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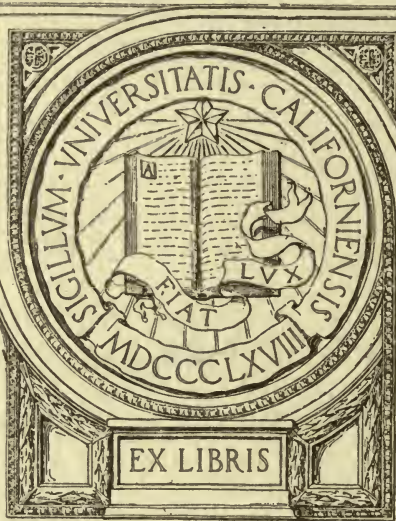


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THE
SERVICE OF INFORMATION

SCRIVEN

GIFT OF

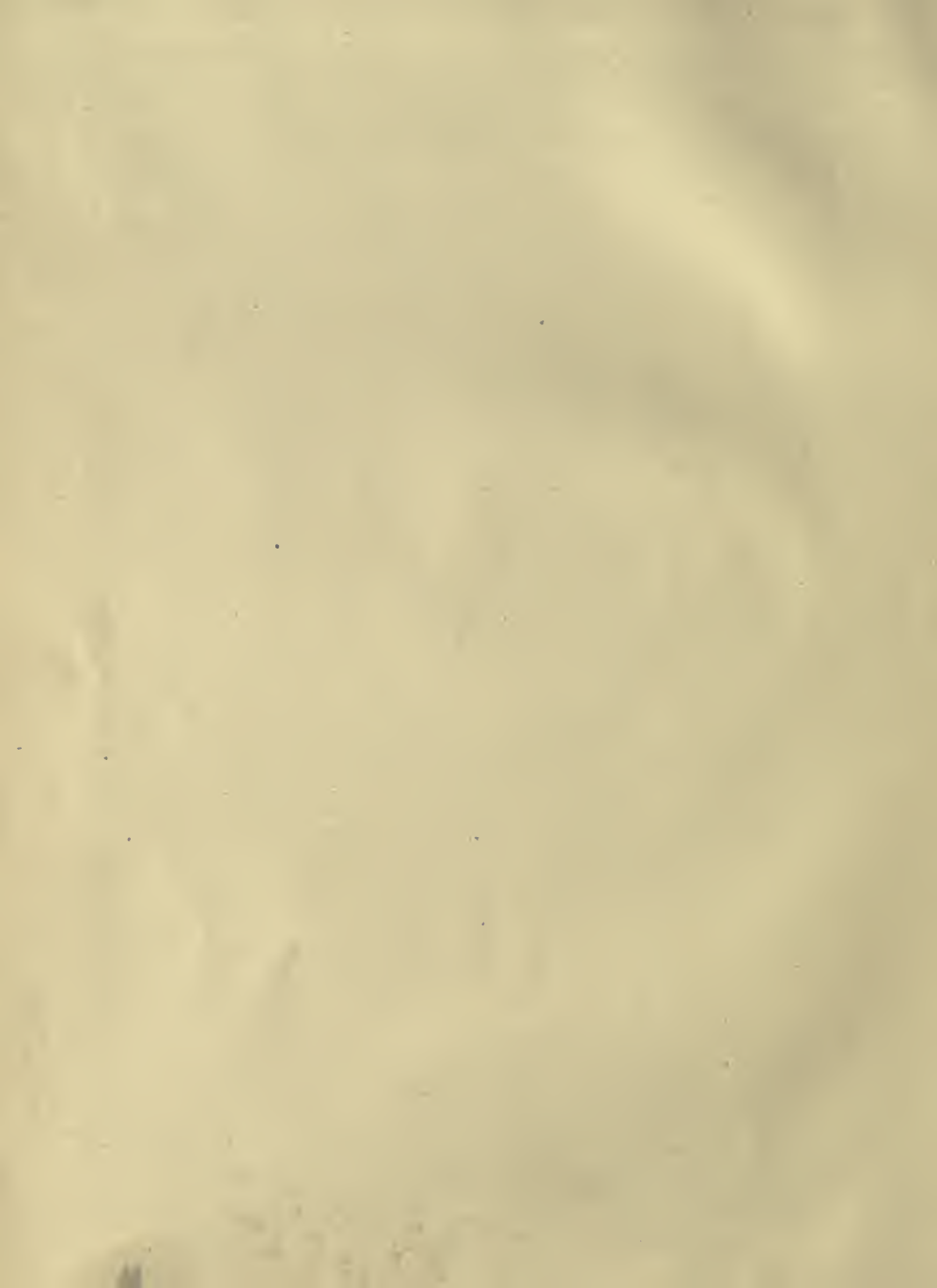


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OFFICE OF THE CHIEF SIGNAL OFFICER, 1915

THE SERVICE OF INFORMATION UNITED STATES ARMY

A REVIEW OF THE NATURE, USE, FIELD OF SERVICE, AND ORGANIZATION OF THE SIGNAL CORPS OF THE ARMY, WITH AN OUTLINE OF ITS METHODS, AND TECHNICAL APPARATUS AND NOTES ON THE SERVICE OF INFORMATION AND THE ORGANIZATION OF THE AVIATION SERVICE OF THE LEADING FOREIGN ARMIES

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WASHINGTON
GOVERNMENT PRINTING OFFICE
1915

WB250
S3

DEPARTMENT OF INFORMATION
UNITED STATES ARMY

GIFT

TO THE
ADDRESS

PREFACE.

It has long been the belief of the writer of these notes that the functions of certain branches of the service auxiliary to the line in the United States army are not in general well understood even by people who are interested in military affairs. The reasons for this are, no doubt, in part due to the fact that the functions of these auxiliaries are many and varied, and are not outlined in available form or even clearly defined except in the brief and general statements of laws, regulations, or orders affecting the service. This lack of knowledge seems to be especially true of the corps with which the writer has long had the honor to serve, the name of which gives no indication whatever of its functions, scope, and value to the army. It is thought, therefore, that an outline of the duties and field of usefulness of the signal corps of the army may be of value to those interested in military affairs, to others upon whom the army must depend for its maintenance, and to officers and men of the national guard who will be called upon to perform the duties of signalmen. To instructors and students at military schools, to officers of the regular army who may be called by detail or by accident of service to construct and maintain lines of information, and to the great mass of the volunteers if called to the defense of the country, these notes may also be of interest and use. For these reasons they have been prepared.

The writer begs to acknowledge his indebtedness to Lieut. Col. Samuel Reber, Maj. Edgar Russel, Capts. Charles S. Wallace, George S. Gibbs, and G. Soulard Turner, of the signal corps, and Mr. William M. Reading, of the signal office, for their assistance in the preparation of these notes.

GEORGE P. SCRIVEN.

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THE SIGNAL CORPS AS AN AUXILIARY
BRANCH OF THE ARMY.

THE SERVICE OF INFORMATION.

THE SIGNAL CORPS AS AN AUXILIARY BRANCH OF THE ARMY.

It is a matter of common knowledge in this country that a soldier is a fighting man whose services are due to the state; that there exist in the regular army soldiers of infantry who march and fight on foot; cavalry troopers who ride a horse; and artillerymen who serve the guns. It may even be known that engineer troops exist who belong to the line and perform the ordinary duties of the soldier in addition to their special service as engineers.

But how few people realize, even if they know, that attached to all armies there must be, in addition to the men whose first duty is to fight, other bodies of troops whose services are absolutely needed for the proper conduct of military affairs; soldiers who while they are combattant troops are charged primarily with duties technical in character and requiring special training and organization. That in fact in every properly organized army there exist, in addition to the men who carry a rifle or a saber or who man the guns, certain auxiliary and special troops upon whom the success of campaigns depend, and by whose services alone can the general in command hope to intelligently meet his enemy and oppose him with an adequate force properly supplied with food, ammunition, and the thousand needs of an army.

These troops are not as essential to success when the shock of contact comes as are the guns and sabers of the fighting line, nevertheless they are indispensable to every armed force and without their aid no mobility can exist, no battle be engaged, no knowledge of conditions be obtained. An army fights with its guns, therefore it must have powder; it fights on its belly and the belly must be fed; in these days, too, it fights with its brain and the brain must be informed. In the United States army this last function—that is, the

service of military information—is placed in charge of one corps, the Signal Corps of the army. The service thus concentrated and not scattered among several branches of the army varying in intelligence, instruction, and experience, as is the case generally abroad, is believed to have an advantage in consolidation that has not only been proved, but that is increasing with the steady advances in the science of war.

Few people, however, know the character of this corps, fewer still the service it performs, the scope of its duties or the reasons for its existence; the name but vaguely indicates the nature of its work. Since the creation of a signal corps in the early days of the civil war, its then simple functions have taken on great increase in scope and variety and its usefulness has been enormously enlarged until it is now evident that the importance of this service in military affairs, its necessity in the control of armies in the field, and its paramount value in the conduct of war have been proven beyond a doubt. Indeed, it is hardly too much to say that the great extension of fighting lines, the destructive power of enormous engines of war, and the control of the master mind seen in the present war of the nations of Europe, and indicated in the earlier struggle in Asia, are made possible not only by the advance in mechanical arts but by the harnessing of electricity and by modern methods of transmitting intelligence, which we call the transmission of military information. It is true, however, that all this is merely a growth, and though the need of information to the fighting man is more urgent now than in the earlier days as the size and power of armies increase and the control of the master mind grows more imperative, the fundamentals have not changed since man became a thinking animal. The first need of a commander, now as then, is a knowledge of events as they occur, and of conditions as they exist. To transmit this knowledge, no matter how obtained, is in brief the primary function of the signal corps.

Within the past few months it has been shown by events abroad that the service of the lines of information has become a major factor in the conduct of military affairs, if it is not now, indeed, the paramount element in the control of modern wars. Without information

and knowledge of events and conditions as they arise, all else must fail.

It is probably true, as has been said, that the art of war has not changed with the passage of years, but it is true that the science of war has changed enormously since the days of muzzle-loading guns, captive balloons and messenger service. To this change perhaps no elements have contributed more effectually than electricity and air navigation which are the two functions that permit the rapid dissemination of information regarding events as they occur, and have replaced the slow groping in the dark of contending forces of former years. With the use of these elements the signal corps is charged, and as a corps it may be said to exist for one main purpose: THE SPEEDY DISSEMINATION OF MILITARY INTELLIGENCE OR INFORMATION. True, it has other duties; but that given, the exchange of ideas in military affairs is the real reason for its existence. It is the nerve system of the army by which information is transmitted to the brain.

The *collection* of military information, also a function of the corps, though important, is secondary, since it is a duty shared by many persons in and out of the military service and does not belong to the signal corps alone.

In peace the signal corps is concerned with the management of military affairs; in war, with the control of troops and the conduct of campaigns. Undoubtedly in peace others duties are assigned to it, but these are merely superimposed upon the real work and can be equally well performed by nonmilitary agencies and do not affect the real functions of the corps.

From what has been said, therefore, it seems clear, at least to the writer, that an outline of the field of work of the signal corps of the army, both in peace and war—that is, some description of the value and conduct of the service of information, its scope and importance to the army, and its uses to the line—is needed at this epoch of constructive legislation and military uncertainty. Little has been presented on the subject, and it is certain that few laymen and not all soldiers can know or be expected to appreciate fully the value of the service that is now performed by this branch of the army.

TRANSMISSION OF MILITARY INFORMATION IN GENERAL.

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 and reach beyond the limit of years. 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 distance of thousands of miles 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, or, indeed, hears uttered words or the sound of a voice long since passed away, that at a time within the memory of living men these things were not only regarded as impossible but were undreamed of. Indeed, until the first message of the Morse telegraph passed from Washington to Baltimore thought was conveyed much as it had been 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 long construction, war speedy 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, which the signal corps had placed by cable within five minutes of Washington, or, more recently, the events abroad, of which we have but a glimmer of knowledge, but yet sufficient evidence to show the vital, almost transcendent, importance in war of the transmission of information, so signally illustrated in many actions, especially that at Nueve Chappelle.

But in war, as in peace, changed methods of intelligence communication—with all that this implies—have been due to many agencies; chemistry and the mechanical arts have, of themselves, done

their share in improvement and given us air craft in its varying forms, the searchlight, the heliograph, the acetylene light, pyrotechnics, and many other useful devices. But other agencies have played their part, and the fighting world no longer moves only on the surface of land and water. Indeed, advances in the arts of peace have vastly increased fighting power in war, and the application of science to the usual business of life, while it has multiplied the comforts of man and perhaps increased his welfare, has also enormously augmented his killing powers. At no period of the world's history has this truth been better illustrated than in the tremendous application of science to war made by the fighting nations of Europe.

If we consider for a moment the value of this application to the transmission of military information, shown in the use of the telegraph and telephone to-day in Europe and long ago by our own army in Cuba, the Philippines, and in China, and note the importance of the radio, to say nothing of the surpassing influence of the aeroplane and the many applications of science to the service of war, it should seem unnecessary to dwell here upon the military value of these aids to war. However, there are still people of intelligence who in practice think that the transmission of military thought is summed up in the use of notebook, the orderly, and his horse. But these are passing, and the trained soldier and educated volunteer understand the vital importance of time in military operations and the need for the immediate transmission of information. Hence, the necessity for a signal corps or its equivalent; for without its aid modern armies can no more be controlled than can great railway systems; the commander in the field remains blind and deaf to the events occurring around him, incapable of maintaining touch with conditions, and out of reach of his superiors or those under his authority, upon whom he depends for the execution of his plans. The brain lacks the power to control because the nerves are wanting. Time is the main factor in war; 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 lines of information of the army.

Lines of information are no longer theoretical. Of them Maj. Gen. Greely, a well-known authority on the subject remarks:

Their practical operation is the story of the field duties of the American Signal Corps in China, Porto Rico, and the Philippines. Its work placed the White House 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 with 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, alone kept 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 10,000 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 in campaigns was in general measured by the speed of the couriers; distant movements were left to take care of themselves or neglected, since, if discovered, they could only be reported after the event; immediate operations were limited; the chessboard was small. Now all this is changed, and if everything concerned in war and with the efficiency of armies should be of the best, certain it is that the nerves extending from the controlling brain to the striking arm—that is, the lines of thought transmission—should be the most perfect, the most rapid, and the most certain that science can give. Only the best should find a place. Air service, the radio, telegraph, telephone, and visual signaling apparatus, all must be supreme of their kind lest a club be placed in the enemy's hands, to our own 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 is better than that 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, the successful soldier commands the situation by force of superior knowledge, and never is it more true than in war that knowledge is power. But the kind of knowledge commended by the adage is not merely that acquired by stress of effort, but should embrace that knowledge which comes from information regarding passing conditions, which alters with them and changes from moment to moment as the shadows change. It is the comprehension upon which successful action depends and without which few of the undertakings of war can be brought to a successful conclusion. The means of securing this knowledge of events as they occur and conditions as they exist are vital in warfare. The commander inferior to his enemy in the character and service of his intelligence communication is like a blind man fighting him who can see. It follows that his information service must be of the best, and also that he must be able to use it to the fullest extent. Two great means to this end have been placed in the hands of the modern general—electricity and the aeroplane.

PERSONNEL.

It has unfortunately been the experience not only of the writer, but of many officers of experience with whom he has talked, that the value of a signal corps is not so generally understood as it should be, and that for this reason its use is frequently neglected in peace. When war comes it is reasonably certain, unless a change takes place in this respect, that many persons, especially men untrained in military affairs 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.

It will probably be conceded, considering the duties they must perform, that the men who make up the signal corps should be intelligent and well instructed; furthermore, that both officers and men should remain long with the service and make it their profession. Furthermore, it is obvious that all soldiers must be trained in peace in the use of the weapons they will employ in war, and no matter how

efficient may be the instruments and equipment of an army, no matter how good may be its telegraph lines, its radio, or its aeroplanes, it is certain that their value will depend almost wholly upon the men who use them. Hence the need for an efficient and trained personnel in peace times.

In the United States the transmission of military information is, as has been said, wisely placed in charge of one corps—the Signal Corps—and not scattered among several branches of service. The advantage of this concentration has been proved; and it is not perhaps saying too much in claiming for the men of this corps as high a standard of faithfulness, industry, intelligence, and efficiency as do or can exist among any body of soldiers the world over. The enlisted force is recruited from intelligent men in civil life, they are given severe training, and practical instruction as telegraph, telephone, and radio men; as automobile drivers; in telegraph construction and maintenance; in cable laying and testing; the use of scientific and electrical apparatus; in the inflation and handling of balloons, and scouting and reconnaissance work of aeroplanes; in the use of visual methods of signaling; riding and the care of horses and pack animals with the field companies; in fact, in the almost innumerable duties which fall to their lot in service with their corps, and the writer is glad to be able to say of the signal troops in general that in time of peace the work of the corps is essential and growing steadily in scope and importance. The theater of operations is widely extending; the march of military service is rapidly progressing; electricity and the mechanical arts have changed the very face of war; and so a technical corps such as is the signal corps must use its utmost endeavor to keep up with the progress of ideas. To advance and to properly perform the duties imposed upon it in peace, this corps should be provided with a personnel of trained men in number and skill to carry on its work in widely scattered regions, both at home and abroad. In these theaters of operation the corps is called upon in times of peace to furnish the means of transmission of information for some 90,000 men of the army on a regular footing, and should war arise it must make provision for the signal equipment of an army presumably large, but of indeterminate size.

In addition, and above all, the signal corps is charged with the building up of an efficient aeronautical service; and is slowly, laboriously, but, it is believed, effectively, performing the work. These duties are multifarious and are far too onerous and difficult to be performed in their full requirement by the force now allowed for this work.

It has been said that recent field experiments with troops have conclusively proved that for every specially trained signal corps soldier provided, not only is the field information service many times increased in efficiency, but that 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 orderlies of the past. Since this messenger service must be provided, either through 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, 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, and it needs but a glance at the enormous development of the signal service during the past year in Europe to realize the vast importance of the lines for the transmission of information to a modern fighting machine.

The duties of a corps for intelligence communication are not, however, confined to the transmission of information alone, though that is its principal function. For 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. Indeed, this corps, whose soldiers are classed as staff troops, is while in service kept by its duties in the forefront of military operations, and in the war with Spain, as in recent border troubles with Mexico, has suffered greater proportional losses in killed and wounded than any other branch of the army. 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, while signalmen have unusual opportunities for the collection of information in the enemy's country, they have at hand the means of transmission as well, 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. This is the first duty of signalmen; but in addition signal troops, and especially the aviators, have become, even more than the cavalry, the eyes and ears of the army.

From all that has been written it follows that the need for training and experience on the part of the officers and men engaged on this service is too obvious to need more than a mere mention and it will be here sufficient to quote, as an indication of expert opinion on this subject, the following remarks of a distinguished French officer:

Information service fails especially because the world is ignorant of its principles, processes, and modes of action. The transmission of intelligence demands special organs. Most armies give some telegraphic training to noncommissioned 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 be well considered a military axiom to be placed at the head of all treatises and laws affecting the army.

AIR CRAFT.

AIR CRAFT.

The signal corps is intrusted with the air service of the army—undoubtedly the most important, as it is the most recent, auxiliary in the collection and transmission of military information. Air craft are now employed for strategical and tactical reconnaissance and the prevention of reconnaissance by the enemy's air craft; for the direction and control of fire of the field artillery; for the destruction of the enemy's personnel and matériel by explosive and incendiary missiles and other means; and for the rapid transportation of superior commanding officers. The value of air craft and especially of the aeroplane, in the field of reconnaissance has been proved beyond the shadow of a doubt. Whatever may be the opinions of military men as regards the offensive importance of air craft and the present standing of the dirigible there is no longer a question as to the value of the aeroplane in rapid and long-range reconnaissance work, and of its power to secure and to transmit by radio, visual signal or direct-flight information of the utmost importance to armies in the field. So true is this that it seems probable the aeroplane and, to some smaller degree, all air craft have altered not the principles of strategy, which are immutable, but the theory and application of grand tactics. It now appears that the actual game of war is played openly with cards laid on the table, and opportunity no longer is given for inference as to concealed movements or for surprises, perhaps not even for the exercise of the high military quality of anticipation of the unseen movements of the adversary. It is now recognized that the possibility of brilliant and unexpected blows and surprises by enterprising commanders has been largely eliminated from modern operations of war by the information supplied by the aviators. It is proved that the modern air craft lays open to the field of mental view the whole visible area of the immediate theater of war and that the commander's vision reaches far beyond the limits of the actual sight of his marching troops. The air craft sees and indicates the larger operations of war and points out to the slowly moving men on the ground not only

the object to be attacked or defended, but to reconnaissance troops, especially the cavalry, the objective to be sought, the localities to be searched, and the character of information to be obtained.

