considerable force of men whose duty shall be first and always to the communications, and it should appear, considering the technical duties these men are called upon to perform and the experience needed by them, that a suitable detachment of signal men must be maintained at every artillery district, and that the service this detachment will be called upon to perform should not be shared by others whose first duty will be to the guns or other elements of the defense. The work of installing the lines of intelligence within artillery districts is performed by the signal corps of the

army, but the maintenance of the systems as a whole is at present divided between the signal corps and the artillery, and no satisfactory method of procedure has been established, in the opinion of the writer. The problem of maintenance has already arisen, and as the present solution is general, the following definite suggestion is offered when the strength of the signal corps permits: That in each artillery district there be assigned in peace a detachment of signal men of the army of such strength as the exigencies of the service may require; (say) fifteen men to a district, made up of three or more artillery posts, these men to be ordinarily stationed at district headquarters, but sent wherever needed throughout the district to repair and maintain lines of information; that the signal detachment be placed under the immediate command of an officer of the signal corps—a lieutenant or captain—who shall be on the staff of the artillery district commander, and directly under his orders, as is the artillery engineer, or as a signal-officer in the field is on the staff and under the orders of a commanding officer, or of a department commander in peace; that the signal-officer be responsible for the condition of the lines of information of the district and for the transmission of information; and furthermore, that he and the men under his control be required to assist in the training of the signal men of the organized militia when called out for exercises or maneuvers in peace, and to organize and direct the signal men of the militia when summoned to the coast defense in war; that this signal-officer and his men have charge, under the direction of the district commander, of the service and maintenance of lines of information, but confine this work in connection with the fire-control system of the district to such duty as the district commander may direct in connection with land lines and cables when the assistance of the signal corps cable-boat and her trained crew of both soldiers and civilians becomes necessary.

In offering this solution of the problem of maintenance of artillery lines of information the regular duties of signalmen are purposely confined to the use and maintenance of these lines alone, since the fire-control systems are in the hands of the artillery; but it is believed that if a wise policy compels the presence of a number of signalmen, operators, linemen and the like for telegraph, telephone and wireless service in connection with the lines of information or intelligence alone, as seems probable, a still wiser policy of administration suggests

that these detachments be utilized to the fullest extent by giving to the artillery commander the authority to use, not merely in connection with lines of information, but in the care and maintenance of the great and costly systems of fire control as well, the signal men under his command, together with the civilian electricians and cable men whom it is the policy of the signal corps to engage for its technical work, as the civilian employees of the engineer department are engaged.

In making the above suggestion,* it is, of course, presumed that the authority of the artillery commander will be exercised through the signal-officer of his staff, who will be responsible for his work to the chief signal-officer of the army as well as to the artillery commander, as is a signal-officer in the field.

In this and foregoing papers which the JOURNAL OF THE MILITARY SERVICE INSTITUTION has done the writer the honor to republish, an effort has been made to outline the more important work of that branch of the army which is charged with service of the military lines of information, that is, of the signal corps.

Imperfect as the result of this effort is, it will not have been wholly in vain, if it serves to emphasize the steadily growing value to the army of lines of military information. The subject is as broad as it is important; but divides itself naturally into two widely separated branches, each of which is essential to the military service of the country and vital to its safety. They are: First, The lines of information of the mobile army in maneuver and in campaign; and second, the lines of information of the national coast defense in the exercises of peace and in the exigencies of war. It is useless to attempt to weigh the relative value of these two branches of the service of the transmission of information; they constitute the field of duty of the signal corps of the army, and it follows that the signal corps

*The suggestion is due to an artillery officer of rank and experience, and is thought to be in the interest of economy and efficiency, provided the signal corps is able to supply the necessary officers and men, and the artillery corps approves the plan. The last appears probable, for the electricians and other enlisted men of that corps will presumably have enough work in other directions, without caring for *electric communications* in addition. Besides this, it is very improbable that enlisted men of the army, no matter in what corps they serve, with the exception of a few, will have sufficient electrical knowledge and mechanical skill to maintain and repair the more complicated electrical system now installed, and that a higher order of acquirement must be secured from civil life and paid accordingly. In other words, at each artillery district an electrical expert, such as those now paid by the signal corps, must be engaged by somebody for the maintenance of both fire control and information services; it is a necessity imposed by present conditions and must be so accepted.