By no means does the air craft supersede, nor can it ever supersede, the work of obtaining detailed information which can be acquired only by close observation, by contact, and by development of the enemy's forces and positions. This remains the duty of the troops in the field; but the air craft does indicate to either commander the character, location, and general disposition of opposing forces, and of his own commands. Not only has it been proved that the aeroplane is invaluable in locating the position of the enemy, but it has especial value to a commander in finding his own troops, in keeping him informed when movements are taking place, and of the position of his flanks and center, his outposts, his cavalry, his artillery, of the positions attained by any detached body—in short, of keeping him constantly in touch with the locations and movements of all the units of his command under the changing conditions of war.

This much is proved, but it does not follow that the air craft curtails the work of reconnaissance of other arms of the service, the infantry, the signal corps, and, more especially, the cavalry. On the contrary, it extends the usefulness and power of all, for if the general field of reconnaissance is outlined, it is obvious that the cavalry or infantry can more readily strike its objective and more quickly and accurately obtain information regarding any particular point than if obliged unseeingly to search the whole field of operations for locations and forces regarding which an intimate knowledge is desired or contact expected. In other words, by aid of air craft, and more especially of the aeroplane, a reconnaissance by troops moves less in the dark, knows better what to look for and search in detail, and loses less time and effort in accomplishing the object sought. No move of concentration from flank or center, no envelopment of a wing nor reenforcement of a weak position should remain unknown to the adversary in the case where he possesses a thoroughly efficient flying corps. It would seem, therefore, that not only has the power of all reconnaissance troops been increased by the air craft, but also that the need and importance of the cavalry in reconnaissance work

have not been lessened, but, on the contrary, have been greatly increased by them.

In addition to the influence exerted by air craft on grand operations, events now appear to show that their value in more detailed operations is great and may increase in the future to enormous proportions. It is well established that the accuracy, value, and effect in service of field and siege artillery and, indeed, of the heavy guns afloat and ashore have been greatly increased by this agency. It may almost be said that guns are fought by means of the eyes of the aviator. So clearly has this been shown that there now appears a noticeable change in artillery practice. Instead of the old-fashioned system of range finding by trial fire or of observation from the battery or elevations near by, the exact range is now found with the help of aeroplanes, by signaling positions and noting the fall or burst of the shrapnel, and there can be no doubt that artillery-fire direction has been enormously increased in accuracy by the aeroplane, especially when the shrapnel burst can not be seen from below. Infantry fire has been largely improved in efficiency by the same means.

Besides influence of this character the aeroplane has undoubted use in the finding of concealed positions, in locating hidden howitzers or mortars, and in pursuit and rear-guard actions. It will be useful in the location of ships at sea or at anchor within defenses, possibly in the detection of submarines and submarine mines, and certainly in the enormous increased efficiency given to seacoast gun fire, and especially to the coast defense, the coast guard, and many other details of observation.

But the useful, approved, and most important work of air craft is to be found chiefly in reconnaissance and the collection and transmission of information in the theater of military operations. For this reason aviation must be reckoned as a vastly important branch of the signal corps of the army.

The use of the aeroplane as a defense against aeroplane attack and for the rapid transmission of commanding officers or important personages to destinations sought is, of course, obvious.

**FUNCTIONS OF THE SIGNAL CORPS AND ITS
RELATION TO THE LINE OF THE ARMY.**

FUNCTIONS OF THE SIGNAL CORPS AND ITS RELATION TO THE LINE OF THE ARMY.

The duties of the personnel of the signal corps, formidable in peace and vital in war, cover, in addition to training as a soldier, a large amount of technical education, which requires on the part of both officers and men experience and intelligence beyond the ordinary. The duties of signalmen are many and varied. In peace these duties require the building of telegraph lines and stations amidst the frozen wastes of Alaska; the maintenance of radio service across the icebound waters of Norton Sound, and the care of cables thence south to civilization. They include the construction of lines of information for the people of our distant island possessions, and the permanent and wandering telegraph and radio systems along the southern borders of the country. They pass from the highly technical work of experiment and construction of electrical and scientific instruments in the laboratories at Washington and at the Army Signal School and the training of men in telegraphy, telephony, and radio work at Forts Wood and Leavenworth, to the aeroplane service at San Diego and San Antonio, and the tactical work and care of horses and equipment of field companies. Indeed, so many and so varied are the duties of the signal corps that it would seem its field of endeavor, if not universal, is of such vast extent as to be almost boundless. That this field is not cultivated to the highest point of utility throughout its great area and can not be so cultivated until the necessary means are furnished for the work is not the fault of the signal corps of the army. The crying needs are, of course, men and money, but first of all a comprehension of its fields of usefulness by those who should know. In other words, full employment.

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. The training for service with troops can only come through association with the line, to whom, when war comes, the signalmen are bound as

closely as are the three arms of the service to each other, for it should be remembered that, like all staff and auxiliary troops, the signal corps is essentially an adjunct to the line of the army and can have no separate existence. Indeed if we omit its special functions with the coast defense, the value of the signal corps 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 the scope and power of the corps is vital. If this knowledge is far less than it should be, as may happen with troops hastily summoned to the colors, it is a condition arising from lack of opportunity to learn.

In peace the means of acquiring knowledge of the use of a signal corps in a practical way are few; field exercises are almost the only school. When war comes the time to learn has passed. Theoretical knowledge, however, may be acquired by other means than maneuvers, and such knowledge 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, in order that the general may put in use instinctively knowledge the beginnings of which were acquired as a subaltern. Hence the need of peace training in the duties of this important auxiliary and of a sufficient personnel for its service in peace to carry on the work of training for war. Obviously a knowledge of technical equipment can not be obtained without long application, and the use of special apparatus can not be acquired between sunrise and sunset. It follows that the signal corps should, like the field artillery, be maintained at full war strength for an army of any probable size and to leaven and instruct the volunteers required for defense.

There can be no doubt that this corps in peace should be associated as closely as possible with the line of the army, with the reserves, the militia, and the volunteers if existent. With the training of these troops, their methods and service, the signalmen must be familiar, for with them his duties in war will be intimately connected. It appears therefore that a force of trained signalmen should be present at all exercises and maneuvers of troops in the field, and that an efficient number of signalmen should be placed at

large garrisons, training schools, and camps, and held in readiness to take part in all movements and exercises. Signalmen, then, should serve habitually with troops of the mobile army, and especially with the field artillery for whom various forms of signal apparatus, the radio, and especially the aeroplane become most important auxiliaries, as have the telephone, the buzzer, and pyrotechnics.

In addition, detachments of signalmen should perform many duties in connection with the coast defense and its auxiliaries. Besides these two fields of work lies the still undefined service of the coast guard where the field apparatus of the signal corps—the land cables, the buzzer, radio, aeroplane, and perhaps the dirigible and captive balloon—must find a large and important field for the defense of the country.

As has been said, 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 those who will use them in the field, and especially by those in control. It is evident, for instance, that no officer 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 the 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. For that reason he 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 quartermaster; 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 skillful 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 to not only 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.

FIELD LINES OF INFORMATION.

FIELD LINES OF INFORMATION.

THE DIVISION.

The ordinary lines of information of a division under the three conditions of the camp, the march, and contact with the enemy are worth a word of consideration, although they can not, 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 will no doubt first be sent to select sites for the encampments of the various units; quartermaster officers will locate their depots; and the medical officer the field hospitals. It will then become the duty of the signal officer of the division to install the lines of information. With division, corps, and army headquarters there will travel a radio-tractor set of the largest or smaller type now adopted by the signal corps, and these will first be put in commission. Then the signal officer will establish at division headquarters a central 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 wire or radio corps or army headquarters (if such exist) and for convenience will carry telephone lines to the chief quartermaster 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, the camps of the engineers, the signal corps, the cavalry, field artillery, to independent commands at a distance, and probably to aero squadrons; through regimental to battalion headquarters; and in case of need to outpost stations or trenches.

Within the divisional camp itself the telephone will be the ordinary means of communication between fixed stations, the telegraph

or radio being reserved for more distant work; the telegraph and telephone lines will usually be carried by lances. In addition to the 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 aero stations. 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 or radio. In a camp of this character the radio—pack, tractor, or horse drawn—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 electrical connection with its base through the last station occupied, and for this purpose the pack radio may well be used. As the advance continues lines will extend forward or the radio will maintain communication with 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 radio stations, the buzzer, or field wire advance they should be followed, if practicable, by the telegraph train with the necessary material for a lance line to replace the field or buzzer wire, for the latter 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 lines may in turn be replaced by a permanent system erected by the telegraph 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 the buzzer wire may 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 or radio only will be used for rapid work; the latter by the leapfrog method, i. e., by the use of three sections, the rear station jumping past the two preceding and thus constantly maintaining two stations in operation.

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 brigade and important commands, as the ribs of a fan expand; but here, again, the radio may best be used. 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 communication will be had by means of visual, radio signals or the aeroplane. Indeed, in flank communication there is a great field for the radio and aeroplane. During halts wire lines can quickly be thrown out, but here visual signaling may be used to advantage, and above all the radio, especially of the wheel type.

The day's march over, the division eats and rests; not so the signalmen. Then radio stations must be established and buzzer lines run from the advance guard, from the flanks, from the corps headquarters, and from the rear to division headquarters, and others laid to 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 radio will 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, probably by radio, 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. In these operations the aeroplane will find an important part to play. It will be well also to connect retreating columns moving by different

roads, and this can be done by wire and radio more readily 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 abandoned. 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.

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 chances 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 radio, 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. Herein lies one of the greatest of the fields of usefulness of the aeroplane.

However, as the division approaches the enemy the commander will make as certain as possible of his lines of information—wire, radio, or aeroplane—with corps and army headquarters, with supporting and reserve troops, and with the rear, and when actual contact comes buzzer lines will be carried to brigades, to regiments, and sometimes to the outposts. It seems probable that the radio now will be less important, and, for the troops engaged, buzzer lines will be carried forward to the firing line, where trained observers, perhaps officers, 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 radio or even by wire between the smaller reserves, the supports, and the main bodies, but

the latter is doubtful, since a great multiplicity of wires on the field of battle is hazardous.

All can not 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, except the aeroplane. Then, too, wires may be cut by the enemy's fire as at Nueve Chappelle.

Of course, when the division is actually engaged against the enemy its commander will extend his field or buzzer lines to the positions occupied by the infantry and artillery commands. He will depend in general on the radio to keep him in touch with his cavalry. The artillery will no doubt, in addition to its other lines of information, 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, and for efficiency of fire will depend upon the aeroplanes. In addition to this, the commanding general will early establish lines of information by field telephone or by buzzer, by radio, and by visual signals between some fixed positions (designated as his own) and the observation stations, captive balloons, or aeroplanes. 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.

From events abroad it seems that under no conditions in the field are lines of information of more importance than in the fire direction of field batteries, of enormous guns and mortars and in the trench fighting that has now become so enormously important in campaign. The development shown, especially in wire, telephone, and even microphone signals, though not yet fully known in detail, points to applications of electricity to the fighting line undreamed of a year ago. The radio, though still of unproven value so far as known in aviation work, is of major importance in the field and especially when used at the larger headquarters. It is thought that the four types—pack, divisional tractor, army tractor, and skid—now in use or under construction by the signal corps of the army are quite equal to any

elsewhere existing. To these must be added wheel radio of the horse-drawn type especially adapted to service with field companies. But in the development of the uses of the telephone perhaps the greatest extension of service is to be noted.

Again, in the firing of the great howitzers and mortars, concealed of course from observation, the laying and firing is done habitually by telephone from some probably distant point of observation. But it is useless here to multiply instances, and not until long after the present war is ended will a full knowledge of these and other marvelous developments be known. But enough is now known or surmised to make it certain that the work of a signal corps is growing by leaps and bounds.

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, the aeroplane, and on the portable radio of the field or skid type. With all such expeditions a supply of Very pistols and 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 20 miles, and it can be used by hand even from a boat on quiet water. But, in addition, buzzer and field wire in necessary amount must be carried as well as 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, in addition to the radio, 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. An ex-

cellent example of this was offered in the advance to Peking at the time of the Boxer troubles. Expeditions of this kind offer an important field to radiotelegraphy.

Little has been said regarding the use of radiotelegraphy, as it is obvious that the details of control of this important adjunct must be left to the commanding generals of divisions or of higher units and their chief signal officers. The same considerations apply to the service of aeroplanes and of captive balloons. The aeroplane is no doubt the greatest of all means of obtaining information in war, as the radio is at all times the most important of all methods of transmission, since it can not be cut, and under ordinary conditions may be kept free from interference and remain confidential when used with even a simple cipher. The captive balloon, too, seems to be again coming into importance. It is to be added, however, that the most reliable means of transmitting information when a line can be maintained free from interruption is the telegraph key or the buzzer.

FIELD LINES OF INFORMATION, CONCLUSION.

The signal corps is especially organized, trained, and equipped for the collection and transmission of military information, and it follows that only the most general instructions should be given to officers and men as to the manner of performing their duties. It is inadvisable, especially in brief field orders, to attempt detailed instructions; it will suffice in such orders to state the commands to be joined, their location, and a broad statement of the object desired. No details need be specified as to the means by which communications are to be maintained. It must be assumed that the signal officer, acting under his general instructions and the orders of his immediate commander, will possess the knowledge, the initiative, and the energy to meet conditions as they arise. This, however, does not follow regarding the air service when the particular objective of the commander of a division or of field artillery must be designated.

The signal officer at headquarters, in addition to caring for the technical administration and supply of the signal troops, will keep himself informed as to the location of commands, the time and character of projected movements; in short, regarding all actual and

probable happenings, so that he may make due provision in advance. He must arrange for the prompt transmission to proper authority of information received, and for the delivery of all messages. He will see that the military intelligence contained in messages to the commanding general and chief of staff is properly recorded on the map or otherwise graphically so as to be instantly available, and for this purpose should establish a central station at division headquarters, equipped to properly file all messages sent and received, in chronological order and by organizations. This station should also be able to furnish at all times exact information as to signal stations and location of troops. In carrying out the regulations for transmission of messages over any lines, the chief signal officer at army, corps, or division headquarters will be called upon to act as censor, a task requiring great tact and judgment. Another duty of a senior signal officer, especially important since the introduction of radiotelegraphy in the field, is the use of code and cipher. To him should be given the responsibility for the issue of code books, the preparation of ciphers, the enforcement of the rules for their use, the coding and enciphering of messages at headquarters, and the deciphering of messages received. This responsibility will be no small thing. In addition a signal officer in the field will be charged with the issue of field glasses, visual signal and electrical apparatus in the hands of line troops, and will make the necessary provision for their use to cooperate with the field organizations of signal troops.¹

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 information to the full extent and knows how and when to use telephone, buzzer, radio, visual signals, and the aeroplane, possesses great ability, if not genius, but there are lesser 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.

¹ Taken largely, but with unimportant modifications, from official bulletin from the office of the Chief of Staff.

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 the 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; of radio or visual stations in unknown places which he has not time to find? It follows, therefore, that systems of lines of information must not only be skillfully established and maintained, 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 are to the average citizen. As a consequence, the commanding general should not keep himself alone informed regarding the systems established 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, the general 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. Care in this matter should be enjoined until such familiarity with the lines of information and stations exists as to cause 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 intelligence can not help producing an abundant harvest. The signal corps can not work alone; it needs the best assistance that the army as a whole can render, and that assistance can best be given the signal corps by service with the line troops.

SIGNAL CORPS IN WAR.

SIGNAL CORPS IN WAR.

In war the field of operations of the signal corps contracts in extent, 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 aids to this service may, without danger, be omitted to enable the corps to fully meet its needs.

I can at this moment think of no better practical and actual description of the value and extent of lines of military information in the modern operations for war than that given in a letter from an English officer and quoted in the London Times History of the War:

I am very much surprised to see in the English press so little mention made of the field telegraphs or signal service, as it is now known. In time of war the signal companies of the Royal Engineers are one of the most important and necessary arms of the service. They are the nerves of the army.

Most of the important towns in the north of France and also London and Paris are in direct touch with general headquarters. They are called the main lines of communication, and over their lines day and night pass a continuous flood of traffic for the hospital bases, ordnance, remount, and store depots. From general headquarters radiate wires to the various army corps headquarters, and, again, each army has its communications to the divisions, which, further, have wires right up to the brigades. It will thus be seen that in the space of a few minutes the war office is fully and clearly informed of what is going on in the firing line. In fact, were the lines joined straight through it would be possible to hear the roar of artillery and the bursting of shrapnel in Martin's-le-Grand.

As the tide of battle turns this way or the other and headquarters are constantly moving some means have to be provided to keep in constant touch with general headquarters during the movement. This emergency is met by cable detachments. Each detachment consists of two cable wagons, which usually work in conjunction with one another, one section laying the line whilst the other remains behind to reel up when the line is finished with. A division is ordered to move quickly to a more tactical position. The end of the cable is connected with the permanent line, which communicates to army headquarters, and the cable detachment moves off at a trot; across country, along roads, through villages, and past columns of troops, the white and blue badge of the signal service clears the way. Behind the wagon rides a horseman, who deftly lays

the cable in the ditches and hedges out of danger from heavy transport and the feet of tramping infantry with the aid of a crooked stick. Other horsemen are in the rear tying back and making the lines safe. On the box of the wagon sits a telegraphist, who is constantly in touch with headquarters as the cable runs swiftly out. An orderly dashes up with an important message; the wagon is stopped, the message dispatched, and on they go again.

At Le Gateau the situation was so desperate that signal companies were sent to the trenches to assist the infantry in repelling a heavy attack. For this piece of work we were highly complimented by Gen. Smith-Dorien, who at the same time expressed his great satisfaction at the way in which his communications had been established throughout the campaign.

Telegraphists are often left on duty in the trenches and lonely farmhouses, chateaux, etc., close to the firing line, and I leave it to your imagination to picture how difficult it is to concentrate one's mind on the signaling and reception of important messages while the air is filled with the deafening roar of artillery and the screaming and bursting of shells. An experience of this kind happened to me a short time ago in a lonely chateau on the Ypres-Menin Road. The chateau was the center of a perfect hell of German shrapnel for nearly a week, until it became almost untenable, and was abandoned by the headquarters' staff. The general gave instructions that a telegraphist was to remain behind to transmit important messages from the brigades, and I was left in charge of the instruments in this shell-swept chateau for a day and a night. On the second day the Germans broke through our trenches, and wires were cut by the shell fire. I was given orders to evacuate the building and smash up my instruments. These I saved by burying in a shellproof trench, and then I had to escape between our own fire and that of the enemy's across a field under a terrible tornado of shrapnel. On the early morning of the same day one of our cable detachments was cut up and another captured by the Germans, only to be retaken by our sappers and drivers after a desperate and glorious fight.

In the region of the Aisne, where the hilly and wooded nature of the country admitted of much cover, spies often took advantage of this to tap out wires. The lines are constantly patrolled by mounted linemen, whose duty is attended with much risk. On one occasion a lineman in passing along his patrol noticed that there was a quantity of slack cable lying on the side of the road. Dismounting to coil it up out of the reach of traffic he found to his surprise that a piece of spare wire had been tied into the main line, and upon investigating discovered that it led to the top of a haystack, the wire being cunningly hidden in the straw. Going farther down the line he tapped it and reported the matter to headquarters, then mounting guard over the haystack he awaited the arrival of an armed escort, who discovered the spy, together with several days' supply of food, hidden in the depth of the hay.

Wireless telegraphy, of course, plays an important part in this war, most of the larger aeroplanes being equipped with apparatus, by which means they swiftly communicate important observations to headquarters. The Germans also make elaborate use of this system.

An instance was related by an American correspondent present on one occasion at a German headquarters mess when, in reply to a question of conditions on the firing line, some 40 miles away, the general commanding took up a telephone receiver from the table, called one station and there was distinctly heard the boom, boom of the artillery and the rat-a-tat of infantry fire; connecting with a second station farther along the lines of the western front, merely the infantry fire was heard, and still farther along the trenches was silence—a complete and instantaneous report of fighting conditions as they existed.

Of course, numberless examples may be cited from the civil and subsequent wars, but it seems unnecessary to note others here.

PRESENT ORGANIZATION.

PRESENT ORGANIZATION.

To perform the work at present imposed upon the signal corps there is provided an organization made up of 1 chief signal officer, 9 field officers, 18 captains, 18 lieutenants, and 1,212 enlisted men. In addition, there are allowed for the aviation section of the signal corps 60 officers and 260 enlisted men.

It should be evident, if allowance be made for absentees, the sick, changes of details from and to the Philippines, Alaska, Hawaii, Panama, and other losses, that the actual number authorized is far too small to carry on properly the duties that the mobile army, the coast defenses, Alaska, Hawaii, Panama, and the Philippines have a right to expect from a signal corps in peace, to say nothing of the coast guard. Should activities break out this force would be too small to even properly leaven 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 100,000 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. It is obvious also, in considering the enormous present importance of aeronautics, especially of aviation in the conduct of military affairs, that the number of officers and men allowed by law for the aviation service is utterly inadequate for this work. Indeed, as will be later shown, the force provided is hardly more than a nucleus upon which to build.

SIGNAL CORPS AT LARGE.

The field organization of the signal corps at large includes 5 field companies and 1 telegraph company. One field company is stationed in the Philippines, 1 in Hawaii, 1 in the Canal Zone, and 2 companies are on duty in the United States. Two platoons and headquarters detachment of a telegraph company are on duty in the

United States and a platoon is stationed in the Canal Zone and Hawaii.

The remainder of the signal corps at large is organized into depot companies, carrying on their rolls all men stationed in Alaska, at the schools for enlisted men at Fort Leavenworth and Fort Wood, the supply depots, radio operators on transports, and all detached soldiers at stations in the United States, Hawaii, and the Philippines.

The strength of the commissioned personnel of both field companies and telegraph companies is shown in orders as 1 captain and 3 first lieutenants each—a total of 6 captains and 18 first lieutenants for the 6 companies. There are at present assigned to these companies 6 captains and 7 first lieutenants, the services of the other lieutenants being required at the Army Signal School, Fort Leavenworth, Kans.; on the Washington-Alaska Military Cable and Telegraph System, and on duty as property officers at depots, etc.

Under existing regulations a field company consists of 4 officers and 96 men, divided into six sections, four of which are wire sections provided with equipment for laying field wire for buzzer and telephone communications, and two sections equipped with field radio pack sets, designed particularly for maintaining communication between divisional headquarters and the divisional cavalry. A telegraph company consists of 4 officers and 139 men, divided into six sections, three of which are telephone sections and three telegraph sections. This company is intended for service in the construction and maintenance of semipermanent telegraph and telephone systems.

The Tables of Organization, 1914, also provide for the enlargements of these units to field battalions and telegraph battalions, respectively, in time of war, and it is believed that such a reorganization of existing companies and telegraph companies to be organized would be imperative under war conditions.

A field battalion is indispensable to a division or an approximate unit. Consisting of 1 wire company, 1 radio company, and 1 outpost company it is prepared under all conditions to furnish the communication that knits the division into a whole.

The wire company, as now proposed, is divided into four sections, each equipped for laying field wire in establishing buzzer communi-

cations, with two extra reel carts in reserve. This organization contains 3 officers and 75 men. The radio company is organized into four sections, two of these being pack radio sections and two wagon radio sections, with 3 officers and 75 men. The outpost company is divided into four platoons, each equipped to supply the necessary interior communication within a brigade. This organization contains 5 officers and 75 men. The field battalion is commanded by a major, and the headquarters and supply detachment contain 2 officers (including the major commanding) and 13 men.

The main difference between the former organizations and that provided in the present tables is in the separation of the radio organizations from the wire organizations and the addition of the outpost company. It is believed that the independence of function thus introduced will serve to emphasize even more strongly the useful part which each may play in the peculiar fields to which it is adapted, and by the specialization thus made possible to train the officers and men of each organization to greater efficiency, each in his own line of work.

The telegraph battalion is charged with one of two duties—it may maintain service between the interior and the field army or connect the headquarters of the field army with its component parts. The first of these duties can be performed by a battalion assembled from the trained personnel of the signal corps serving in interior posts.

The second duty requires a unit with special equipment, which should always be maintained as such. In operations involving the occupation of territory organizations of this kind will prove of great value. They are equipped for the construction of the lines of information required for such work, and can furnish service which the field battalions could not supply on account of their being equipped with only the very portable and light material required for combat lines.

Two telegraph companies are included in a telegraph battalion. Each is organized into three telegraph and three telephone sections and includes 4 officers and 139 men. The battalion is commanded by a major, and the headquarters and supply detachment contain 2 officers and 5 men.

However, the enlargement to battalions of the companies now organized would require the following personnel:

Majors.....	6
Captains.....	17
First lieutenants.....	53
Enlisted men.....	1,473

Such a personnel would include every major of the signal corps at large, all captains but 1, all lieutenants with a deficiency of 35 in this grade, and all of the enlisted personnel allowed by law with a deficiency of 261. It is evident that such a reorganization would require the abandonment by the signal corps of the Washington-Alaska Military Cable & Telegraph System, the Army Signal School, the supervision of all communications in interior posts, all special duty, such as with radio stations and tractors and for research work, and the reduction of depots to one or two.

The maintenance of the Washington-Alaska Military Cable & Telegraph System, now incumbent on the signal corps, is necessary until further disposition of this service can be made; the Army Signal School, as a training school for officers and men, is vital to the signal corps; and the other work on which detachments from depot companies are now engaged is no less important. To maintain these activities with the smallest efficient personnel and yet equip the battalions called for by the Tables of Organization would necessitate an increase over the strength allowed the signal corps by law, as follows:

Majors.....	6	Sergeants.....	85
Captains.....	11	Corporals.....	140
First lieutenants.....	46	First-class privates.....	435
Master signal electricians.....	23	Privates.....	141
First-class sergeants.....	69	Cooks.....	22

AVIATION SECTION OF THE SIGNAL CORPS.

The present organization of the aviation section of the signal corps consists of one aero squadron; a school detachment stationed at the aviation school at San Diego, Cal.; and a detachment on duty in the Philippine Islands. It is proposed to organize as soon as practi-

cable three additional aero companies for duty in the Philippines, Hawaii, and the Canal Zone. The personnel for the company designated for the Philippines is now at San Diego, and it will be sent to Manila at the close of the typhoon season of the present year.

Under existing regulations an aero squadron is composed of squadron headquarters and three aero companies. The personnel of squadron headquarters consists of 1 major, commanding; 1 first lieutenant, for duty as adjutant and quartermaster; 2 master signal electricians; 2 first-class sergeants; 6 corporals and 2 first-class privates. The personnel of an aero company consists of 1 captain, commanding; 5 aviators, first lieutenants; 1 master signal electrician; 2 first-class sergeants; 5 sergeants; 9 corporals; 2 cooks; 14 first-class privates; and 6 privates. The transportation for the squadron consists of 3 auto trucks, 1 machine-shop tractor, 1 tank tractor, and 4 motor cycles, while the material and transportation for each company comprises 4 aeroplanes, 5 auto trucks, and 1 motor cycle.

DESIRED ORGANIZATION.

DESIRED ORGANIZATION.

The table given below shows in detail what is considered to be the proper organization of signal troops for an army consisting of seven divisions and two field armies, as well as the signal corps personnel required for the service of the interior. The latter troops are necessary regardless of the size of the army or the number of its tactical divisions, but should the number of divisions be increased or decreased, the proportion of signal troops required for duty with these divisions should be added to or taken from accordingly.

It is proposed that the organization of a field battalion shall be the same during peace as in war, and that such a battalion shall consist of three companies, as follows: A wire company, containing 1 captain, 2 first lieutenants, and 75 enlisted men; a radio company, containing 1 captain, 2 first lieutenants, and 75 enlisted men, and an outpost company, containing 1 captain, 4 first lieutenants, and 75 enlisted men. The battalion would be commanded by a major, with a first lieutenant as battalion adjutant and quartermaster, and an enlisted headquarters detachment of 13 men, making in all for the personnel of the battalion, 13 officers and 238 enlisted men.

The commissioned and enlisted personnel assigned to each of these companies has been determined from considerations as follows:

The wire company consists of four wire sections to provide for the four fundamental combat lines to the brigades.

The radio company has four pack radio sections and one wheel radio set, the former to provide constant communication with the divisional cavalry, supply trains, and for other necessary communication where the laying of wire is impracticable, the wheel set for communication with other divisions, field-army headquarters, and base.

The outpost company has four platoons, one platoon to each brigade, for the necessary interior communication within the brigade.

The lines of information of the field army are served with telegraph battalions for information to the rear and with field battalions forward to the division.

The telegraph battalion should have the same organization in peace as in war and should, as now organized at war strength, consist of two companies. It will provide all necessary camp telegraph and telephone installation in the field army and supply it with lines of information toward the base. For this purpose the companies are organized into telegraph and telephone sections.

Proper organization of the signal corps for a regular army consisting of the over-seas garrisons, four tactical divisions, the coast artillery, and auxiliary troops.

SIGNAL CORPS, LESS AVIATION SECTION.

	Brigadier general and Chief Signal Officer.	Colonels.	Lieutenant colonels.	Majors.	Captains.	First lieutenants.	Master signal electricians.	First-class sergeants.	Sergeants.	Corporals.	Cooks.	First-class privates.	Privates.	Total enlisted.
MOBILE ARMY.														
9 field battalions.....				9	27	81	27	144	225	369	54	1,080	243	2,142
2 telegraph battalions.....				2	4	16	12	42	66	92	8	260	86	566
Chief signal officers of divisions (proposed).....			7											
Chief signal officers of two field armies.....		2												
ALASKA.														
Washington-Alaska military cable and telegraph system.....				1	1	3	8	28	30	33	5	112	34	250
SERVICE OF THE INTERIOR.														
Office chief signal officer.....	1		2	1	2									
Army signal school.....				1	1									
Department signal officers, including Philippine and Hawaiian departments.....		2	3	1										
Supply depots, cable boats, Fort Wood, and assistant at New York.....						5	1							
Enlisted men for detached service.....								9	33	36	39	6	135	42
Army signal school and recruit detachment.....								3	11	12	13	2	45	14
Total.....	1	4	12	15	40	101	59	258	369	546	75	1,632	419	3,358

Proper organization of the signal corps for a regular army, etc.—Continued.

AVIATION SECTIGN.

		Brigadier General C. S. O.	Colonels.	Lieutenant colonels.	Majors.	Captains.	First lieutenants.	Total commissioned.	Master signal electricians.	First-class sergeants.	Sergeants.	Corporals.	Cooks.	First-class privates.	Privates.	Total enlisted.
Overseas garrisons:																
Philippines.....	1 aero squadron.....				1	3	16	20	5	8	15	33	6	44	18	129
Hawaii.....	do.....				1	3	16	20	5	8	15	33	6	44	18	129
Panama Canal Zone.....	do.....				1	3	16	20	5	8	15	33	6	44	18	129
In the United States:																
Mobile army—																
4 divisions.....	4 aero squadrons.....				4	12	64	80	20	32	60	132	24	176	72	516
Aviation administration.	Aviation administration.....	1	1					2								
Aviation school....	Detachment.....				1	3	2	6	3	6	12	18	2	24	12	77
Total proposed aviation section.	.....	1	1	8	24	114	148	38	62	117	249	44	332	138	980	

The additional officers would be procured by promotion and detail, under the provisions of section 26 of the act of February 2, 1901, and in general the method of selection in force in the ordnance department should be followed.

The additional enlisted strength would be procured by promotion and enlistment.

AVIATION SECTION.

The organization of the aviation units in the foreign armies suggests a squadron of 12 machines as the basis for our organization, 8 of these machines to be of the reconnaissance type and 2 each of the pursuit and combat type. In case the army remains at its present authorized strength, the personnel of the aviation section should be increased to give the sufficient personnel to supply seven aero squadrons, one for each of the four tactical divisions organized for duty in the United States, three for overseas garrisons, and a detachment for duty at the aviation school. It is to be pointed out that there is need for at least one squadron for reconnaissance work in each of the three

coast artillery districts in this country, and that a sufficient number of aeroplanes should be provided for fire direction and control of the field artillery on the basis of one aeroplane per battery, with one in reserve, or, in round numbers, six aero squadrons for this arm. This calls for the addition of nine squadrons to those above mentioned.

While the above-mentioned force will give a personnel for a flying establishment in time of peace, a much greater number of officers and men will be required in time of actual hostilities. As a step toward getting the flying men necessary to meet war conditions, an aviation reserve corps should be created including citizen aviators, mechanics, and constructors of aircraft. The officers of the aviation reserve corps should be such qualified pilots of American citizenship as shall have demonstrated their fitness for the aviation service under regulations to be established by the Secretary of War, and should be subject to call whenever hostilities are imminent. On entering the corps, these officers should agree to serve at least three weeks in each year at one of the aviation stations in the country, and while so serving should receive the pay and allowances of a first lieutenant. The men should be enrolled as members of definite organizations of the aviation reserve corps, and while so enrolled and while actually so engaged or employed in business connected with the operation or manufacture of aircraft or certain aircraft materials, should be given pay upon a peace basis. Members of the aviation reserve corps should be subject to call to aviation service, and while on such service should receive the same pay per grade as in the regular army. Organizations of the aviation reserve corps should conform to similar organizations in the regular army.

It is believed that the personnel needed for such an organization is available in the country. Although there are very few skillful cross-country fliers among the civilian pilots in the United States, there is undoubtedly material among them that could be utilized at the outbreak of hostilities. The methods of recruiting and officering such troops would be entirely dependent on the methods adopted by the line of the army.

THE SIGNAL CORPS AND GENERAL COAST
DEFENSE.

THE SIGNAL CORPS AND GENERAL COAST DEFENSE.

In the following outline of the duties of a signal corps in coast defense, duties which are made possible chiefly by air craft and 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 application and aspects, and a comprehensive survey of them is at least helpful, if not necessary, in estimating the scope and value of systems of information communications in the coast defense for the country.

The United States, unlike other 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 power and number of commercial ships and of navies increase. Types, speed, and size of ships are bringing alien shores yearly into more intimate relations and are making sea attack more easy, more swift, and more dangerous than ever before. The weight and range of floating batteries, the number and speed of merchant vessels and their great transporting power, the swarms of rapid and dependable auxiliaries, the submarine, the aeroplane, and the dirigible, leave all but strongly protected coasts without the chance of defense in war, except by airships and submarines and of course the mobile army, and fixed defenses in addition to a navy whose duty at the outset may call it into distant seas. No better instance of this kind can be cited than the attacks on the English coast about Scarborough, where coast defense was nonexistent and the navy was absent. The probability of the absence of the navy at the very moment when coast protection becomes most necessary is so strong as to amount to a certainty with a powerful and aggressive home

fleet, a fact that is well pointed out in a passage of ex-President Roosevelt's message to Congress, in which he says:

Parrying never yet won a fight. It can only be won by hard hitting, and an aggressive seagoing 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 enemy's 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.

It may be said, however, that if to the fortifications mentioned there are added airships, submarines, and an adequate mobile force, then, indeed, the plea above quoted, though primarily for the navy, stands as well for efficient coast protection.

It must be remembered that coast defense can not be improvised and that preparation for national safety can not be delayed until hostilities begin, not even until the cloud no bigger than a man's hand appears upon the horizon. Plans must have been perfected long before the country is threatened, the fixed defenses completed, and the lines of information made ready; the mobile armies and auxiliaries prepared. All this must be done during the leisure of peace, and the work must cover all zones of danger, since no man may know when or 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 the writer to enter here upon a thorough consideration of the great question of national coast defense—which must be left to abler minds—but rather to consider it in such detail only as may serve to point out its relation as a whole to sources and lines of information upon which alone intelligent action of the system can be based; that is to say, to outline the lines of signal communication which must form the nerves of any adequate system of coast security in war. 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 coast 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 the later days of tranquillity prevented the making by the nation of any serious effort to protect the coasts of the country from foreign attack until some thirty years ago when indifference began to give way 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 at last directed more and more strongly to the personnel of the defense. At last the coast artillery was given a working, if, still a skeleton, organization; efficient armament and satisfactory equipment were added; systems of fire control and direction were devised and at least partial lines of information installed. Finally it began to be understood, though dimly at first, that defenses themselves must be defended; that the eyes and the hands of men must assist in coast protection and that two important factors of the defense, namely, the coast patrol and the mobile army must form a front for any adequate system of protection.

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 attack on any part of the coast line, may be divided into six factors, each related to the other in operation and all dependent upon coordination of action for the full accession of their value. These are, first, the fixed and floating defenses: of the artillery, consisting of the armaments, submarine defenses, and material, coast and scout ships, and to some extent air craft, 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 air service, including the necessary aero squadrons of various types, with their auxiliary tractors and the dirigible when used for coast patrol and defense. Fourth, the coast patrol, including

the coast guard. Fifth, the service of the lines of information; that is, the signal corps of the army. Sixth, the navy, placed last as having little to do with the subject of this paper.

Although each of the factors given above supplements the others, it is evident that the one which binds them all into a working whole, and without which the other five will have rather less cohesion and connection than so many reeds shaken by the wind, is that of the signal corps in control of the lines of information and the service of air craft.

To arrive at a proper understanding 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 it may be practicable to do so.

The first of the factors of defense to be considered is that of the fortified positions.

FORTIFIED POSITIONS.

PERMANENT COAST OR HARBOR DEFENSES.

It may be said, in general terms, that the permanent defense of a coast or harbor 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 artillery emplacements, the fighting or tactical units of which constitute a chain of command. The artillery defense as a whole is made up of a series of tactical areas, each measurably complete and independent in itself, but separated usually by considerable distances of coast from the others, and the whole kept in touch by lines of information, usually commercial, which form a chain encircling the country.

On the coasts of the United States there are 81 separate forts where modern defenses are installed or are in process of installation; in the Philippines there are 6; in Hawaii, 4; in the Canal Zone, 5; a total of 96. It is evident, therefore, that in the event of a serious

war the fixed defenses alone will require a vast number of lines of information and, further, that for the purpose of control of its vast coast line these positions must be kept in communication not only with great centers of population and with the capital of the country but with each other, and that under certain probable conditions of war the chain of defense from Portland to Galveston, from San Diego to Puget Sound, or perhaps from Quoddy Head to the Straits of Fuca, must be kept in constant and immediate touch by telegraph, telephone, or radio. This, of course, will be largely a problem for the existing commercial lines to solve.

But without further discussing the lines of information needed to keep in touch these many positions, it becomes necessary here to consider the mobile army of coast defense.

THE MOBILE ARMY OF COAST DEFENSE.

It is probably evident to all who have considered the matter that the most necessary factor of the land defense of the coast is the mobile army, together with its auxiliaries. It is therefore unnecessary in this place to insist upon the importance of an adequate mobile army for the defense of the country. Even to the unthinking it must be obvious that without such forces there can be no real and substantial protection for the coasts, except at those positions which have been selected beforehand for fortification, which of necessity will be few in number. Even if these fixed defenses could stand alone, which they can not do, they will of necessity form but a partial and interrupted protection to an extended seaboard and will leave open to attack many important towns, serviceable harbors, and landing places that may be used by an enemy as a base or as coaling and supply stations. The fortified positions are really harbor defenses only. It is clear also that a country offering to attack some 5,700 miles of coast line, indented with innumerable minor harbors and anchorages and dotted with important towns that invite destruction, can not 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 defending navy remains within reasonable distance of the coast the 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 distant seas; to the troops of the mobile army, aided by such land batteries as can be hastily constructed and armed; to the submarine and to the air craft. 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. Protection against this danger rests with the mobile army alone once a foothold has been established on our coast.

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, in these days every serious sea attack, to be successful, must be accompanied by land operations, a fact well illustrated by the fall of Tsingtau and especially by the desperate sea fights of the Dardanelles and of the Gallipoli Peninsula and the subsequent land attacks. It is evident that though ships unsupported may cause great damage and even destroy cities or fortified positions, they can produce but little effect upon the ultimate result of a campaign unless combined with land operations, by means of which the defense is not only destroyed, but overwhelmed, the objective occupied, together with the surrounding regions.