of the future will be called upon to cultivate not one but two fields of duty, equally important but very different in character, either one of which will demand the best efforts of a force of special troops far larger than now provided by law. This force will no doubt grow in size and importance as military organization improves, but it is useless to hope that in peace a full measure of preparation for war will ever be granted to the signal corps of the army, or indeed to any branch of the regular establishment or of the organized militia. With the people of the United States deep planted indeed is the belief expressed of his own country in bygone days by one of the greatest of French writers: "Thrice fortunate land, where the ground has only to be struck in the name of the nation, * * * for armies to immediately rise from it, as though by magic."

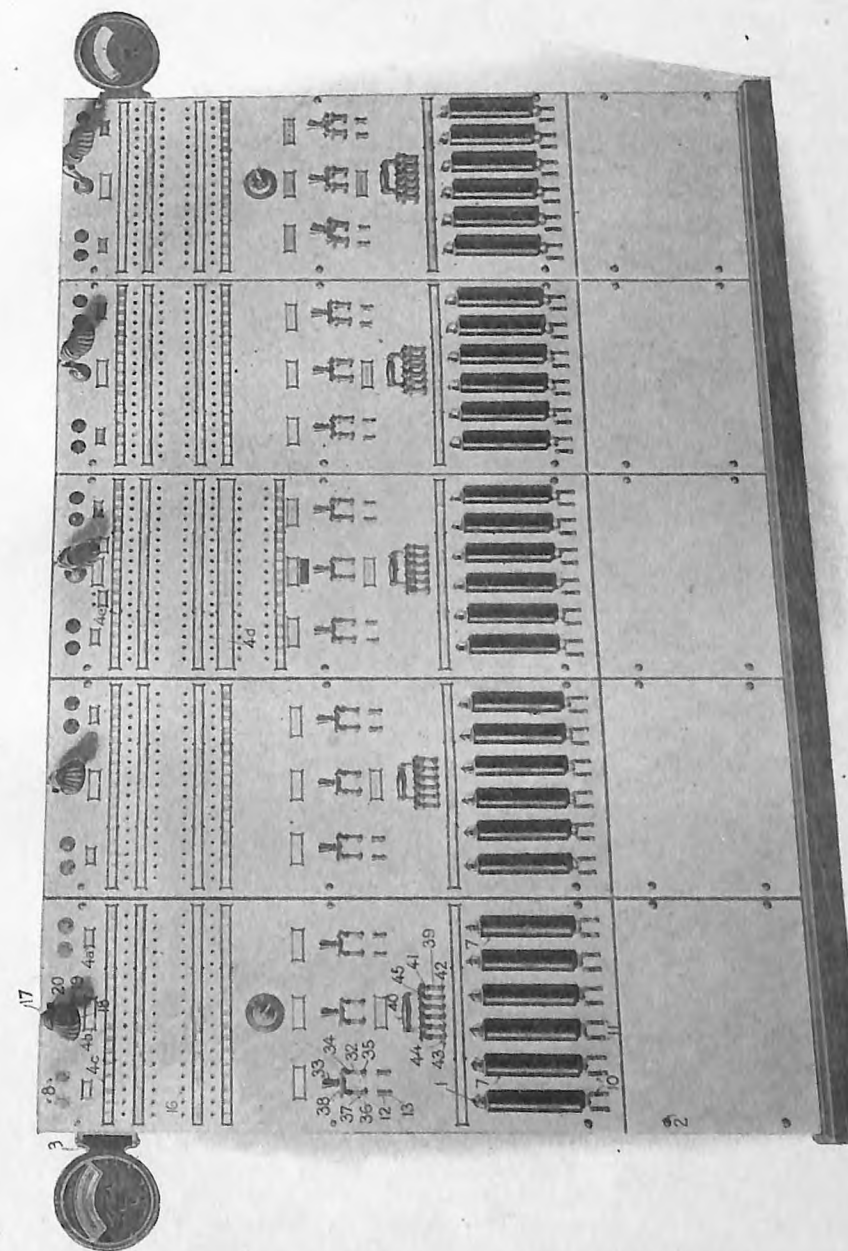
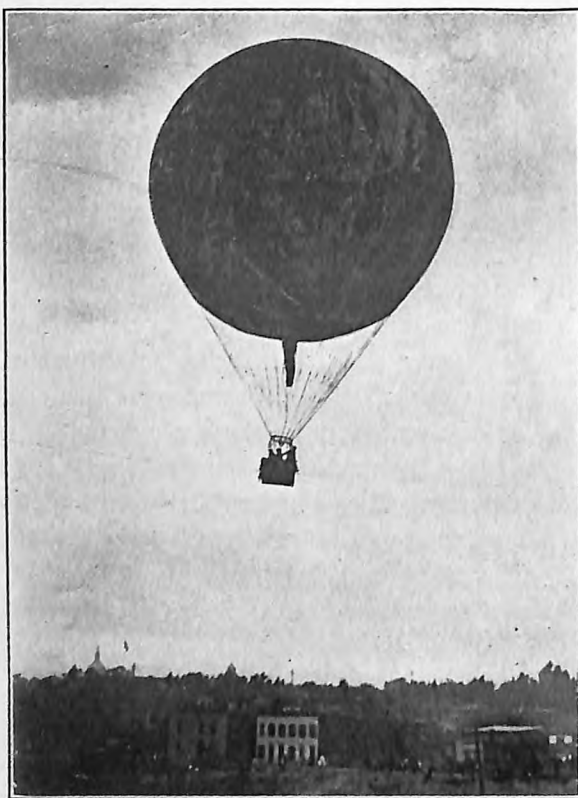