It appears, then, should war arise, the country must be prepared to prevent throughout the vast extent of its seaboard the seizure and occupation of any one of many important points, both fortified and unfortified, and of all of its harbors and landing places useful to an enemy. This implies the existence of a mobile force so placed and so large and effective in organization 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 these mobile troops in reserve at strategic positions of the coast or possibly of the other frontiers as to permit the use of an overwhelming number of defense troops at any threatened point.

In the defense by a mobile army the plan adopted may well be somewhat as follows: The Atlantic, the Gulf, and the Pacific seaboards will be divided into defensive areas, the extent and boundaries of which will depend upon strategic, geographical, and economic conditions. These areas will not, as a rule, be coextensive with military departments, since they depend upon different conditions and lie mainly along the sea, and will be controlled by their own general officers, acting presumably under one chief. In each area there will exist in war a mobile force adequate not only for its defense proper—that is, for land defense of fixed positions, unprotected harbors, and other vulnerable points within the area itself—but for service with other troops who, upon the certainty of hostilities, will be mobilized and held as a general reserve. Within defensive areas there will be placed before the outbreak of war a sufficient number of men of the regular army, of the volunteers, and of the organized militia of the state or neighboring states to form a nucleus of the force that will be required. In addition to the aero squadrons, which form part of a division of the mobile army, there should, of course, be gathered together all of the flying men who can be brought into service with the militia or the volunteers, and to them should be allotted the duty of watching the coasts, so far as practicable.

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 signal troops, especially of the aviation section, since the first step in mobilization will be the establishment of lines of information, of which soldiers alone should be in control, and the training of airmen.

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 positions, but it is believed that if the

peace training of the militia is to thoroughly fit it for coast-defense work in its several forms this training should be widened in scope to embrace not only the lines for fire control but to include the duties of signal troops in campaign in the collection and transmission of information by all of the many methods that are employed by the signal corps in the field and by a thorough familiarity with aeroplanes and their use in reconnaissance and patrol work.

It is evident that the mobile troops of the coast defense 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 attempts at coast landing, and to perform the duties of mounted troops in the field and for air service.

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—the telegraph, the telephone, radio and air service—will be urgently needed in the organization, disposition, and control of newly organized levies. The state troops now become national troops, and, together with the signalmen of the regular army, will undertake the organization of additional signal troops from the volunteers.

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 may 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.

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 nonexistent with the organized militia of many of the states in ordi-

nary times. No doubt the main reliance must be placed upon the infantry of the organized militia and volunteers, but this, too, in the early days of a struggle will be weak in transport, staff, quartermaster, and ordnance departments, and lack of the assistance of technical troops, a condition that will hamper the defense, give to the troops little mobility, and compel them to remain tied to their base or semipermanent camps. This condition will doubtless be corrected as time goes on, but 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 the first line and the reserves will be linked together and to the permanent works should from the early 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.

SUPPORTS.

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 mobile 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 signalmen 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 mobile troops, coast guard, and with the navy.

The lines of information of these supporting troops will be those of the field army. They will be mainly dependent upon the buzzer, aeroplane—or perhaps the dirigible—the radio, field telegraph or telephone, and visual signaling.

From all that has been said it should appear that the mobile troops 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 in campaign 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 network throughout the defense area but will tie each theater of operations 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 mobile 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 headquarters and from observation stations and 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, army, 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 is 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.

It is hopeless to suppose that the signal corps of the regular establishment can ever supply more than a leaven for the mass of men needed, especially for the air service, 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 pursuits of the country, and from the few who have been trained in aeroplane work, such 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 volunteers. 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 and the assistance of the organized militia and of suitable and willing men in civil life must be asked and given. The 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, trained militiamen and airmen are at present few and confined to 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 and the air service, 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. From all this it is evident that a general reserve of telegraph, aero, telephone, and especially of flying men should be created at once, for the service of information in war.

SERVICE OF AIR CRAFT IN COAST DEFENSE.

A third and very important factor in coast defense is the service of air craft, and it is becoming increasingly evident that in addition to lines of information laid or worked on land, there must now be recognized and carefully considered the part, and it promises to be tremendous, that will hereafter be played in coast defense and observation by aerial fleets. It is not intended here to speak of the aeroplane merely, but to suggest also the potential value of the lighter-than-air craft, whose special use is now thought to be in scouting or reconnaissance work, which means, of course, its use as a coast patrol. Divided into areas or districts patrolled by dirigibles or aeroplanes, all communicating back to central stations and maneuvering far out to sea, such scouts should make impossible a hidden approach or surprise attack by an enemy. The captive balloon would also find a useful place in service of this kind. But the time has not yet arrived to indicate definitely what form the defense air service will take. It has been suggested that the coasts of the country be divided into sections or areas each of which should contain an aerodrome or center from which scouting land and sea planes could operate at sea and send reports by radio, if satisfactorily installed, to the central stations regarding the movements of enemies' or friendly ships.

Whether this air patrol shall eventually be installed and conducted by the army, the navy, or the coast guard is undecided, and in the present condition of affairs is not a matter requiring consideration here. There is involved, however, a vast and important field of signal

corps work, not alone in this aviation service, but in the transmission by wire, radio, or otherwise news received from air craft at central stations, often located at isolated points, to the proper headquarters.

The fourth 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, or coast guard, as it is now called.

THE SIGNAL CORPS AND THE COAST PATROL, OR COAST GUARD.

It will perhaps appear to a student of the present condition of our defense that the important subject of coast observations, or coast patrol has not received from the army the attention it deserves. It is true that radio and signal stations have been erected within artillery districts, and by the navy; but great stretches of coast, often containing good harbors, landing beaches, and magnificent lookout stations, sometimes deserted and at others occupied by men of the executive branches of the government, at many of which valuable information of friend or enemy at sea may be gathered, remain not only unprovided with lookout stations, but are also without the means of rapidly communicating their news to the telegraph and telephone lines of the country, and remain in general unprepared for service in war. This condition will no doubt soon be changed in accordance with the act of Congress of January 28, 1915, by which a coast guard is created by combining the life-saving service and revenue-cutter service, under the Treasury Department in time of peace and under the navy in time of war or when the President shall so direct. But it is believed that the need of the cooperation of the trained men and efficient equipment prepared by the signal corps for just this kind of work is important. 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. The 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 is only beginning to be taken up seriously as a whole, and sec-

ond, to lack of means and multiplicity of duties imposed upon the small signal corps of the army which should be associated with any plan for coast patrol.

It appears that the navy and the Treasury Department have prepared or are now preparing a guard of the coast, and have included in this service officers and men drawn from the revenue-cutter and life-saving services. It can not be doubted that the guard thus organized will form a most valuable auxiliary to the coast defense. A glance at conditions, however, will show if any doubt can exist on the subject, how closely the services afloat and ashore are interwoven in the duties of a coast guard or coast patrol; yet, perhaps for the reason that the army has thus far taken no steps towards the organization of such a guard, the cooperation of the land forces at present appears merely incidental. It seems, however, that the army should, without delay, be given a standing in regard to the coast guard and become something more than a mere auxiliary in this factor of defense, and through a properly organized patrol and air service ally itself fully with the other departments of the government in this important work. In fact, without the full cooperation of the signal corps of the army and the participation of troops trained in the service of lines of information and in the use of the aeroplane; the establishment of signal stations, and telegraph, telephone, and buzzer lines; cables; the captive balloon and the dirigible, it is hard to see not merely how the best methods of gathering intelligence in war can be employed by a coast guard, but how, when so gathered, the information obtained 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 lighthouses, or from the floating auxiliaries and passing ships, with the speed and certainty which alone make such information valuable.

INFORMATION IN WAR.

In general it appears evident that when war comes 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, but will in war become the duty of the mobile army, the fixed defenses, and of every man of the government service, both civil and military, and, indeed, of all people of the country. But although important information may thus come from many sources and, no matter what the source, should be transmitted to proper authority, yet incidental information, like incidental soldiering, is merely auxiliary to the organized service of information. 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 air craft, signal, and observation stations, from lighthouses 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, upon all of whom reliance must be placed in war to collect that information upon which will depend the attitude of the defense.

But both judgment and experience in regard to the weight to be given this information will be needed by officers and men in charge of this service, and of its transmission, 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 areas, and perhaps its ability to prevent surprise or repel attack; that the news or no news, often equally important, from the coast will govern the preparedness and vigilance of the mobile troops and supports and keep the artillerymen 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 information*, which is the second element of the service of security, 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 telegraph key or a radio instrument. In other words, that the section of the coast guard to which *the duty of transmission of information is intrusted should be composed of men trained in naval and military signaling and be familiar with the methods of the signal corps of the army*. In addition to service with the coast guard, however, it is presumed that signal men of the army and of the militia will be detailed to service with air craft as well as aboard scout ships, patrol and picket boats, and other floating auxiliaries, for duty as radio 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, the 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. It follows, and it can not be doubted, that this patrol or guard when organized should 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, should be not only steady, well-disciplined soldiers, but in addition must be carefully selected, intelligent, and keen men, skilled as observers and trained in the use of the telegraph and of mechanical appliances. Besides all this they should 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, but these men must be trained as soldiers.

ASSOCIATION OF THE SIGNAL CORPS WITH THE COAST PATROL OR
COAST GUARD.

It appears that the signal corps of the army should be closely associated with the coast guard for the duty of collecting and transmitting military information along the coasts of the United States, and especially at such exposed positions as the Philippine Islands, Hawaii, and the Panama Canal, which are of paramount importance. If so associated, it seems evident that the equipment of the coast guard for the transmission of information back from outlook and patrol stations along the coast should be that of the signal corps, which has the advantage of having been approved and well tried out in service. It is believed further that the portion of this patrol which must in time of war come under army control should be organized, trained, and equipped by the signal corps, and that the collection and transmission of information so far as it relates to army command 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 charge at the front. The men required for this work can not, and need not, be actually present during peace, except those of the executive departments of the government and hence the actual enrollment of the army 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 coast zone of a patrol of the necessary strength, made up in peace from the organized militia, 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 aeroplane and probably the dirigible; the operation of field and radio stations; the establishment of observation stations; the service and maintenance of field telegraph and buzzer lines; and, in general, 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 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 guard 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 guard will in future, in addition to the naval and other services, provide that in war the signal men of the militia be formed into companies and battalions with the signal troops of the regular army and with the necessary number of technical men of the volunteers taken from aviators, electrical men, radio and 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 patrol, however, will be governed by the character of the coast they are called upon to patrol and can not be stated generally. But probably at least one-half of the total required 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 lighthouses, 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 and hangars for aeroplanes, hydro-aeroplanes, and perhaps of captive and dirigible balloons. In addition, island stations and lightships 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 or wheel or pack radio, could rapidly be extended at need to commercial offices. In this way departments of the government which are always on duty will, when needed for coast patrol service, be ready for almost immediate use. At mainland stations of the Government should be placed signal stores of a bulk character, telegraph or telephone material, wire, lance poles, supplies for electric batteries, flags, and other apparatus for the use of the communications 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 information 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 can not 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 could be stored at the nearest artillery post or quartermaster depot.

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 commands not only should such magazines be established but each of them should be given signal and radio stations of the types authorized. With no factor of the defense is the signal corps of the army more intimately connected than with the coast patrol or coast guard, and it should be evident that without signalmen such a guard will be feeble indeed.

LINES OF INFORMATION OF COAST DEFENSE.

It is unnecessary here to enter into a consideration of the part played in past years 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 by the signal corps for the service of fire control. These matters have largely passed into the hands of the coast artillery itself. Suffice it to say that what follows applies only to lines of information that are permanent in character, which, from their extent and importance, can only be properly installed during the leisure of peace.

The work of installing the fire control was formerly performed by the signal corps of the army, and many of the types of instruments used have been designed or adapted by the corps. But in addition to the fire-control systems there must exist both within and without artillery districts the fifth factor of the coast defense, that is 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; the factors and elements of the defense are brought into coordination; 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 units are, as a rule, separated from each other by considerable distances. Each headquarters, however, 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 areas 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 radio, 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 searchlight, the tick of the telegraph key, or call of the buzzer to the message of the long-distance radio and of the aeroplane or dirigible.

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 skillfully 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, can not 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.

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, mobile troops, to headquarters and observation stations of the coast patrol. The telegraph and telephone radio sets and visual appliances should be in readiness for use in the exchange of signals between the fixed positions and coast-defense ships, patrols, picket boats, and scout ships, as well as 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 the aeroplane and dirigible should be at hand to send by radio or visual signals their messages from land or 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 radio 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 radio 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 to employ 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 areas, in addition to the material required for the emergency repair of permanent systems.

In war the headquarters of each artillery position, 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 intrusted with the transmission of intelligence for the general defenses of the coast 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 again the acknowledged importance to the defense of the radio and the air craft.

CONCLUSION.

In this paper an effort has been made to outline the actual and potential 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 coast defense and 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. These two 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 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. 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.

HISTORY.

HISTORY.

SIGNAL CORPS AT LARGE.

The first employment of a successful system of telegraphic communications in armies had its beginning in the army of the United States. The idea and its development sprang from the genius and enthusiasm of Albert James Myer, then a young army surgeon. After perfecting the codes and apparatus he urged the adoption of the system in the army. Much delay and opposition ensued, but finally, after being tried out by a board of officers and recommended by the Secretary of War, it was accepted.

The office of signal officer of the army, with the rank of major of cavalry, was created by section 17 of the act of June 21, 1860, and Albert J. Myer was appointed to the position—the first of its kind in history. He was at once sent to the department of New Mexico, where he was ordered into the field in an expedition against hostile Navajo Indians. The first signal detachment detailed to assist him consisted of Lieut. L. L. Rich, Fifth Infantry, and Lieut. O. B. Wagner, of the engineers, and 16 enlisted men. This campaign, which ended in February, 1861, demonstrated conclusively the success of Myer's system of signaling. Other officers were then detailed for instruction at Santa Fe, but upon the outbreak of the civil war Maj. Myer was ordered east. At Fortress Monroe, pursuant to an order by Gen. Butler, dated June 12, 1861, the first school for instruction in signaling was opened by Maj. Myer with 10 officers and 30 men detailed as students. On account of unwillingness to serve or inefficiency 4 of these officers were soon relieved and replaced by others. By the middle of August, 1861, the great value of communication by signals on the battlefield began to be generally recognized, especially since it became known that the Confederates had efficient signal officers in the field, and details of officers and men for signal duty were made by Gens. Banks, Stone, McCall, and others. These men were gathered into small camps of instruction at Sugar Loaf

Mountain, Hyattstown, Poolesville, Tennallytown, and Darnestown, and on August 29, 1861, a central camp of instruction was established on Red Hill, in Georgetown, D. C. Lieut. Samuel T. Cushing, who organized and commanded the signal camp of instruction at Georgetown, said:

It was a motley crowd. The officers and men were detailed from the various regiments of the army of the Potomac. Men from Massachusetts, Pennsylvania, New York, Maine, Vermont, New Jersey, Michigan, Wisconsin, New Hampshire, Rhode Island, Indiana, etc.; infantry, cavalry, artillery, buck-tails, chasseurs, lancers, zouaves, etc., all wearing uniforms that had been adopted by the state organizations before being mustered into the United States service.

As soon as they were instructed, signal parties were sent out to the various headquarters and with expeditions, and officers were sent to various commands to establish and instruct other signal parties. In December, 1861, no less than 73 officers and 147 men reported, and the total number instructed at the Georgetown camp up to March, 1862, was 103 officers and 212 men.

The parties sent out into active service varied in size. Seven officers and 14 men went with Gen. Sherman on the Port Royal expedition; 3 officers and 6 men reported to Gen. Burnside for duty on the Newberne expedition; 9 officers and 25 men joined Gen. Hooker on the south Potomac on February 24, 1862. Most of the parties sent out to brigades and divisions were called "sections," and consisted of 2 officers and 4 men.

By an act of Congress approved February 22, 1862, the acting signal corps got its first legal recognition in the words: "All officers, temporarily serving as signal officers, shall receive, for the time they are so serving, the pay of officers of cavalry." The officers of the acting signal corps were all lieutenants. There was no promotion for them in the body to which they were detailed, and being absent from their regiments they were debarred from the chances for promotion open to all other volunteers. No instance can be found of the promotion of an officer while absent from his regiment on signal duty. This same unfortunate and discouraging restriction applied equally to the enlisted men. The order under which the details for signal service were made prescribed that the officers should be "intelligent men of

education, possessing good eyesight, and persons in whom regimental commanders have especial confidence, the privates to be selected on account of their intelligence and to be able to read and write."

It is said that men of this character were quite generally picked for detail, though the sole reward was in the privilege of having work of unusual interest and the consciousness of duty faithfully performed.

Such were the effects of the system of regimental details upon the individual welfare of those concerned. The effect upon the service itself was a matter of more vital concern. Officers were frequently and unexpectedly relieved either by their own wish or that of their regimental commanders. In some cases, whole detachments, sent to fields remote from the influence of the controlling genius of this new service, were there disbanded by commanding generals and returned to their regiments for duty. This was in time remedied in part by a War Department order forbidding the relief of acting signal officers except by order of the adjutant general of the army.

Just as the appointment of the first signal officer and the detail of subsequent officers had been actively and in some cases bitterly opposed by officers of that class who were antagonistic to innovations and progress generally, the acting signal officers and men were at first used more frequently as aides and escorts and scouts than as signalmen.

The retardation of progress in the art of military signalling due to these causes varied in every command. The detail system was given a fair trial throughout a period of two years in campaign and upon the battle field. As stated by a student of the period—

in this length of time its merits, if it had any, should have been made overwhelmingly manifest, and its faults should have suggested their correction. But the experiment showed the faults too deep-seated for correction short of radical reconstruction, and the merits expected were uniformly absent.

By section 17 of the act of March 3, 1863, a signal corps was created to consist of a chief signal officer with the rank of colonel, one lieutenant colonel, two majors who were to be inspectors, and for each army corps or military department one captain and as many lieutenants, not exceeding eight, as the President might deem necessary. The officers thus provided were to receive the mounted pay of their

grades and were to continue in service during the pendency of the existing rebellion.

For each officer authorized by the act of March 3, 1863, one sergeant and six privates were to be detailed from the volunteer armies, who were to receive the pay and allowances of men of the engineers. Eligibility for appointment and detail were to be determined in part by prior faithful service in the acting signal corps, and were conditional in all cases upon the successful passing of a preliminary examination.

The history of the signal corps during the rest of the civil war merges into the history of the several armies in the field. As general officers became acquainted with its capabilities, its activities in its special line grew, its efficiency grew, and its services became indispensable to those commanders progressive enough to avail themselves of its modern and timely assistance.

It was divided among 12 military departments.

On October 21, 1863, the roll of the signal corps showed :

Captains	45
First lieutenants.....	88
Second lieutenants.....	65
Officers.....	<u>198</u>
Sergeants	47
Privates.....	767
Men.....	<u>814</u>

Of these officers, there were serving in the army of the Potomac, 26; army of the Cumberland, 42; army of the Gulf, 15; army of Virginia and North Carolina, 18; army of the South, 21; army of the Susquehanna, 3; army of the Tennessee, 41; headquarters and instruction camp, 22. From first to last about 2,500 enlisted men served with the signal corps, of which 1,783 were members of the corps. From all of these only 9 received commissions as signal officers. The commissions went principally to subalterns of volunteer regiments, a few going to enlisted men from the same, and a score or so to civilians.

Considering the short range of weapons of that period, the comparatively short lines and limited areas occupied by military operations, the system, perfection of training, and effectiveness of apparatus of the signal corps seem to have been fully adequate for the needs of its day and to have created for that corps a permanent field of usefulness.

The indispensable character of this service was uniformly attested by a long list of famous generals, including Sherman, Sheridan, Thomas, Hancock, Pleasanton, and many others.

At the close of the war, as the various armies dissolved, the signal detachments were mustered out and the corps ceased to exist.

A reorganization of the regular army followed. The military peace establishment provided by the act of July 28, 1866, included one chief signal officer with the rank of colonel, but made no provision for a signal corps. It did authorize the detail of 6 officers from the line and not to exceed 100 enlisted men from the engineer battalion. The hard-learned lessons of the great war were ignored. A system of organization that had failed and been discarded was now begun all over again. Acting signal officers were detailed from the line from time to time in varying numbers, thus exceeding the provision of the law. Likewise the number of enlisted men soon came to be fixed by executive regulation.