FIG. 20.—DISTRIBUTING SWITCHBOARD.

APPENDIX.

I. FIRE CONTROL CABLES.

As practically all the means of transmitting intelligence now employed are electrical; it follows that a working system of wires and cables is essential to a fire-control installation.

Advantage is taken of the fire command organization to have the cables connecting its integral parts radiate from the switchboard room usually provided for each rifle command. Mortar battery and mining fire command cables are usually centered in these switchboard rooms, as their requirements are not enough to justify separate accommodations. Owing to the large number of storage batteries and the auxiliary charging machines and controlling switchboards necessary for the telautograph equipment where there are several fire commands it is not usual to duplicate this equipment, but to have one telautograph battery serve all the instruments of the post by running bus-bar leads to the different switchboard rooms, although the telephone batteries are duplicated in each case.

The subterranean cables used to connect the various units of an artillery post are mostly rubber insulated and lead sheathed, and are laid in vitrified clay conduits with concrete manholes at convenient distances. When the necessary number of conductors exceeds twenty-four, which is not often, a paper insulated, lead sheathed cable is used to reduce the size, although more susceptible to injury. Where vitrified conduit is not provided the cables are wire armored and buried in the earth. It is the present aim to reduce the amount of aerial wire exposed to gun fire to a minimum, and about the only pole lines used in permanent installations are those comprising part of the post telephone systems for such circuits as would not be absolutely necessary to the defense of the position.

Communications must be established between the posts comprising an artillery district, so that the various base line connections can be made and the district and battle commanders kept in touch with the various commands and armaments under their control; this requires the laying of submarine cables, their auxiliary land lines and terminals where junctions are made. The ordinary type of rubber insulated and armored submarine cables are laid when the number of conductors is small, but the rapid increase in the lines of communication authorized between artillery posts has caused the rubber-covered cable to give place to the paper insulated, lead sheathed and armored cable, which by its compactness enables a large number of conductors to be carried in one cable; the latter are also far cheaper than the rubber covered, an important fact since these cables are necessarily laid across channels through which merchant ships are continually passing and interrupting service by their anchors. This difficulty is to some extent due to the fact that it is the policy of the Government to conceal the location of fire control cables. In war, no doubt, danger of interruption will be minimized by proper restrictions. Another advantage of paper insulation is its comparatively low electrostatic capacity, which permits the establishing of good telephone communications over much longer distances than can be obtained with rubber-insulated cable.

EQUIPMENT OF FIRE COMMAND SWITCHBOARD ROOM.

The most complicated part of the installation is the switchboard room, which provides not only a convenient test station for the cables centered there, but also contains the necessary telephone and telautograph storage batteries and their attendant charging motor-generators and switchboards, and in the recent types of installation at Boston and New York, a distributing switchboard as well (Fig. 20). This switchboard, in addition to accommodating the necessary retardation coils

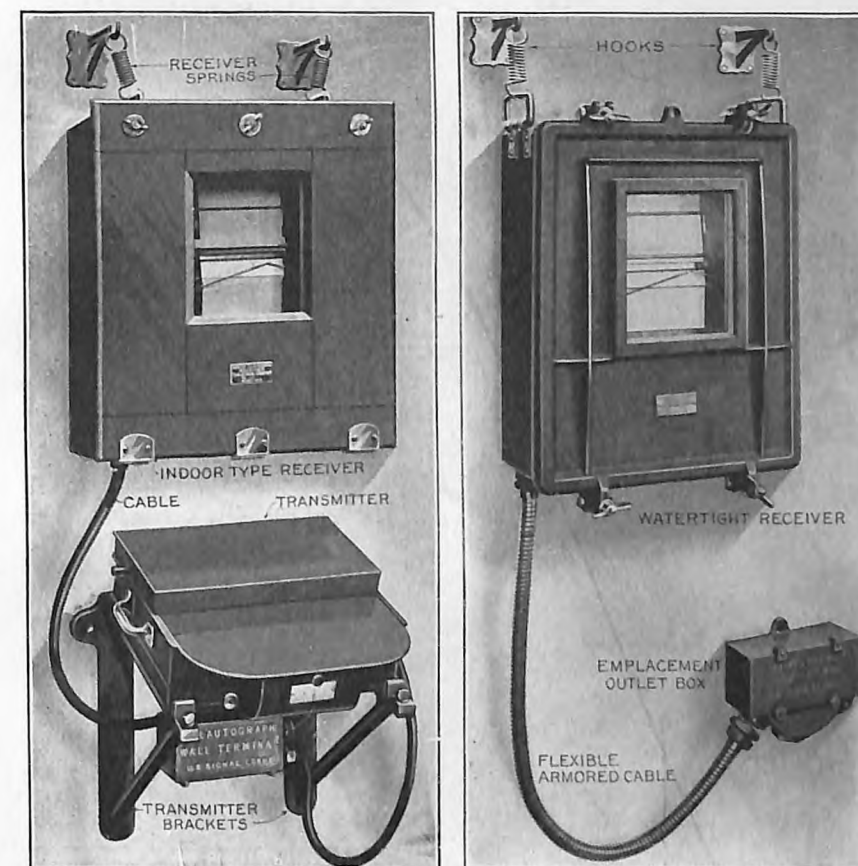


FIG. 21.—TELAUTOGRAPH INSTRUMENTS—TRANSMITTER AND RECEIVERS.

for the telephone circuits, and the switches controlling the telephone, telautograph and other power circuits, also, when the stations of the fire command are adjacent (Fig. 23), allows the interchange of base lines as demanded by circumstances or desired by the fire commander to enable him to use his own station as a battery primary. In fact, practically any combination of stations can be made, but experience has shown that this is not always advisable or practicable, since to attain the results desired requires a switchboard whose complications

preclude its maintenance and care by any but a trained electrician, and since it unnecessarily complicates the base line system. Complexity also interferes with its usefulness, and the usual electrician found among enlisted men will not be able readily to establish the necessary connections. The latest installation, however, make no provision for the interchange of base lines, and the distributing switchboard has been replaced by a switching panel for each primary station of the fire command on which are provided switches controlling the telephone, telautograph and time interval bell, power lines and meteorological data