By the act of March 3, 1871, the duties connected with the observation and report of storms were assigned to the signal corps.

By the act of June 18, 1878, the number of enlisted men was established at 450; and by the act of June 20, 1878, the enlisted force of the corps was fixed at 150 sergeants, 30 corporals, and 270 privates, who were to receive the pay and allowances of enlisted men of corresponding grades in the battalion of engineers. By this enactment the commissioned force of the corps was increased by the annual appointment of two second lieutenants, to be selected from the grade of sergeant.

The rank of brigadier general was conferred upon the chief signal officer of the army by the act of June 16, 1880, and the number of privates was increased to 320.

By the act of August 4, 1886, the number of second lieutenants was limited to 16, the signal school of instruction at Fort Myer, Va., was abolished, and the Secretary of War was authorized to detail five commissioned officers of the army for signal duty, this number to be in addition to the second lieutenants already authorized by law.

This requirement was repeated in the acts of October 2, 1888, and March 2, 1889, by which enactments the number of second lieutenants was reduced to 14.

During the 24 years from 1866 to 1890, urged only by the sluggish demands of peace the corps advanced through a cycle of progress that corresponds almost identically with that of the first two years of the war, from 1861 to 1863. The same insurmountable obstacles were encountered. For the second time the detail system was pronounced a failure and was discarded.

President Cleveland, in his first annual message to Congress, recommended a reorganization of the signal corps of the army.

By the act of October 1, 1890, the strength of the signal corps was established at 1 chief signal officer with the rank of brigadier general, 1 major, 4 captains, 4 first lieutenants, and 50 sergeants (10 first class with pay and allowances of hospital stewards). The second lieutenants then in the corps not selected for appointment as first lieutenants were transferred to the line of the army.

Just as in 1863, the officers appointed to the corps were selected from the officers of the army by competitive examination. In selecting the board of officers to pass on the comparative merits of applicants the Secretary of War so constituted it as to represent the volunteer soldier, the scientific professions, and the graduates of the military academy.

The sergeants were selected in part from old members of the corps, and in part from the numerous candidates among noncommissioned officers of the line.

The corps was shorn of its extraneous occupations, and there began an era of feverish activity in the development of its purely military side.

The military telegraph lines on the frontier and in the Indian country were extended. Practice in signaling in line organizations was supervised, and proficiency became more general than ever

before—or since. Visual signaling, especially with the heliograph, reached a degree of perfection beyond that ever attained in any army. New instruments, new types of wire, and apparatus for handling it were invented, and the service of electrical field lines brought to a practical basis.

In the act of August 6, 1894, it was provided that upon the occurrence of a vacancy in the office of the chief signal officer the commissioned personnel of the corps was to consist of 1 colonel, 1 lieutenant colonel, 1 major, 3 captains, and 3 first lieutenants.

The act of March 2, 1897, authorized the promotions provided in the act of August 6, 1894, to be made.

Such was the signal corps at the outbreak of the Spanish-American War in 1898—a corps of commissioned and enlisted specialists.

Under the act of April 26, 1898, authority was given to add to the signal corps of the regular army in time of war 10 corporals, 100 first-class privates, and 40 second-class privates.

In providing for a signal corps for the volunteer army then being raised the same principles of organization were wisely adopted.

By section 2 of the act of May 18, 1898, and joint resolution No. 53 of July 8, 1898, a volunteer signal corps was authorized to consist of 1 colonel, 1 lieutenant colonel, 1 major as disbursing officer, and not to exceed 1 lieutenant colonel for each army corps, and 2 captains, 2 first lieutenants, 5 first-class sergeants, 10 sergeants, 10 corporals, and 30 first-class privates to each organized division of troops. It was provided that a certain proportion of these men were to be skilled electricians or telegraph operators.

In the act of March 2, 1899, authority was given to continue in the service or to appoint in the volunteer signal corps 4 majors, 9 captains, 9 first lieutenants, and 9 second lieutenants.

In orders of the Secretary of War, dated March 8, 1899, the enlisted strength of the signal corps of the army was established as 100 first-class sergeants, 200 sergeants, 50 corporals, 300 first-class privates, 50 second-class privates, and 20 cooks; and by general orders, No. 17, from headquarters of the army, dated February 16, 1900, the enlisted strength of the signal corps of the army was increased to 800 enlisted men, in grades as follows: 130 first-class

sergeants, 220 sergeants, 70 corporals, 310 first-class privates, 62 second-class privates, and 8 cooks.

By joint resolution approved June 4, 1900, the President of the United States was empowered to appoint 10 first lieutenants of volunteers in the signal corps, whose commissions were to expire June 30, 1901, and to increase the enlisted strength of the regular army to 800.

In the history of the war with Spain the regular and volunteer signal corps are inseparably connected. The 60 regulars—men and officers—were but a framework to the 116 officers and 1,000 men of the volunteers. Apart from the chief signal officer, every regular signal officer but one served as a volunteer, and all were merged and unified into one command.

While the volunteers were for the most part untrained soldiers, they were largely technically educated and skilled men—electrical and civil engineers, electricians, telegraph operators, line construction men, and the like.

The hitherto unequalled achievements of the signal corps in the war with Spain and in the Philippine insurrection which followed it are well known.

Again, as in the days of 1863 and 1864, the corps attained such efficiency in the handling of field lines of information and rendered a service so valuable that it made for itself an indispensable place in the conduct of all military operations.

The expressions of Gens. Lawton, MacArthur, Bates, Bell, and many others were unanimous and positive in recognizing not only the inestimable value of the service rendered, but the high individual ability of the officers and men of the signal corps, and the efficiency of the organization as a whole. The expressions of this character that are available would make a considerable volume, and reports of failures of the corps are curiously lacking.

After the close of the war with Spain the peace establishment of the regular army was fixed by the act of February 2, 1901, which gave to the signal corps 1 chief signal officer with the rank of brigadier general, 1 colonel, 1 lieutenant colonel, 4 majors, 14 captains, 14 first lieutenants, 80 first-class sergeants, 120 sergeants, 150

corporals, 250 first-class privates, 150 second-class privates, and 10 cooks. It provided also a system of details by the operation of which the permanent commissioned personnel of the corps would be gradually replaced as vacancies occurred by officers detailed from the line of the army for a period of four years.

In connection with the legislation of February 2, 1901, authority was granted "to continue in the service during the present emergency for duty in the Philippine Islands 5 volunteer officers in the signal corps with the rank of first lieutenant and 5 volunteer officers in the signal corps with the rank of second lieutenant."

When the war ended it seemed logical that the size of the corps and the amount of its duties would be materially decreased. The corps itself was decreased, but the duties imposed upon it continued to increase.

In order to provide in some measure for the demands upon its personnel, the act of June 30, 1902, increased the enlisted strength by 50 first-class sergeants for duty in the Philippines and Alaska only; and again, by the act approved March 2, 1903, the commissioned force was increased by the addition of 1 lieutenant colonel, 2 majors, 4 captains, and 4 first lieutenants.

These additions were followed by the provisions of the act of April 23, 1904, which fixed the enlisted force of the signal corps at 36 master signal electricians, 132 first-class sergeants, 144 sergeants, 156 corporals, 552 first-class privates, 168 privates, and 24 cooks.

By the act of July 18, 1914, an aviation section was created as part of the signal corps and charged with the duty of operating or supervising the operation of all military air craft. This section was also charged with the duty of training officers and enlisted men in matters pertaining to military aviation, and provided that in addition to such officers and enlisted men as should be assigned to it from the signal corps at large to executive, administrative, scientific, or other duty, it would contain not to exceed 60 aviation officers and 260 aviation enlisted men, with grades as follows: Twelve master signal electricians: 12 first-class sergeants; 24 sergeants; 78 corporals; 8 cooks; 82 first-class privates; and 44 privates.

HISTORY OF THE AVIATION SECTION OF THE SIGNAL CORPS.

The history of aviation in the army naturally divides itself into three periods, the first being that before there was any recognition of aviation by law, or until the passage of the act approved March 2, 1913. The second period is that from the passage of this act until the establishment of the aviation section of the signal corps by the act approved July 18, 1914, while the third period embraces the time between the formation of this section until the present. Outside of the part that the signal corps played in the experiments of the late Prof. S. P. Langley, which were terminated by the unfortunate accident to his man-carrying "aerodrome" on December 8, 1903, nothing was done to develop military aviation in the army until 1907, when the chief signal officer obtained an allotment of funds from the board of ordnance and fortification for the purchase of an experimental aeroplane for military purposes and established an aeronautical division in his office by his memorandum No. 6 of August of that year, since which latter date the division has been charged with "all matters pertaining to military ballooning, air machines, and kindred subjects."

In December of 1907 advertisements for proposals for an experimental military aeroplane were issued and 42 bidders responded, although only one presented a machine in the summer of 1908 at Fort Myer, Va. During the test of this machine an unfortunate accident resulted in the death of an officer on aviation duty and the serious injury of Mr. Orville Wright. This caused a suspension of activities until the following summer, when a new machine having been submitted for trial at the same place successfully passed the tests and was accepted.

By this time four officers were on duty in the aeronautical division, and an aviation detachment composed of enlisted men of the signal corps had been formed and stationed at Fort Myer, Va. An aviation field at College Park, Md., was leased in August of 1909 and temporary buildings erected. The lease of this field was terminated in 1913. After the acceptance of the Wright machine, it was transferred to the field at College Park, and the training of two officers, under the supervision of the Wrights, was initiated. The

aviation detachment and the aeroplane were sent to Chicago, Ill., for a display at the electrical trades exposition in December of that year, and in February, 1910, was transferred to San Antonio, Tex., for duty with the maneuver division then stationed there. When this division was disbanded in July of 1911, the detachment was consolidated at College Park with another one that had been organized there on July 7 of that year.

The establishment at College Park, Md., was designated as the signal corps aviation school by office memorandum No. 13, from the office of the chief signal officer, dated July 3, 1911, and special orders, No. 143, War Department, of that year, directed an officer of the signal corps to assume charge of the aviation field at College Park. The school was transferred to Augusta, Ga., for the winter in November of 1911, and returned to College Park in March of 1912, where it remained until November of the same year, when it was again returned to Augusta, Ga., for the winter. At the time of the departure of the school for Augusta a detachment was sent to North Island, San Diego, Cal., and after the arrival of the school at Augusta, Ga., a detachment was sent in February, 1913, to Palm Beach, Fla. This detachment joined the main detachment in March of that year after the main detachment had joined the second division at Texas City, Tex., to which place it had been ordered in March. The detachment remained at Texas City until the early part of June, 1913, when it was transferred to North Island, San Diego, Cal. On its departure from Texas City a detachment was left for duty with the second division, and this detachment rejoined the school at San Diego in November of 1913. In June of 1913 a detachment was sent from San Diego to Hawaii and return to the former place in August of 1914. In the early part of March of 1913 an aviation detachment was organized in the Philippine Islands. In December of that year the school at San Diego for the theoretical and practical instruction in aviation was announced to the army as the signal corps aviation school, per special orders, No. 79, War Department, 1913, and was made a part of the educational system of the United States army by paragraph 449, army regulations, 1913.

The act approved March 2, 1913, contains the first reference to personnel engaged on aviation duty that is to be found in the law. That part of the act referred to reads as follows:

Provided further, That from and after the passage and approval of this act the pay and allowances that are now or may be hereafter fixed by law for officers of the Regular Army shall be increased thirty-five per centum for such officers as are now or may be hereafter detailed by the Secretary of War on aviation duty: *Provided*, That this increase of pay and allowances shall be given to such officers only as are actual flyers of heavier-than-air craft, and while so detailed: *Provided further*, That no more than thirty officers shall be detailed to the aviation service.

Immediately after the passage of the act of March 2, 1913, three officers were ordered to report to the chief signal officer, Philippine Department, on or about March 10, 1913, for a course of instruction in aviation at Fort William McKinley, and one to command the signal corps aviation detachment at Texas City, while additional officers were detailed on duty pertaining to aviation at other points in the United States.

The act approved July 18, 1914, charged the signal corps "with the duty of operating or supervising the operation of all military air craft, including balloons and aeroplanes, all appliances pertaining to said craft, and signaling apparatus of any kind when installed on said craft; also with the duty of training officers and enlisted men in matters pertaining to military aviation," established the aviation branch, fixed the number and grades of officers and men, made general provisions for their detail, rating, and relief, and fixed their pay. At the time of the approval of this act there were 18 officers on duty with the aviation section. Twelve of these were rated as junior military aviators, three as aviation students, two remained on their status under the act of March 2, 1913, and one on his status under paragraph 18, special orders, No. 211, War Department, 1913.

No funds were appropriated for the purchase of aeroplanes and accessories previous to the passage of the act approved March 3, 1911, which carried the sum of \$125,000 for that purpose for the fiscal year ended June 30, 1912, \$25,000 of which was rendered immediately available. One hundred thousand dollars was appropriated for the fiscal year of 1913, \$125,000 for the fiscal year of 1914, \$250,000 for

the fiscal year of 1915, and \$300,000 for the current year. Until the passage of the act of March 3, 1911, the signal corps had been unable to purchase any aviation equipment. The only machine available for service for a period of 18 months was the original Wright machine obtained through an allotment of funds by the board of ordnance and fortification. The limited appropriations have always been a serious embarrassment to the signal corps, as it has never been able to purchase equipment adequate to the needs of the aviation service. The lack of a sufficient number of suitable machines and equipment has greatly hampered the instruction of the officers and men on aviation duty and seriously delayed the development of a suitable aviation establishment in the army.

TECHNICAL APPARATUS.



TECHNICAL APPARATUS.

Having indicated some of the many duties of the signal corps of the army, it is proper to mention here some of the most important instruments and materials which experience has proved to be suitable for this service. These instruments and apparatus, of course, change from time to time with the progress of events and the advances of electricity and the mechanical arts, but the more important of those used at the present time may be briefly set down as follows:

RADIO APPARATUS FOR THE MOBILE ARMY.

The enormous importance of radiotelegraphy in military affairs needs no comment here; suffice it to say that great attention is and has been given recently to this method of communication, and several types of apparatus have been devised by the signal corps and are in the hands of troops. The first of these is known as the radio tractor. The instruments and switchboards are installed in a specially designed covered body, which is mounted on the chassis of a commercial gasoline truck. Sufficient space is available for the transportation of a crew of 10 men. By means of a special clutch and gear the engine is made to drive an alternator for furnishing the necessary electrical energy.

The mast and umbrella type antenna are raised by means of a shears located on top of the tractor, and the average time consumed in erecting the antenna and placing the set in operation is eight minutes.

The tractors thus far developed are of 1 and 2 kilowatts capacity. Under ideal conditions the larger set has transmitted messages for distances of 250 miles; the normal range of this type under the most trying atmospheric conditions is 100 miles. The 2-kilowatt tractor is intended for use at field army headquarters. Its weight without crew is about 9,200 pounds.

The smaller tractor, known as the divisional type, has a range of from 50 to 150 miles, varying according to atmospheric conditions. The weight of this set is about 5,700 pounds without crew.

Both types of radio tractors will, it is believed, prove satisfactory under field conditions. But it is probable that horse-drawn sets, specially constructed, must be provided for the field companies.

Two types of skid sets have been developed. These are intended to be transported in escort wagons or similar vehicles. In the smaller (1 kilowatt) set the engine and the generator are mounted on skids and can be carried by two or four men. In the larger type (2 kilowatts) the engine and generator are mounted on separate frames, but so constructed that they can be readily bolted together. The weight of each unit does not exceed 350 pounds.

The receiving and transmitting instruments and switchboard are carried in a fiber case about the size of an ordinary trunk. When not in operation the switchboard lies flat in the case; in use its position is vertical.

The sectional masts and antennæ are similar to those used with the radio tractors; that is, 60 and 80 feet long, according to size of set.

The receiving and transmitting instruments of the latest type of radio packset are contained in a case slightly larger than an ordinary suitcase. The transmitter is supplied with energy obtained from a 500-cycle 110-volt self-excited alternating current generator operated manually by means of two crank handles connected with a series of gears for turning the armature at the necessary speed. The generator and gears are inclosed in a dustproof housing, so arranged that the gears continually revolve in a lubricant. The generator is mounted on a standard.

A 40-foot sectional mast is used. The antenna is of the umbrella type and consists of four stranded wires, each 85 feet long, insulated at the open ends and held by guy ropes. Instead of a direct ground connection, a counterpoise, consisting of four insulated wires, each 100 feet long, is radiated from the mast along the ground.

The time required to place the packset in operation is three minutes. Its range under ordinary atmospheric conditions is 25 miles.

Another type of radio apparatus is the radio table set, designed for use on harbor boats employed in the seacoast defenses of the

United States and island possessions. Practically the same apparatus as that in the radio packset is used in the table set, the only difference being that the instruments are mounted on a table, and instead of the hand generator, a motor generator, usually of the 110-volt direct-current type, is used. Current for the motor is supplied from the ship's lighting system. The antenna is erected on the ship's mast and does not form a part of the regular table set equipment.

Due to the fact that signals are transmitted largely over water, the transmitting range is slightly greater than that of the radio packset.

THE SERVICE BUZZER.

The service buzzer is one of the most efficient and serviceable instruments used in the army. It is strictly a portable device and can be used either as a telephone or for sending telegraph signals. When used the latter way, the sound received in the distant telephone receivers is similar to a high frequency radio spark. Signals have been exchanged over a broken line, both ends of which were slightly grounded. By providing a suitable opening in the leather case for connecting cords and directly over the knob of the sending key a round aperture covered with flexible pigskin, the instrument can be operated with the case closed—a great advantage in inclement weather. An adjustable carrying strap is provided.

FIELD INDUCTION SET.

This instrument is used on semipermanent field lines and usually replaces the service buzzer.

As with the buzzer, a high electromotive force is obtained with a small induction coil by means of which lines having poor insulation or high resistance may be successfully operated. The field induction set is designed for the transmission of telegraph signals only. All instruments are inclosed in a wooden case with carrying strap.

CAMP TELEPHONE SWITCHBOARD.

This new 40-drop switchboard is the result of years of development, and the principal advantages claimed for it on camp-telephone sys-

tems are compactness, portability, and stanchness. It has proven to be very efficient in camp service. When taken down for transportation or storage the switchboard resembles a small chest.

CAMP TELEPHONE.

This was designed particularly for use in camps, and it can be used for permanent or temporary installations. It is of the local battery type. In stormy weather it can be operated with the cover closed. The transmitter and watchcase receiver form a unit, termed a hand set, and are mounted on a metal base. When the receiver is placed to the ear the mouthpiece is automatically adjusted to the proper speaking distance.

Ordinarily the hook protrudes through the case, but when ready for transportation or when it is desired to remove the component parts from the base of the case it is merely necessary to depress and push the hook toward the case to place it in the down position. This opens the battery circuit and protects the hook. The instrument may be hung to the vertical pole of the tent or placed on a table.

HELIOGRAPH.

This method of signaling employs the concentration and reflection of the sun's rays by means of mirrors. The heliograph as originally designed abroad did not possess the features necessary to make its operation entirely successful, but in the present type developed by the signal corps many improvements have been made, so that it is now a reliable medium for visual signaling.

The latest type of heliograph consists of a screen designed to operate a shutter and control the flash reflected from an immobile mirror. All parts are carried in a leather pouch with shoulder strap.

The range of signaling depends entirely on atmospheric conditions and suitable terrain. Under favorable conditions good results at distances as great as 30 miles have been obtained, but the heliograph has been known to work at much greater distances. The rate of transmission is from 5 to 12 words per minute.

ACETYLENE LANTERN.

This is a night-signaling lantern ordinarily supported on a tripod. The carbide generator is hung from the apex of the tripod and the gas flows through a soft rubber tube to the lantern. The lantern is equipped with a special aplanatic lens mirror. Signals are made by depressing a key that opens a gas valve and causes the ordinarily dim light to flare up. Messages can be sent a distance of about 20 miles. The rate of transmission is about the same as with the heliograph.

THE VERY PISTOL.

The Very pistol is a breech-loading, single-shot pistol with an 8-inch steel barrel chambered to receive a 12-gauge commercial shotgun shell. Brass shells are used and are packed in boxes colored to indicate an element of any alphabet or any special signal which may be desired.