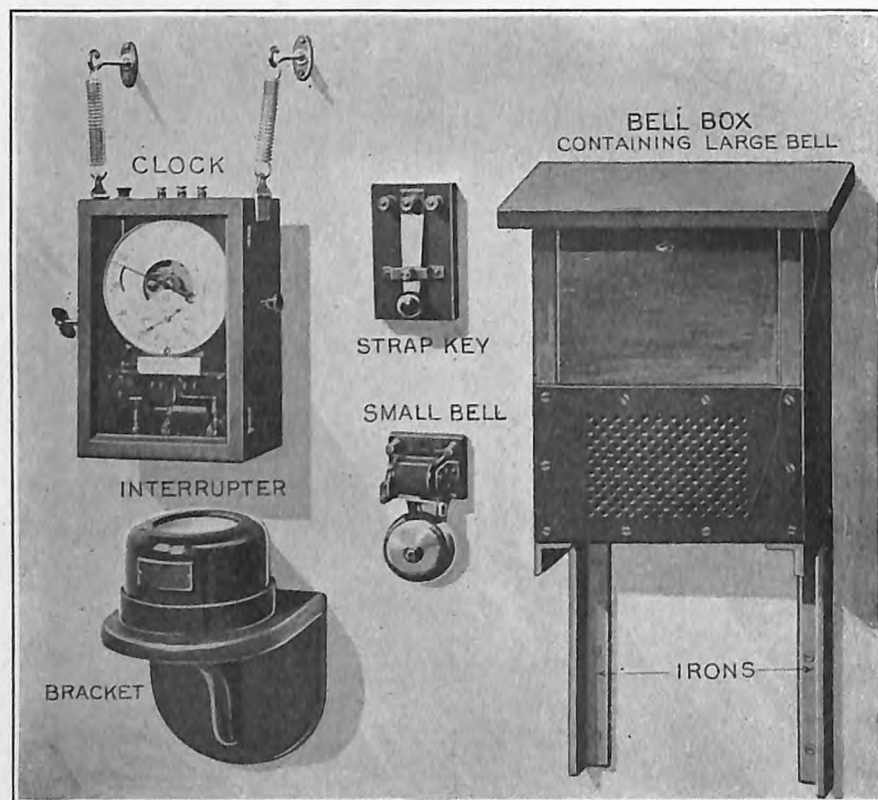


FIG. 22.—TIME INTERVAL BELL INSTRUMENTS.

circuits. The remaining equipment and functions of the distributing switchboard are now centered in the primary station on what is known as the terminal cabinet, which, it is thought, more nearly meets service requirements.

TELEPHONES AND TELAUTOGRAPHS.

The telephone, which is the most important instrument of fire control, although invaluable, is not always reliable in the din of action, and to obtain satisfactory results it is necessary to verify spoken messages by a visual repetition of them; and thus far the most satisfactory way of accomplishing this is by means of the telautograph, which electrically

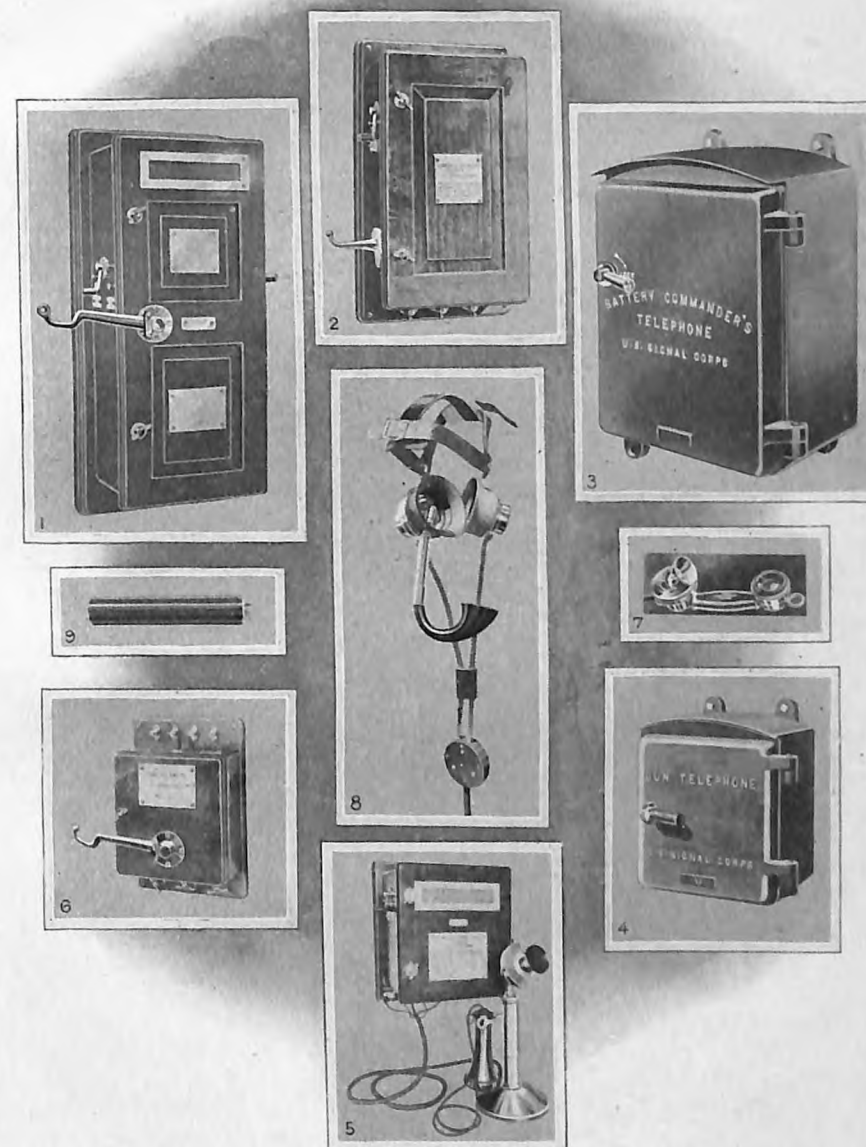


FIG. 23.—TELEPHONE INSTRUMENTS—FIRE-CONTROL TYPES.

reproduces writing and diagrams. The telautograph is necessarily a delicate instrument; the basic principle of the receiver being the ingenious application of two D'Arsonval or Weston voltmeter movements whose combined action controls the reproducing pen. The transmitters in the primary stations are variable resistances, controlled by the transmitting pencil, in series with the receiver movements. These instruments were adopted only after much difficulty to the severe demands of the coast artillery service. Though still far from perfect, the telautograph, as now constructed, gives fair satisfaction (Fig. 21). These instruments operate at a voltage of 110, with very little allowable variation, and the connecting lines to secure good results must always be maintained at the highest insulation. On the other hand, the telephones provided require no such care; they operate ordinarily with a common battery of thirty volts potential, but are so wired that they can be used in emergency with a local dry battery, placed in the instrument, if the central energy fails. Practically all the fire-control telephones now installed have been designed by the Signal Corps to meet the special needs of the Artillery.

TIDE AND METEOROLOGICAL INSTRUMENTS.

The types of the instruments devised for this work are shown (Fig. 24).

Meteorological information is conveyed to the stations indicated in the general scheme for fire control by aëroscope indicators carrying a current of 110 volts. The instruments are furnished with dials over which passes an indicator controlled by synchronous relays with reversing attachments, operated in unison by observers at the controlling instruments in the tide and meteorological stations. Much of the data formerly recorded by these instruments is now considered unnecessary, and the instruments simplified.

TIME INTERVAL CLOCKS AND BELLS.

In order that observations of the target may be taken in unison and at regular intervals for plotting and predicting positions, time intervals are marked every fifteen, twenty, or thirty seconds, by bells placed in electric circuits controlled by master clocks in each primary station. These instruments (Fig. 22) operate at thirty volts. Owing to their delicate nature, however, the clocks have given trouble, and it is hoped that they may be replaced by a master motor-generator designed to control the time intervals for the entire post or fire command.