The Very system projects red, white, and green stars which rise to a height of about 200 feet and remain visible for some time. This system is not adapted to the general use of the dot and dash code, but should be used with preconcerted signals or with the international Code of Signals or other conventional code book.

FLAG KITS, GENERAL SERVICE AND SEMAPHORE.

Five kinds of flag kits are issued by the signal corps: The standard 2-foot kit, the Infantry 2-foot kit, and the standard 4-foot kit, for use with the general service code, and two types of semaphore-flag kits, one standard and the other of a pattern temporarily in service in the field and coast artillery, both for use with the two-arm semaphore code.

The 2-foot kit.—The standard 2-foot kit consists of one white and one red signal flag, one three-jointed staff, and a suitable carrying case to contain the outfit. The white flag is made of white galatea 2 feet square, with an 8-inch turkey-red center. The red flag is of similar size and material, the only difference being an alternation of colors in the body and center. The means of attachment to the staff consists of a loop at the center and two ends of white tape at each edge of the back of the flag body. The staff is made of hickory in three joints, each 23 inches long, and is assembled by means of brass-screw ferrules.

Brass eyes are provided on the first and second joints to receive the tape ends at the edge of the flag. The olive drab carrying case is of convenient size and shape to contain two flags and staffs complete and is bound with leather and fitted with a shoulder strap.

The infantry kit consists of one flag 2 feet square with staff and case identical with those furnished with the standard 2-foot flag kit.

The standard 2-foot kit is essentially a practice kit, although under favorable conditions of weather and terrain it may be used to advantage as a short-distance service signalling outfit. Two of these kits are issued to each troop of cavalry, each company of coast artillery, and each company of Philippine Scouts.

The 4-foot kit.—The standard 4-foot kit is of essentially the same description as the 2-foot kit except as regards size. The flags are 3 feet 9 inches square with 12-inch centers, and the staffs are considerably heavier, the joints being 36 inches long. The 4-foot kit is the standard field flag kit, and the range at which signals can be exchanged with it depends on a variety of factors, such as the condition of the weather, the location of stations, the proficiency of signalmen, etc. The speed for continuous signaling is seldom greater than five to six words per minute.

The semaphore flag kit.—This kit consists of two flags, with two staffs and case. Except those now issued temporarily to the field and the coast artillery the flags are 18 inches square divided diagonally into two parts, one of red and the other white; the staffs are 24 inches long. This is the standard semaphore flag kit.

For the field and coast artillery, the semaphore hand flags now issued temporarily are of orange with a scarlet center and scarlet with an orange center, one of each constituting a kit. The flags are 18 inches square, the center 9 inches square, and the staffs 24 inches long.

FIELD WIRE.

The wire used for lines of communication in the field has been reduced to four types, namely, field, buzzer, outside distributing, and galvanized iron.

The first type is a rubber-insulated and braided strand composed of 10 steel wires and 1 copper wire having a tensile strength of not

less than 300 pounds and weighing about 75 pounds to the mile. It is laid and recovered by means of wire carts and is used principally for telephone and buzzer work.

Buzzer wire is a conductor composed of two steel strands and one copper strand, double-cotton covered, and impregnated with an insulating compound. It is supplied in half-mile lengths and is usually laid by means of a hand reel, operated by a mounted soldier. Being used principally for buzzer lines, high insulation is not essential.

Outside distributing wire is a twisted pair and consists of a steel core plated with copper. The steel is used for strength and the copper for conductivity. It is rubber-insulated and braided and has a tensile strength of about 150 pounds. It is used chiefly for telephone purposes, as for lines between switchboard and instruments.

Galvanized iron wire is used for long or semipermanent telegraph or telephone lines and is strung on insulated supports, such as poles and brackets attached to trees. It is usually 12 or 14 gauge.

FIELD WIRE CART.

The flying field telegraph lines laid with the mobile troops are handled by means of special wire carts. These carts have been developed since the period of the Spanish-American war by successive improvements. The latest type is a two-wheel vehicle drawn by two horses, which carries upon its drums 5 miles of special field wire which can be payed out at a trot or at a gallop, and which by means of a special take-up arrangement is capable of picking up the wire as rapidly as it can be payed out.

The wires thus laid are followed by mounted linemen provided with wire pikes. These men place the field wire out of harm's way along the side of the road or trail.

This cart contains a compartment under the seat in which is carried all of the equipment, instruments, and materials used in the operation of the lines.

TIME-INTERVAL APPARATUS.

A highly efficient and accurate instrument called a time-interval device has been developed by the signal corps for use chiefly in the

fire-control systems of seacoast defenses. It is often necessary to make observations at the same instant at locations miles apart; for example, the two ends of a geometric base line. For making such observations single-stroke time-interval bells are furnished which, in connection with the time-interval apparatus, ring simultaneously and intermittently.

The apparatus is operated by means of a small inclosed series-wound electric motor with speed governed by means of a fly-ball governor to make 1,280 revolutions per minute. This motor is geared to a shaft supporting four metal disks placed equidistant longitudinally. The disks revolve at the rate of one revolution per minute. To each disk are attached metal blocks which project beyond the periphery of the disk.

The number and spacing of these blocks on the respective disks vary. The four disks operate four circuits, the interval of the signals operated being 10, 15, 20, and 30 seconds, respectively. It will be noted that at the end of each interval the circuit is energized three times, the metal blocks attached to the disks being provided with three projections, which engage and operate a quick-brake contact arm. The contact opened and closed by the contact arm is in circuit and acts on the circuit in a manner similar to a single-pole switch.

ATMOSPHERE SLIDE RULE.

This device is used in fire control in connection with ordnance of high power at seacoast fortifications. The method of construction is similar to that of the well-known commercial type of slide rule, there being two slides in the same groove. Graduated scales indicate the barometer readings on one slide and powder temperature on the other. On the upper side of the barometer slide is a stationary scale indicating thermometer reading; on the lower side is a stationary scale marked "Atmosphere." When barometer readings are placed opposite thermometer readings an arrow on the slide indicates a number on the atmosphere scale. This number is used at the plotting board in making corrections for temperature, there being a predetermined scale on hand for that purpose. In addition, on either side of the powder temperature slide is a muzzle velocity scale, one of these

scales being a continuation of the other. By placing opposite the last muzzle velocity reading obtained the temperature of the magazine on that occasion, the present muzzle velocity is indicated opposite the present temperature reading.

FIELD GLASSES.

Type A, 1910.—Magnification approximately $3\frac{1}{2}$ and $5\frac{1}{2}$ diameters; Galilean type; object lens, $1\frac{1}{2}$ inches; interpupillary adjustment; tan leather finish; tan leather-carrying case with compass; weight of glass complete, with case, cord, and strap, 28 ounces. At a distance of 1,000 yards the field view includes a diameter of 110 yards for the $3\frac{1}{2}$ power and 70 yards for the $5\frac{1}{2}$ power. Length of glass, closed, 4 inches. This glass is issued as a part of the visual signaling kit to companies of coast artillery, infantry, and Philippine Scouts, and to troops of cavalry.

Type B.—Magnification approximately $4\frac{1}{2}$ and $6\frac{1}{2}$ diameters; Galilean type; object lens, $1\frac{3}{4}$ inches; interpupillary adjustment; tan leather finish; tan leather carrying case with compass; weight of glass complete, with case, cord, and strap, 31 ounces. Length of glass closed, $4\frac{1}{2}$ inches. At a distance of 1,000 yards the field of view includes a diameter of 106 yards for the $4\frac{1}{2}$ power and 70 yards for the $6\frac{1}{2}$ power. This glass was formerly issued as a part of the fire-control equipment to field artillery.

Type C.—A high-power prismatic binocular, the present issue being the Terlux 10-power; object lens, $1\frac{3}{4}$ inches; interpupillary adjustment; common focus for both barrels, and one barrel equipped with independent focusing device; tan leather finish; sunshade; tan leather carrying case; weight of glass complete, with case, cord, and strap, 48 ounces; length of glass closed, $7\frac{3}{4}$ inches. At a distance of 1,000 yards the field of view includes a diameter of 70 yards. One glass is issued to the commanding officer of each machine-gun company and machine-gun troop.

Type D.—Prismatic binocular, the present issue being the Busch 8-power "Stellux"; object lens three-fourths inch; interpupillary adjustment; common focus for both barrels, and one barrel equipped with independent focusing device; tan leather finish; tan leather

carrying case; weight of glass complete, with case, cord and strap, 21 ounces; length of glass closed, $3\frac{5}{16}$ inches. At a distance of 1,000 yards the field of view includes a diameter of 96 yards. This glass is issued to field companies of the signal corps and on account of its excellence, light weight, and small size this glass is especially suitable for the personal field glass of an officer who desires a high-power field glass.

Type EE.—Prismatic binocular, 6 power; object lens, $1\frac{3}{16}$ inches; interpupillary adjustment; each barrel equipped with an independent focusing device; one barrel equipped with a horizontal mil scale; tan leather finish; sunshade; tan leather carrying case with compass; weight of glass complete with case, cord, and strap, 41 ounces; length of glass closed, $4\frac{1}{8}$ inches. At a distance of 1,000 yards the field of view includes a diameter of 140 yards. This glass is the approved glass for issue to field artillery organizations.

To the above brief outline of the more important apparatus used in transmitting military intelligence are added, of course, pyrotechnics, smoke and flash bombs, radio apparatus, and other signals for use with aeroplanes; telegraph instruments, cipher codes, and other small matters too many to note here. Indeed, it may be said that any device which promises a new or exceptionally good method of transmitting intelligence is tried out for adoption by the signal corps of the army.

**OPPORTUNITIES FOR VOCATIONAL TRAINING
OFFERED BY THE SIGNAL CORPS.**

OPPORTUNITIES FOR VOCATIONAL TRAINING OFFERED BY THE SIGNAL CORPS.

Probably in no other branch of the service are there more opportunities for character development and vocational training than in the signal corps. This corps, although having the status of a staff corps, offers also many of the advantages of the cavalry and the infantry. The opportunities afforded to capable, ambitious young men to secure a technical education in many lines of endeavor, in addition to the beneficial influences of outdoor work, are especially valuable. The primary function of the signal corps is the transmission of military information, and the present-day methods of communicating thought, embracing as they do the telephone, the telegraph, the radio, the aircraft, visual signaling, and especially the use of many kinds of gasoline engines and motors, are subjects of endless investigation and vast possibilities.

The technical education of the signalman is very carefully considered. Schools of instructions are maintained at Fort Wood, New York harbor, and Fort Leavenworth, Kans., where courses are given in telegraphy, including radio, military signaling, electricity, photography, line construction; general instructions concerning the care and handling of government property and rendering the necessary reports, and handling moneys received at military telegraph offices, as well as practical military instruction covering the duties of a soldier; while the aviation school at San Diego, Cal., and the aviation center at San Antonio, Tex., furnish instruction regarding the repair, maintenance, and flying of aeroplanes. In addition to the schools named, each field and telegraph company has its school, in charge of capable officers, where classes are conducted for instruction in the duties performed by the signal corps. Separate laboratories are maintained in Washington, D. C., and at the United States bureau of standards in the same city. Detachments of the signal

corps on duty at these stations are engaged in experimental work of a most interesting character. Associated with electrical and radio engineers of a high degree of training and ability, members of these detachments are furnished opportunities, in both theory and practice, to perfect themselves in technical and intricate branches of electrical engineering. Excellent opportunities are also offered for making use of any special aptitude, as that of a blacksmith, carpenter, engineer, machinist, plumber, cable splicer, and many similar occupations, and men possessing a limited knowledge of any of these occupations on entering the corps have in many cases been able to gain valuable experience and practice, thus not only often leading to rapid promotion and agreeable service while members of the corps, but equipping them with a calling wherewith to earn a livelihood in civil life after their terms of enlistment has been completed.

Among the subjects taught by the signal corps, special mention is made of modern aeronautics and radio telegraphy. The development of aeronautics in the army, with which the signal corps is charged, offers a field that is new and full of promise. Modern aeronautics, likewise electrical power in the army, depend primarily on the gasoline engine—the machine that has been the magic force in modern progress—which in itself can be made the subject of a liberal education. The rapid rise of radio telegraphy and its general application have been phenomenal. The signal corps has applied this means of communication wherever its use is possible, and has developed and built high-power stations in Alaska, the Philippine Islands, and in the United States; has devised and constructed portable tractors of the automobile type for use at division, corps, and army headquarters, as well as skid and pack sets for use with small commands and under varying conditions. Radio operators are required for the operation of these stations, as well as expert gasoline-engine men for the high-power stations, and chauffeurs with the tractors. The signal corps has also installed radio stations on all army transports and supplies the operators needed at these stations.

The constantly changing aspect of radio telegraphy and the rapid advance in the instruments employed for wire communication in the

mobile army offer a field of experimental and research work of unlimited extent and value. The highly efficient and modern instruments now employed by our army for both wire and radio communication are almost all the direct results of development work accomplished at the signal corps laboratories. Opportunities for so easily and cheaply acquiring high professional attainments of a character readily translated into terms of success are rare and exceptional, yet the signal corps is to-day offering such opportunities.

In photography, another field of commercial endeavor, the signal corps is also deeply interested. Charged as it is with the making and collecting of the pictorial history of the country's military life, experimental and practical work of this character is not the least of its many opportunities. In its Washington laboratories both motion and ordinary photography are studied for the benefits of its service at large.

The course at the schools at Forts Wood and Leavenworth usually covers a period of about six months, at the end of which the men have ordinarily obtained the necessary foundation in theory and practice to enable them to be assigned to practical work, such as maintaining telephone systems at military posts; operators at telegraph offices and radio and cable stations; linemen; gasoline engineers, and photographers at detached stations or with field and telegraph companies. The men upon completing the course of instruction at the aviation school at San Diego are usually assigned to duty with aero squadrons at aviation centers.

The exceptional feature about an education obtained in the signal corps is that it not only furnishes the necessary theoretical knowledge, but also supplies the practical experience without which theory is to a great extent worthless. The signal corps is constantly installing and operating telephone, telegraph, and cable systems and radio stations under conditions as varied as may be found anywhere on the face of the earth. At the forts throughout the United States and in our possessions abroad telephone systems are constructed that offer all and considerably more problems than are found in ordinary commercial work; the operation of the Washington-Alaska military cable and telegraph system furnishes experience in deep-sea cable

laying and sending and receiving messages by means of the siphon recorder; while in Alaska, in the southwest, the Philippines, the Canal Zone, and Hawaii the corps constructs and operates telegraph lines and radio stations. At the aviation school and at aviation centers valuable experience can be gained in the care and operation of flying machines. Service in the mounted organizations of the corps—field and telegraph companies—in addition to furnishing knowledge along the lines of signal corps work, adds experience in the care and handling of animals and the novelty of service with line troops of the army.

Whereas it is of course evident that no one man can receive instruction in all or even in many of the matters taught, it will be seen that the breadth of operation of the corps makes the practical experience to be gained more extensive and varied than is possible in more constricted services of either civil or military life. The enlisted personnel becomes efficient in both inside and outside construction, coming in contact with practical electricity when applied to communication in all its aspects, as well as obtaining physical stamina by reason of healthful outdoor work and exercises.

Another incident to service in the signal corps, both instructive and agreeable, is the opportunity for service in various parts of the world, the extent of which is perhaps offered to no other branch of the service. The care and operation of a complete network of cable and telegraph lines and radio stations, and the installation of telephone systems take them to all parts of the United States, the Canal Zone, the Philippine Islands, Hawaii, and Alaska.

After 30 years' service, signal corps men, like other soldiers, are entitled to be retired and to receive monthly during life three-quarters of the regular pay received at date of retirement, with additional allowances for clothing, subsistence, quarters, fuel, and light. A soldier entering the service at the minimum age of 18 years may therefore retire before he is 50 years of age. Should a noncommissioned officer so retired have reached the grade of master signal electrician he will have a pension for the remainder of his life of \$90 a month; a first-class sergeant, \$67.50 a month; a sergeant, \$60.75 a month; a corporal, \$47.25 a month, while a cook, first-class private, or private would receive \$51.75, \$42.75, and \$34.50 a month, respectively. It follows that after 30 years of service, even if the soldier

has saved nothing from his pay or allowances during the time of his service, he will still have accumulated a very comfortable income for the remainder of his days. A number of men retired from the signal corps have obtained responsible and well-paying positions in civil life.

The grades and pay of enlisted men of the signal corps are as follows:

	First enlistment.	Second enlistment.	If reenlisted within three months.				
			Third enlistment.	Fourth enlistment.	Fifth enlistment.	Sixth enlistment.	Seventh and subsequent enlistments.
Master signal electrician.....	\$75.00	\$79.00	\$83.00	\$87.00	\$91.00	\$95.00	\$99.00
First-class sergeant.....	45.00	49.00	53.00	57.00	61.00	65.00	69.00
Sergeant.....	36.00	40.00	44.00	48.00	52.00	56.00	60.00
Corporal.....	24.00	27.00	30.00	33.00	36.00	39.00	42.00
Cook.....	30.00	33.00	36.00	39.00	42.00	45.00	48.00
First-class private.....	18.00	21.00	24.00	27.00	30.00	33.00	36.00
Private.....	15.00	18.00	21.00	22.00	23.00	24.00	25.00

The pay of enlisted men serving in Alaska, China, and the Philippine Islands is increased 20 per cent, and a further increase of 35 cents per day is allowed enlisted men of the signal corps employed in Alaska on the Alaska cable and telegraph system for periods of not less than 10 days.

All enlisted men, in addition to their regular pay, receive rations, quarters, clothing, fuel, bedding, medicine, and medical attendance when required.

Owing to the technical and professional nature of the service in the signal corps, a large proportion of the enlisted men are non-commissioned officers.

About one-third of the entire enlisted strength of the signal corps are professional soldiers who expect to remain in the service until they reach the retiring age.

More than 60 per cent of the men who enlist in or are transferred to the corps fail to reenlist at the expiration of their terms of enlistment, the majority of whom, no doubt, being enabled, as a

result of the technical training and experience obtained during service in the signal corps, to secure lucrative employment in civil life.

It must, therefore, be evident that service with the signal corps of the army not only offers an excellent career for young, energetic, and ambitious men and affords training in the development of self-control and regularity of habits, as well as improvement in physical vigor, but extends excellent opportunities for advancement in many lines of mechanical endeavor, including some of the most useful and unlimited occupations falling to the lot of man.

NOTES ON THE SERVICE OF INFORMATION
IN THE ARMIES OF FOREIGN NATIONS.

THE ORGANIZATION OF TELEGRAPH TROOPS.

NOTES ON THE ORGANIZATION OF TELEGRAPH TROOPS IN FOREIGN ARMIES.

The notes which follow, referring to the signal and flying services of foreign armies, are taken from the best available sources of information at the time of writing, but under present conditions there can be no doubt that changes are many and frequently made, especially in the flying corps. Much, however, is unchanged, and these notes are useful and interesting.

GREAT BRITAIN.

The army signal service of Great Britain has been recently reorganized along lines that are similar to our own. The data that follows does not apply to the special units organized in India nor the units furnished for the transmission of information within or between permanent fortifications. The means furnished for communication in permanent fortifications depend upon the particular situation in each case, and no definite organization is laid down for this purpose. The communication units within the Indian Army are based on the same general lines as of the main force at home, but the organizations that are attached to the higher units, such as armies and corps, have not as yet (1914) been organized. It is probable, however, that service in France has necessitated the assembling of such units.

The army signal service of Great Britain is one of the great administrative services of the army. It is commanded by a director of army signals, whose instructions are given by the general staff. Thus the director of army signals occupies an analogous position to our chief signal officer. Representatives of the director are assigned to the headquarters of the inspector general of communication, an army, cavalry division, infantry division, and a detached brigade.

The service is organized into signal squadrons, troops, and companies. To each unit is furnished the necessary equipment for the

particular duties which it may be called upon to perform. The assignment of the signal-service organizations to units of the Army is based on the fact that commanders are charged with the arrangements for communication between themselves and their subordinates. Consequently units of the signal force are assigned as a component part of the various tactical units down to and including a brigade for the use of their commanders, as circumstances may require. This assignment is about as follows:

For a cavalry division: One signal squadron.

For a cavalry brigade: One signal troop.

For a division: A divisional signal company, consisting of four sections; one section for divisional headquarters communication; three sections for employment within a brigade.

For an army and for general headquarters, as circumstances may require: One general headquarters signal company, an army headquarters signal company, and such air-line, cable, and radio sections as the character of the campaign may demand.