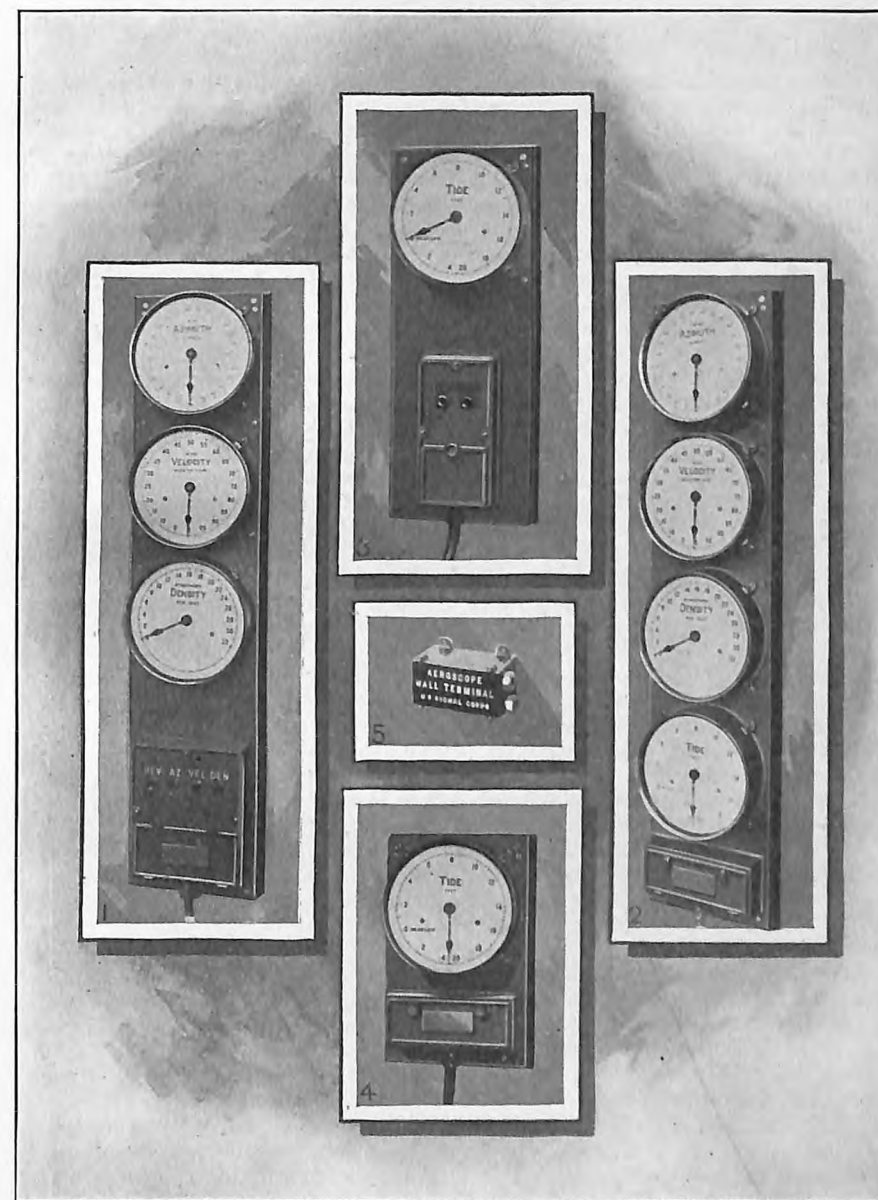


FIG. 24.—AEROSCOPE INSTRUMENTS—CONTROLLERS AND INDICATORS.

II. THE PRESENT STATUS OF MILITARY AERONAUTICS.

(Data from Signal Office March 15, 1908.)

The public at large has no full realization of the fact that aerial navigation is, at the present moment, sufficiently successful to guarantee great practical developments in the very near future.

France, Germany and England have, in the past few years, displayed unusual activity and interest in the development of air-ships for military purposes. At the present moment each of these countries has one or more successful dirigible air-ships capable of carrying several persons and limited amounts of supplies.

France. Dirigible balloon *La Patrie*: length, 198 feet; greatest diameter, 34 feet; engines, 70 horse-power—made a flight of 146½ miles in 7 hours and 15 minutes, with conditions unfavorable; best speed 34 miles per hour. The air-ship lost November 29, 1907. French Government now building a new dirigible named *La Republic*, same type as *La Patrie*, but a little more powerful.