For the lines of communication signal companies are furnished in sufficient number to meet the requirements of the situation. They are provided by the signal service within the limits of the command of the inspector general of communication.

The details of organization of the units that follow were those which obtained at the outbreak of the present war. It is not known what changes this great conflict has brought about, but in view of the special nature of the work required of the signal units in trench warfare, it is safe to assume that changes to fit the particular duties at hand have been made.

In general, signal units attached to the mounted forces make use of the motorcycle, the horse, the bicycle, visual signaling, wire communication—both telephone and telegraph—and radio stations. The signal unit attached to a division, as will be noted, is not provided with means of radio communication. The army signal troops, however, use in addition to the other means the radio section. The signal companies on the line of communication are provided with motorcycles, dispatch riders, and with permanent material for telegraph, cable lines, etc.

The British regulations contain a provision which states that in case the personnel at the disposal of the director of army signals is not sufficient for the needs of a special situation the general staff is charged with the duty of furnishing the required number. The mounted troops attached to a division are available for this purpose.

In addition to the units of the army signal service furnished for communication, there is another group of signalers trained to a greater or lesser degree of efficiency, upon whom depends the communication within and between the units of less strength than a brigade. These troops are a component part of the unit to which they are attached. They are commanded by the adjutant of the unit, or by an officer whose peculiar qualification fits him for the duty. A percentage of these units are trained only as signalers in the use of flag, heliograph, telephone, and buzzer communication, and a percentage are trained in the use of means provided for visual signaling only. This same system pertains to our own service, but to a lesser degree, and in our service no definite rules have been laid down for the employment or command of the individuals as a unit.

The organization of the units of the army signal service in Great Britain are approximately as follows:

The signal squadron, whose total strength is about 200, is divided into four troops averaging about 42 individuals each. These troops are designated A, B, C, and D, and correspond in a measure to the sectional divisions of our field battalion. The equipment furnished to them is practically as follows:

Troop A: 2 radio wagons.

Troop B: 2 wire detachments, furnishing about 28 miles of line.

Troop C: 1 radio wagon and three radio pack outfits.

Troop D: 12 mounted men, 28 bicycles, 6 motorcycles, and 2 motor cars.

The normal duties that fall to the lot of these troops are outlined by regulations as follows:

Troop A: Intercommunication between cavalry and divisional headquarters, and general headquarters.

Troop B: General communication within a division, and intercommunication with the permanent telegraph system of the country.

Troop C: Intercommunication between divisional headquarters and brigades or detachments on reconnaissance.

Troop D: Provisional signaling and orderly messenger duties in conjunction with the other means of communication.

The signal troops with the cavalry brigade, whether assigned to a division or not, are furnished with means of telephonic, visual signaling, and messenger service.

The signal troop for a cavalry brigade within the division is composed of about 24 men, whereas the troop attached to a detached mounted brigade is composed of about 43 men. The divisional signal company, which is divided into four sections, has a strength of approximately 7 commissioned officers and 186 enlisted men. For communication within the division 30 miles of buzzer line are furnished. For visual signaling, orderly duties, etc., there are four mounted men, eight bicyclists, and nine motorcyclists.

For communication within the infantry brigades, or between them and the artillery, 8 miles of line, with 10 portable telephones, are furnished, and 8 bicycles.

The headquarters of the unit attached to the general headquarters is supplied with 24 motorcycles and such cable and wire sections as may be necessary for communication between general headquarters, cavalry, and army corps headquarters, and headquarters of independent divisions or other forces. The unit attached to the army headquarters, designated as an "Army headquarters signal company," is supplied with 18 motorcycles and such air line and cable sections as may be necessary for linking the corps headquarters, division, and the various parts of the corps.

The air-line sections referred to are organized into three sections of two detachments each, with a total of about 6 officers and 205 men. The unit is provided with material for the erection of about 20 miles of line, with the necessary instruments and operators.

The cable section, to which is assigned 7 officers and 179 men, is equipped to set up and maintain 20 miles of cable, with offices, etc.

The radio section consists of 3 officers and 68 men, operating three radio (wagon) sets.

The signal company line of communication is not organized into a unit of definite size, but as is the case in the telegraph battalion of

our service that is intended for use on lines of communication, the organization remains to be dictated by the circumstances of employment.

The subjoined tables, with the explanatory remarks, outline the personnel and equipment that are maintained within the tactical units for intercommunication and that are not furnished by the signal organization.

The various types of artillery organizations—that is, the horse, field, and heavy battery or regimental artillery organizations—in general provide within themselves the necessary means of communication either between their component parts or organizations of other arms. The regulations provide that this equipment is primarily intended to maintain communication between the battery commander and his battery, but when favorable circumstances make it possible it should maintain communication between the artillery brigade commander and the divisional artillery commander and between the artillery and infantry operating in combination.

Air craft are not attached to the signal service, as is the case in the army of the United States. The use of radio apparatus by fliers is regulated by the director of army signals in consultation with the general staff and the commander of the Royal Flying Force.

The following remarks bearing on the equipment may be of interest:

The air-line is a bare wire erected on light poles. It is contemplated that a detachment of 12 men should erect about 5 miles of this line and perform an average day's march.

The field cable, which is similar to our field wire, is insulated and is carried on reels, either in wagons or on packs.

A detachment of 8 men should be capable of laying from 1 to 6 miles per hour of field cable, depending on the nature of the country and the permanency of the construction.

The radio wagon station has a radius of 60 to 80 miles and the pack stations 30 miles.

Visual signaling is carried out by heliographs, flags, disks, or lanterns.

Horses, bicycles, motorcycles, and motor cars are used by dispatch riders, who correspond in a measure to the orderly used in our serv-

ice. The British, however, make a distinct feature of this means of communication and provide special training for such individuals. Their training manual contains an extensive chapter on instructions for dispatch riders.

Table of the intercommunication personnel, telephone equipment, and bicycles maintained in units other than army signal organizations.

Organizations.	Officers and enlisted men.	Bicycles.
Headquarters, cavalry divisional artillery.....	7 rank and file ¹	3
Headquarters, divisional artillery.....	do ¹	2
Headquarters, divisional engineers.....	.....	1
Cavalry regiment.....	1 sergeant.....	} 15
	4 rank and file ²	
	27 rank and file ³	
Cavalry squadron with division.....	3 rank and file ³	} 4
A squadron of Irish horse.....	9 rank and file ³	
Horse artillery brigade:	6 rank and file ⁴	} 8
Headquarters.....	9 rank and file ^{5 6}	
Battery.....	7 rank and file ⁷	3
Ammunition column.....	3 rank and file ³	3
Horse artillery battery.....	9 rank and file ⁵	3
Ammunition column.....	3 rank and file ³	1
Field artillery, brigade:		
Headquarters.....	12 rank and file ^{5 6}	1
Battery.....	7 rank and file ⁷	1
Ammunition column.....	5 rank and file ³	1
Field artillery (howitzer) brigade:		
Headquarters.....	12 rank and file ^{5 6}	1
Battery.....	7 rank and file ⁷	1
Ammunition column.....	3 rank and file ³	1
Heavy artillery battery.....	8 rank and file ⁶	1
Divisional ammunition column.....	6 rank and file ³	6
Field squadron.....	15 rank and file ³	
Field troop.....	3 rank and file ³	
Field company.....	do ³	1
Bridging train.....	.....	1
Infantry battalion.....	1 sergeant.....	} 9
	16 rank and file ²	
	36 rank and file ³	
Divisional train.....	.....	2
Army troops train.....	.....	2
Cavalry field ambulance.....	4 rank and file ³	2
Field ambulance.....	6 rank and file ³	1

¹ Includes 4 trained signalers.

² Trained signalers.

³ Trained in semaphore signaling.

⁴ Dispatch riders.

⁵ Trained in signaling and telephonist's duties.

⁶ Does not include drivers for telephone wagon.

⁷ Trained in semaphore signaling and telephonist's duties.

FRANCE.

Unlike the signal service in the United States army and in the army of Great Britain, the French corps of communication is not a separate establishment, but forms a part of the engineer troops. The engineer headquarters in Paris maintains general charge of the

military telegraph service, while the lines throughout the various districts of the country are under the engineer authorities of such districts. In time of war units of the telegraph service are attached to tactical and administrative organizations, and are placed under the control of the commanders of these organizations.

The telegraph service of a field army has two divisions—that which supplies communication to the army at the front and that which supplies communication to the rear of the army. The line of demarkation is determined by the commanding general and is intimately connected with the zone of the line of communication and the bases. The first line is under orders of the chief of staff, and a field officer of the engineers on the staff exercises direct supervision; the second is under the orders of the director of étapes; that is, the general officer in charge of the lines of communication of an army. Where several armies are operating along different lines of communication, the telegraph services for these armies are finally consolidated under the direction of one officer. This officer prescribes the limits, stations, connecting posts, etc., for each line of communication. Service on the line of communication is provided by one or more telegraph sections, the personnel of which are reservists who belong to the post and telegraph department. They are equipped similarly to the regular telegraph troops. In addition to maintaining communication within their zone, these organizations assist at times in the construction of lines within the zones of the army, reinforce with their personnel the units at the front, and maintain in engineer parks material for use of units serving directly with the army.

The telegraph service connected with the operation of railroads is maintained by the railway troops themselves and forms a part of this system.

The radio telegraph stations form a single system under the orders of the commander in chief. Those stations that are placed with each army are under the direction of the chief of telegraph service of the army and maintain communication with the line of communication and the bases. These stations also communicate with the various organizations of the army, and, if possible, with the headquarters of adjacent armies.

The telegraph lines within each army corps are under an engineer officer, and are maintained by a detachment of telegraph troops. The lines established maintain communication between the corps commander and his superior headquarters, the division headquarters, cavalry patrols, and detached posts. They also maintain communication between corps headquarters and its trains, parks, etc. The chief of staff of an army may assign radio apparatus to assist in this communication.

With a cavalry division is also attached a detachment of telegraph troops under the command of an engineer officer. This detachment establishes communication between the cavalry commander and the commanding general of the army, as far as practicable, through the stations established by the telegraph service of the front.

The chiefs of telegraph service of the first and second lines cooperate with each other in connecting up the front with the rear, and where the duties of one division overlap the other the chief of staff of the army concerned is requested to issue any instructions that may be necessary.

There is no connection in the French army between the telegraph service, secret service, press censorship, or the correspondents of journals.

The work of the army and navy, as far as the establishment of radio stations goes, is harmonized by a permanent commission of 16 members upon which the army and navy have representatives. This commission operates to prevent duplication.

Telegraph and telephone lines to permanent fortifications are under the charge of the engineers. Before new lines are established or old ones altered consultation is had with the commanding general of the army corps in whose district the fortification lies, with the commanding officer of the fortress itself, and with the post and telegraph system of the district; in the several great war ports of France the navy is also taken into consideration. The coast defense lines are partly under the army and partly under the navy, and they can be utilized by both services. All the lines of permanent fortifications are established and operated by special troops of the telegraph regiment.

The aviation service in France is not a part of the telegraph service.

Dirigibles are equipped with radio, and a question of equipping aeroplanes with radio was under consideration at the outbreak of the present war. Transmission of information obtained by air craft is provided for by assigning each aviator a zone within which he is to descend and forward information he has obtained. He is furnished with a map of this zone showing the telegraph and telephone stations therein and the infantry and cavalry positions, which are required to maintain messenger service between themselves and the nearest radio service. Previous to the outbreak of the present war some experiments were being made with radio equipment for aeroplanes which could be utilized upon landing for opening direct communication with radio stations of the armies or corps.

Telegraph troops of the active army of France, which are used in time of war with tactical units down to and including the brigade, are formed into a regiment of 12 telegraph companies, each company consisting of 4 officers and 140 men; one company for radio work of 3 captains, 2 lieutenants, and 220 men; a group of telephonists for permanent fortifications, normally about 166 men; and a mounted company of 3 officers and 127 men who are designated "sapeurs conducteurs." The staff of this regiment consists of 14 officers and 57 noncommissioned officers and privates. The equipment provided for a telegraph company attached to a field army is as follows:

Reel carts (1-horse).....	6
Wagons (2-horse).....	6
Light wagons (2-horse).....	12
Construction wagons (4-horse).....	12
Baggage wagons (2-horse).....	2
Traveling forge (2-horse).....	1
Rack wagon (4-horse).....	1
Cable wagons (4-horse).....	10
Pole wagons (4-horse).....	3
Bicycles.....	24

The following is the approximate assignment of telegraph and technical troops to the various units of the field forces:

To a group of armies consisting of two or more armies: A telegraph detachment attached to headquarters consisting of 1 officer,

19 men, 2 wagons, 8 telephones and 5 instruments with wire, 1 carrier-pigeon outfit, and a radiotelegraph detachment connecting headquarters with all the armies.

To one army: A company of telegraph troops in charge of a field officer assisted by a captain and two organizations comprising 11 officers, 80 noncommissioned officers, 330 men, 53 wagons for service with the first line, and apparatus consisting of 60 Morse instruments, 116 telephones, 24 heliographs, with the necessary cable, etc.

A section of telegraph troops under an officer, consisting of 4 officers and 49 noncommissioned officers and privates, with 12 Morse instruments and 23 telephones, may be attached for service to the second line.

With each army corps a detachment of telegraphers is assigned as follows: One officer, 2 noncommissioned officers, 1 orderly, for headquarters, 4 workshops each consisting of 3 officers and 8 men, and 1 wagon carrying 1 Morse apparatus, 4 telephones, 1 heliograph, 10 kilometers of cable, and 10 kilometers of wire.

An engineer park, which includes a telegraph detachment of 8 officers, 25 men, 2 bicycles, 6 wagons, 8 kilometers of light cable, and 30 kilometers of copper-clad wire, is also attached to an army corps.

For units smaller than a brigade or infantry battalion, heliograph and telephone outfits are used to maintain communication between the units themselves and brigade headquarters. These signalists are not under the orders of the chief of telegraph service. In the cavalry regiments the signalers are trained at the cavalry school at Saumur. For the infantry and artillery battalions the troops who operate the telephone equipment are detailed from these respective units. In the mountain infantry regiments the heliograph is also used, and from these latter regiments a certain number of officers and noncommissioned officers take short annual courses in optical telegraphy at Mount Valerian, the station of a regiment of telegraphers.

Each battery of artillery is equipped with 2 telephones and 500 meters of wire. Each regiment of light cavalry has 2 kilometers of line, 1 bicyclist, and 4 signalists. Four signalists are also attached to each infantry regiment, and each battalion is equipped with 2

telephones, 500 meters of wire, and the necessary equipment, carried by 8 men. Mountain regiments have in addition, 2 heliographs and 6 men to operate them. In each company there are 1 officer, 2 non-commissioned officers, and 4 men for signaling.

GERMANY.

The Germans have long recognized the importance of communication between the units of a command, and consequently have perfected an organization and equipped it along most modern lines.

In this connection, Maj. Gen. A. W. Greely, former chief signal officer of the army, remarks as follows:

Profiting by the successful operations of the United States signal corps in the Spanish-American War of 1898, Germany organized in 1899 a new corps, designated as "Troops of Communication," which was increased in 1905.

To fully develop this important service of communications, Germany, with its usual thoroughness and practicality, devoted thereto one of the three new courses in the Technical Military Academy, which was established in 1903 for utilizing to the utmost modern sciences in the increasing of the efficiency of the German army.

In peace the entire organization of military telegraph troops is under the inspection of field telegraphy, Berlin, which comes under the command of the general inspection of military communication affairs. In April, 1914, the organization was about as follows: One inspector major general and 2 adjutant captains; 3 inspections, the first at Berlin, under a lieutenant colonel inspector, with 1 telegraph battalion, 1 fortress telephone company, and a telegraph school; the second at Karlsruhe, under a colonel, comprised of 3 telegraph battalions and 3 telephone companies; the third at Danzig, under a lieutenant colonel, with 2 telegraph battalions and 3 fortress telephone companies.

In war the telegraph, telephone, and radio formations of various strengths are attached to the larger units of commands. The strategic lines of telegraph and telephone systems are under the direction generally of the imperial post-office authorities, who cooperate with the field direction of the telegraph troops. The direction of

the telegraph, telephone, and radio communication within a body of troops is invested in the staff officer of the telegraph troops at its headquarters. He has, however, control only in technical matters, working through army headquarters and not directly. He also works through army headquarters to the subdivisions of the lines of communication.

The telegraph service bears no relation to the secret service, press censorship, correspondents of journals, nor to the collection of information.

There are no fixed relations between the field telegraph service and the aeronautical service. The flyers make the best of the positions and situations in which they find themselves, and use the existing telegraph lines for transmitting information they have collected.

The telephone systems in cases of the larger fortifications are under the administration of and served by the fortification telephone company. In peace time the higher units of this service come under the inspection of fortifications and communication.

The service connected with the use of homing pigeons is under the control of the third division of the engineer committee. A director superintends the entire service. Each homing-pigeon station is under the engineer officer of the fortification to which it is attached.

Invalided noncommissioned officers are in charge of the patrol stations located at various points.

There are relations existing between the army and navy, with regard to radio telegraphy, but not otherwise.

Telegraph troops are assigned generally upon mobilization as follows:

To armies: One large radio station, 1 army telegraph detachment, and 1 airship fleet.

To army corps: One corps telegraph detachment.

Telegraph organizations are not, as a rule, attached to units smaller than divisions.

The linking up of the attached line of an army deployed, or partly deployed, with the line of another unit takes place whenever circumstances require such action. This is effected by army headquarters

upon receiving such recommendations from the staff officer of the telegraph troops.

The higher commands and the troops act independently as to the use of their telephone formations and troop telephone stations, respectively. The laying and conduct of lines from brigade headquarters toward the enemy comes within the duties of the fighting troops, but the system is such that it is possible to transmit information directly from the line of fire to the higher commanders. This is done by signaling with flags or by the troop telephones connected up to the telegraph net of the telegraph troops.

The organization of the units of the telegraph service referred to above are about as follows:

Army telegraph detachment:

Officers and men	-----	165
Wire, field	-----miles--	75
Telegraph instruments	-----	12
Telephones	-----	18

And necessary tools, etc., for the establishment of 12 telegraph and 18 telephone stations to connect general headquarters with the post and telegraph departments.

Airship fleet: Consists of aeroplanes and dirigibles, attached to the mobile forces and is organized into 19 companies with 1,500 officers and men. Air craft equipped with radio, telephones, sliding cable, carrier pigeons, photographic apparatus, etc., for the collection and transmission of information to the ground forces.

Corps telegraph detachment, consisting of—

Corps telegraph company, with lines of communication—

Men	-----	165
Cyclists	-----	16
Automobiles	-----	2
Wagons	-----	23
Field wire	-----miles--	50
Bare wire	-----do--	15
Telegraph instruments	-----	12
Telephones	-----	18

And necessary tools, etc., for the establishment of 12 telegraph and 18 telephone stations.

Corps telegraph company, with lines of information—Same personnel and equipment as with telegraph company, lines of communication.

Field signal detachment, connecting commanders in battle, or with outlying stations—	
Men	40
Wagon.....	1
Telephones.	
Radio detachment—	
Men	40
Automobile.....	1
Wagons.....	4
Equipped with sets with a radius of about 20 miles. Used in communicating between army and navy, between army headquarters, cavalry division, corps headquarters, and for transmission of intelligence from dirigibles, etc.	
Gas column—	
Men	96
Wagons.....	16

For communication within the smaller units the Germans rely upon personnel trained in the regiments and assigned for duty with battalion, regimental, brigade, and divisional headquarters, as circumstances may require.

The artillery trains its own personnel for intercommunication, but this means is rarely used except for communication within the artillery units themselves.

The cavalry also supplies its own personnel, and is furnished with special equipment for use of mounted troops.

The following notes have been compiled from reports received, but it is thought that they do not include all individuals trained as signalists:

From each infantry company there are detailed for duty by the regimental commander three men, who are specially instructed in signaling, being equipped with two telephones.

One officer, 8 cyclists, and an additional equipment of 5 miles of field wire are detailed to each battalion.