The dirigible balloon *Ville de Paris* has a length of 203 feet; greatest diameter, 34 feet; engines, 70 horse-power. It has made a successful flight of 140 miles and made a speed of 26 miles per hour. This air-ship was taken over by the French Army for station at Verdun, in place of the *La Patrie*, which was lost.

In 1908 the military budget in France includes an item for the construction of a dirigible balloon much larger and faster than the *La Patrie*. It will have a length of 300 feet; greatest diameter, 35 feet; engines, 240 horse-power, which will give an estimated speed of 60 kilometers per hour.

Germany. A large rigid type dirigible balloon, designed and constructed by Count von Zeppelin, has a length of 413 feet; diameter of 36 feet; engines, 170 horse-power. This very successful air-ship has made a speed of 38 miles per hour. It is understood Count von Zeppelin is now designing a somewhat larger dirigible of the same type, which will be driven by engines of 240 horse-power and will probably accomplish a much greater speed.

The German military service also has a successful dirigible balloon designed and constructed by Major Von Parseval, and another designed and constructed by Major Gross, both of which have made successful flights.

England. The British Army constructed, from very limited funds, a small dirigible known as *Military Dirigible No. 1*. It has made a successful flight, but was left exposed to the weather and somewhat damaged by storms. As a result of the preliminary experiments, the aeronautical department now has under construction at Aldershot a *Military Dirigible No. 2*, having engines of 100 horse-power and designed for a speed of 40 miles per hour. It will carry six passengers.

Russia. The Russian Army is now taking steps to construct several dirigible balloons of the *La Patrie* type. Their present estimates contemplate the construction of a fleet of four dirigibles of that size and type.

Belgium. Reports indicate that the Belgian Army has contracted recently with an aeronautical constructor in Paris to furnish a high-speed military dirigible.

Italy. Reports indicate that the Aeronautical Department of the Italian Army has under construction a high-speed military dirigible balloon, which is due for completion in the spring of 1908.

In the development of aerial navigation, two distinct general types of machines are being experimented with, namely, the dirigible balloon, which consists essentially of a gas bag supporting a suitable car, comprising power to drive it through the air; and secondly, all those other forms of machines which possess no gas bag, but depend for suspension upon the dynamic reaction of the atmosphere. The machines of the latter class are heavier than air.

It is believed that the Government should proceed immediately with the design of a high-speed dirigible balloon, equal in efficiency and superior, if possible, to the *La Patrie*.

The Secretary of War has submitted to Congress an estimate of \$200,000 for the purpose of construction of air-ships and accessories for housing and operating the same. The President has taken a special interest in the appropriation and has urged that it be provided by the present Congress.

Aeronautical progress is so rapid at the present time that the loss of twelve months in case this appropriation is not provided will seriously delay the War Department in developing this important "military weapon," which is now receiving such marked attention abroad.

Fundamental scientific investigation indicates that the dirigible air-ship, when properly developed, will be the burden-bearing air-vehicle of the future, and that no serious obstacles are presented, even to-day, in the construction of such a ship of great size and speed of at least fifty miles an hour.

On the other hand, scientific principles indicate that the heavier-than-air machine must be limited to carrying small burdens at high speeds, and will, of necessity, be more dangerous to operate than the dirigible balloon.

The fundamental influence upon military art of the development of the high-speed dirigible air-ship and of the aeroplane cannot fail to be very marked, and, as an indication of this, the Hague Peace Conference saw fit to take up the subject of limiting the dropping of explosives from such ships in time of war.

A single battle-ship of the *Connecticut* type costs approximately eight millions of dollars, whereas the expense of a large size high-speed dirigible air-ship is trifling as compared with a single battle-ship, the whole appropriation asked for being but one-fortieth of the cost of a single battle-ship of this type.

It is believed that the moral influence of an air-ship, designed and constructed by American engineers and capable of operating between different points throughout this country, would be very great, and that the American people would have an inherent pride in which such a ship and a desire to compete with and excel all other nations in this newest field of transportation.

In short, it is believed that Congress will provide the comparatively small amount of funds necessary to enable the War Department to proceed immediately with the design and construction of a high-speed dirigible air-ship.

Three heavier-than-air machines have been contracted for by the Signal Office and presumably will be tried during the coming summer.