It is also understood that one of the company officers is also specially trained in signaling. Disregarding these company officers, this gives a total available within the brigade as follows:

Officers	6
Men	72

Telephones	48
Miles field wire.....	30
Cyclists	40

Within a cavalry regiment there are provided 1 officer and 8 men supplied with a wagon for carrying 2 telephones and about 8 miles of wire, also 2 light field telegraph instruments for cutting in on the enemy's lines. There are assigned for duty with a cavalry division—

Officers and men.....	54
Telephones	12
Cycles and motors.....	36

With field wire and a small supply of cable.

Visual signaling equipment is carried by the individual cavalry organizations.

AUSTRIA-HUNGARY.

The military telegraph service of Austria-Hungary is furnished in time of peace by a telegraph regiment, which, as in the case of the Russian organization, is an integral part of the "Communication Brigade." This brigade is composed of the railway regiment, aeronautic and automobile detachments, and the telegraph regiments. In time of war this brigade is broken up and the units assigned according to the prescribed plan of organization. The telegraph regiment provides detachments for the commander in chief, the army, corps, division, and independent brigade headquarters. The troops provide their own personnel for communication.

The organization of the telegraph regiment in time of peace is as follows:

- Regimental headquarters.
- 4 skeleton battalions of 4 companies each; each battalion forms a telegraph school for training the 130 men present with it.
- 1 radio detachment, 88 men.
- A school for one-year reservists.
- A depot for the care and handling of supplies, 19 men.

No details are available as to the strength or equipment of the telegraph detachments assigned to fortresses, but it is known that the personnel for this duty is trained in the telegraph regiment and is a part thereof, as is also the personnel employed in the operation of

radio stations in certain fortresses. The fortresses on the coast are under the control of the army, and when provided with radio stations maintain communication with the fleet.

As the telegraph system of the country is under government control, messages received at radio stations are transmitted by the public telegraph service.

The strategical lines of information are operated by detachments assigned to the various units in the "zone of the advance." In time of war all lines within the Monarchy, with the exception of the service in the theater of operations, are placed under the central war telegraph office at Vienna. The telegraph service in the theater of operations, which includes the line of communication, is directed by the chief of the field telegraph service. With the supreme commander of field forces is assigned a chief signal officer, who exercises general supervision over the service of the army in the field in a similar manner to that of a chief signal officer of an army in our organization. Signal officers are assigned to the armies, corps, divisions, and brigades.

As the central war telegraph department controls all lines of communication in the country, it is a simple matter to censor telegrams and press dispatches.

The telegraph service is not charged with the duty of collecting information.

In time of war upon the dissolution of the telegraph regiment the following units are formed:

(a) Field telegraph detachments for the commander in chief, armies, army corps, and cavalry divisions. These are normally uniform in strength and equipment and consist of a headquarters with 4 sections of 2 stations with 12 miles of wire each. The strength per section is about 1 officer and 33 men. The transportation consists of 14 horses, 2 wire wagons, and 1 station wagon. The primary function of these units is to maintain communication between groups of armies for short periods.

(b) For duty requiring an organization more mobile in character, mountain telegraph detachments are formed. The organization is approximately as follows: A headquarters of 2 sections each with 3 stations and 12 miles of wire. A section is composed of 1 officer

and 39 men. Nineteen pack animals are substituted for the horse-drawn vehicles used in the telegraph detachment. Eleven of these animals carry the apparatus and cooking utensils, tools, etc., while the other eight transport the wire, which is mounted on drums.

(c) Field telephone detachments. The telephone detachments of the corps and divisions use either wagons or pack animals for transportation. A telephone detachment consists of a commander and 4 sections, each of 2 stations and 12 miles of wire. To each section is assigned 1 officer and 20 men. Four wagons—2 for stations and 2 for wire—or 7 pack animals furnish transportation.

(d) The division telephone detachments are organized into 2 sections each with 2 telephones, 2 signal stations, and 12 miles of wire. The strength is the same as the corps detachment, but 2 pack animals are added to carry the signal stations.

(e) Mountain telephone detachments for duty with the mountain brigades are similar in character to the divisional organizations. They are supplied with an additional telephone and signal station, and use only pack animals for transportation.

(f) The field radio stations, either wagon or automobile, are assigned to commands when necessary. The transportation is about as follows: One wagon for giving and receiving apparatus, 1 wagon for motor, and several wagons for mast material, according to the range of the instrument.

(g) Special telegraph detachments for duty with army commands are supplied with the following equipment, the personnel being detailed as reservists from the state telegraph service: Two wagons, 2.4 miles of river cable, 4 telegraph field wagons with 25 miles of wire, 2 field telegraph wagons, 1 ration, and 1 supply wagon. The general duties of this detachment are to lay river cable, to make repairs to existing lines or those erected by advance detachments, and to furnish repair material to the telegraph and telephone detachments in their front.

All signal detachments function under their immediate commander, who is under the direction of the chief signal officer of the unit to which they are attached. This officer is, in turn, under the supervision of the chief signal officer of the next higher unit.

The personnel used for communication purposes in the infantry, cavalry, and artillery regiments are trained by instructors provided from the telegraph regiment.

It will be noted that the smallest command to which a telegraph detachment is assigned is the corps or cavalry division.

The telegraph detachments of the combat troops are a part of the strength of these troops, and are therefore kept with their command for combat purposes. An exception to this general rule exists in the cavalry regimental telegraph detachments, as these detachments may be separated from their immediate command for use with cavalry divisions. The percentage of telegraph personnel to the effective strength of a division is about 2.7 per cent, and for a corps about 2.6 per cent.

The following tabulation indicates the approximate assignment of communication detachments to the various tactical units:

To an army:

2 army telegraph detachments—	
Officers and men.....	300
Horses.....	140
Wagons.....	28
Miles of wire.....	100
Telegraph stations.....	16
1 special telegraph detachment—	
Men.....	70
Horses.....	40
Wagons.....	10
Miles of river cable.....	2.5
Miles of wire.....	28

To a cavalry division:

4 cavalry regiments to a division, each with—	
Telegraph patrols provided with 2 telephone instruments, 1 telegraph key, 1 relay, 6 miles wire.....	4
Visual signal patrol with heliographs and acetylene apparatus....	1
There is supplied to the cavalry division from the peace-trained telegraph regiment—	
Telegraph detachment.....	1
Instruments.....	8
Miles of wire.....	50
Visual signaling patrol of 7 men, mounted, and 2 pack animals....	1

To an army corps: Corps telegraph detachment for connecting army, army corps, and division headquarters.

Cavalry telegraph detachment of an army corps:	
Officers and men-----	8
Telephones-----	2
Telegraph instrument and relay-----	1
Miles of wire-----	6

Infantry division:

1 telegraph detachment, used for connections in zone of combat—	
Telephone stations-----	4
Signal stations-----	4
Miles wire-----	24
(Pack or wagon.)	

Divisional cavalry:

Telegraph patrol-----	1
Telephones-----	2
Miles wire-----	6
Key and relay-----	1
Visual signaling detachment-----	1

Brigade of artillery, for each battery:

Telephone stations-----	5
Miles wire-----	14
Flag signal stations-----	5

One company of infantry:

Telephone patrol-----	1
Telephone station, equipped with 1 microphone, battery, 1 magneto telephone, 1 mile wire (station used within company)-----	1
Men-----	3
Light signal stations-----	2
Petroleum lamp-----	1
Acetylene lamp-----	1
Flag signal patrols of 3 men each-----	4

Information is not available as to the number of men attached to battalion, regimental, and brigade headquarters.

In the Austro-Hungarian service two regiments constitute a brigade, four battalions a regiment, and four companies a battalion. The personnel and equipment given above for companies is undoubtedly distributed for use not only of the company, but of the battalion, regimental, and brigade headquarters.

RUSSIA.

The great Russian reorganization that took place subsequent to the Russo-Japanese War affected the technical troops as well as the line of the army. The information at hand indicates that the reorganization of the signal troops was along very excellent lines and that such equipment as has been recently inspected indicates a successful effort has been made to organize and equip all troops in most modern style. The organization, stations, and information in general concerning telegraph troops is considered by the Russian government as confidential, and information thereon is not officially given. It is presumed that the difficulty of translating the Russian language also accounts in a measure for the scarcity of detailed information.

The Russian telegraph troops are not organized into a separate corps in time of peace, but as in several other of the European armies are attached to the engineer troops. The sapper battalions are organized in time of peace by the consolidation of three sapper companies and one or two telegraph companies. In war this battalion is disbanded; the telegraph company is attached to a corps headquarters, and where there are two telegraph companies the extra one is assigned to duty with army troops. At the outbreak of the present war reports indicate that 54 telegraph and 7 radio companies were organized; most of these were stationed in European Russia, but some were in the Caucasus.

In addition to these there were some 13 telegraph sections for use in fortresses. These sections are separated from the companies which are assigned to units, and are used solely for the maintenance of communication relating to permanent fortified posts.

The telegraph companies are formed of two radio and two wire sections each. The cable sections are subdivided into those that can construct aerial lines of about $16\frac{1}{2}$ miles per section, and those that lay field cable with about 23 miles per section. These sections are equipped with microtelephones and material for establishing 12 telegraph stations. They also carry 6 heliographs and 6 lanterns for night signaling.

The radio companies are formed of two platoons with three mobile Marconi stations each. In addition there are a number of radio telegraph stations established in fortresses and in the larger ports and towns of European and Asiatic Russia. These are partly under orders of the war and navy departments, and are served by detachments consisting of an officer and from 12 to 30 men.

The special troops attached to fortresses are divided into sappers, miners, telegraph sections, and aviation sections. They are placed under the command of a chief, who, in turn, is under the orders of the fortress commander. Besides these detachments the fortresses are provided with letter-pigeon stations and permanent radio stations.

Upon mobilization four depot battalions of technical troops are organized. These are intended to replace all losses of technical and fortress troops.

In 1912 revised regulations were published for the officers' electro-technical school; the intention of these regulations is to provide that not exceeding 40 officers of the engineer and railway troops be detailed each year for a course extending over a period of a year and eight months in submarine mine explosives, radio telegraphy, telephones, etc. The school is under the supervision of a major general with a considerable corps of assistants. Upon mobilization it is contemplated that the permanent staff of the school expand into a reserve electro-technical battalion of four companies, one of which is for the training of telephonists and telegraphists, one for radio operators, one for electrical engineers, and one for miners.

Owing to the difficulty of translation, as noted above, the details in the organizations of the telegraph troops have not been obtained. It is stated in one of the reports available that a signal company is composed of about 250 men. The assignment of telegraph troops and aviation companies to an army is normally as follows:

Telegraph companies, wire.....	2
Telegraph companies, radio.....	2
Telephone section.....	1

It is to be noted that an army is composed of from three to five army corps.

It is probable that in the Russian organization, as in other organizations, the assignment of technical troops to army headquarters is left to the dictates of the special conditions under which the army may be serving. The army corps is normally composed of two infantry divisions, with cavalry and artillery attached. One telephone section and one telegraph company are supplied for each corps. The infantry divisions, composed of two infantry brigades, with the necessary quota of cavalry and artillery, are supplied with telephone sections. There appears to be no assignment of technical troops for communication purposes to units smaller than a division. Communication between the brigade and the division is undoubtedly maintained by the divisional units, while communication between the brigades and their various parts is maintained by men detailed from the several units to the brigades.

The men detailed for maintaining intercommunication between smaller units of the organization have, according to reports of attachés, reached considerable degrees of efficiency. It is stated, in fact, that the new regulations with reference to the union and control of the service of information effect, perhaps, one of the best organizations in the Russian service. Regimental telephone and signal service are each of a high grade of efficiency. An incident is cited from the maneuvers in which a four-battalion regiment of 3,600 men deployed for an attack in thick underbrush, where it was impossible to see at a greater distance than 50 feet, and all sections were constantly connected by telephone. After the deployment and when the regiment debouched from the edge of the woods for an attack the work of the telephones was immediately supplanted by flags.

The information detachments of the infantry regiments are formed of messenger and telephone sections. The former section in a regiment of four battalions consists of 1 noncommissioned officer, 12 mounted men, and 4 bicycles. In the messenger sections of an infantry or Siberian rifle regiment two sections are under the orders of the regimental commander and the other three are attached to the higher staff. The telephone section has in war 30 men, 2 officers, and 2 carts. It can lay about 6 miles of wire. For each company there

are 8 men trained as signalists. The officer in charge of the communication service of each infantry and rifle regiment is mounted.

To the cavalry regiment is attached a mounted sapper detachment, consisting of 2 officers and 16 men, for the execution of the technical work, including communication.

In the light batteries there are two 1-horse telephone carts, with personnel for maintaining communication.

In the horse artillery telephone apparatus is packed on a horse, as is also the case in the mounted batteries.

The field howitzer batteries have 2 telephone carts.

There is no regimental artillery organization in the Russian service except in the fortress artillery.

ITALY.

There is practically no information available relative to the telegraph troops of the Italian army. We know, however, that telegraph troops are assigned to army corps and division headquarters, and it is therefore safe to assume that communication within smaller units is provided for by men detailed from the units. In peace time the telegraph troops form part of the engineer department, and are organized into a regiment of five battalions. It is from these troops that units are provided for field forces.

TURKEY.

The latest information on this subject indicates that the reorganization of the Turkish army that followed the Balkan war was, until 1914, uncompleted. The data given in this paper is more nearly correct for the ultimate organization of the telegraph troops than for the organization at the present time (1914). It may be remarked that under the direction of the German mission accredited to the Turkish army the telegraph troops will undoubtedly be finally organized as nearly as possible along the lines followed by Germany.

The telegraph service of Turkey is a separate branch, under the war department. No information is available as to the details of administration of this branch. In Turkey the telegraph system is under

the control of the government, and it is believed that in time of war the strategical lines would remain under such control.

Whilst at present (1914) there is no official censorship beyond the fact that telegrams are watched by officials of the department of the interior, it is believed that during the war a military censorship would be established which would be closely related to the telegraph service.

Special organizations exist for lines of information in permanent fortifications, and it is thought that they are under the signal service.

During the Balkan war provisional relations were established between the army and navy, but there are no such relations regularly maintained. The details of the relations between the aviation service and the telegraph service had not, up to 1914, been developed.

An aeroplane and balloon school was established in the district of the army corps at Constantinople.

The tactical organization of the telegraph service is the telegraph company. This unit is attached to field armies and army corps. It is divided into four sections so that detachments may be provided for cavalry divisions and independent divisions. The principal duty of the company attached to an army corps is to maintain connection between the corps headquarters and the field army, and after that within the corps itself. It is probable that detachments from the company maintain communication between units smaller than divisions where circumstances dictate. The company assigned to duty with an army connects the army with the headquarters of the commander in chief, and until the lines on the line of communication have been constructed, connects the army with the permanent lines of the country.

The tactical control of telegraph troops attached to the various units is under the supervision of the chief of staff who initiates instructions to the subdivisions. The chief signal officer attached to the headquarters communicates directly with the commander of the telegraph units upon matters concerning personnel and matériel only.

In 1914 there were 10 telegraph companies organized; in addition there was a radio battalion and a telegraph detachment at the Fortress of Adrianople.

The number of telegraph companies organized is not sufficient to furnish troops for assignment to tactical units as laid down in regulations, and several new units will have to be formed before the proper quota can be supplied.

A telegraph company consists of 5 officers and 101 men. The transportation section attached to it is composed of 1 officer, 51 men, 88 animals, and 12 bicycles. As has been stated, the company is divided into four sections, each section being equipped as follows:

Telegraph instruments-----	3
Telephones-----	6
Kilometers of cable-----	25
Kilometers of thin wire and double cable-----	20
Kilometer of copper wire-----	1

The thin wire is employed in the provisional establishment of telephones, and the copper wire is used for repair work. The cable and copper wire are reported as being very durable, while the thin wire is not.

A construction detachment, which is understood to mean a section, consists of 1 officer, 3 noncommissioned officers, 4 telegraphers, and 14 privates.

No reliable data could be obtained with reference to the use or training of special individuals within the smaller tactical units for communication. In fact, it is not known whether any system exists for supplying such means of communication, but from a study of the organization of the telegraph company it is apparent that this company will not maintain communication further than brigade headquarters, and it is therefore thought that within a brigade the plan is to use a system similar to that provided by the Germans—that is, training individuals from combatant troops.

JAPAN.

The experiences of the Russo-Japanese war indicated to the Japanese authorities that a reorganization of their telegraph corps was desirable. Experiments have been made with a view to perfecting the reorganization and undoubtedly by this time it has been completed. The exact details of the reorganization are impossible to

obtain, as the Japanese War Department has declined to give any information at all with reference to their telegraph corps. We are therefore obliged to obtain our information from other sources, which naturally limits both the scope and the accuracy. It is believed, however, that the following information is fairly accurate.

The telegraph corps of the Japanese army is a part of the "communication brigade," which is composed of a railway regiment and a balloon corps, in addition to the telegraph company. In peace time the telegraph corps is under the orders of the commanding general of the imperial guards division as regards its training. In war time it is assigned by the chief of the general staff to units of troops.

The tactical organization of this telegraph corps consists of a headquarters and eight companies, with the following organization:

Field and staff (all are engineer officers, detailed for this duty temporarily) :	
Colonel	1
Lieutenant colonel.....	1
Majors	3
Captains.....	3
Captain (adjutant).....	1
Company officers (all engineer officers, detailed for about three years) :	
Captains.....	8
First lieutenants	19
Second lieutenants	13
Telegraph company (enlisted) :	
Noncommissioned officers.....	10
Privates	150

The total strength of the corps is about 1,300 men. The privates in this corps serve about two years and are armed as infantrymen.

The corps is used for handling radio apparatus and searchlights, in addition to its normal duties when assigned to troops. It is provided with about 100 horses. The amount of matériel supplied is not known. Remarks as to the character of the equipment will follow later.

The units of this corps in war time are attached to army headquarters only, the communication between other units being furnished by signalmen detailed from the regiments. It has been re-

ported that owing to the unsatisfactory results from this system the strength of the telegraph company was to be increased, and it was to be assigned to divisions. The latest reports, however, state that units smaller than an army are connected up by detailed men.

It must be remembered that the army corps is omitted in the Japanese organization.

The number of men and amount of equipment attached to units smaller than an army, for communication purposes, is approximately as follows:

For a division, 150 men, detailed from its battalion of engineers and infantry regiments. Equipment unknown.

For an infantry regiment, 1 officer and 27 men. Equipment 6½ miles of telephone wire and 6 telephones. Transportation, 6 pack horses.

For a cavalry regiment, 1 officer and 27 men. Equipment, 25 miles of telephone wire and 6 telephones.

Each artillery regiment has its own personnel and equipment for telephone service, the details of which are unknown.

The fortress artillery provide their own personnel and equipment. About 50 men from this branch of the service are attached to the telegraph corps each year for a course of instruction covering seven or eight months.

The telegraph organization for a strategical line of information is unknown. It is probable, however, that the commander of the telegraph service of an army unit exercises control over the telegraph units in the rear of the army.

No information can be obtained with regard to the relationship between the telegraph service, the secret service, the press censorship, the correspondents of journals, and the collection of information. Some relationship exists between the telegraph service and the aviation service, but the extent of this relationship is not known.

The aviation service in general appears at the present time (1914) to be in the hands of a commission of investigation. It has been reported that radiotelegraphy was used in connection with aeroplanes and balloons.

The following general remarks on the Japanese telegraph corps and parts of the equipment furnished thereto, extracted from a report from one of our signal officers, made in the fall of 1911, may be of interest.

The Japanese do not adapt themselves readily to work required of the telegraph corps. Considerable difficulty is experienced in training the officers and men for this particular work. Each year a number of officers from the various branches of the service are sent to the telegraph school for a course of two years' instruction. It has been reported that about 60 per cent of the number so detailed are returned to their regiments as inefficient. Undoubtedly the short period of enlistment for their conscripts is one of the causes of the difficulty in obtaining trained men for this corps.

The use of lance lines is common in the Japanese army. The line platoon of two sections of about 70 men and 40 one-horse carts carries about 12 miles of line. The reels for this wire are wound on a frame carried on the men's shoulders. The wire is placed on lances after they have been erected. The section turned out for inspection ran nearly a mile and a half in 40 minutes.

For their field work one-horse carts are provided, which hold 4 miles of wire on small reels. These reels can be placed in a frame to be carried on the men's backs. In laying wire over fire-swept zones the men work in pairs, each carrying one-third mile of wire. One only of each pair lays the wire, thus providing at all times a double amount of wire for repairs or other purposes.

The Swedish cavalry buzzer is used, which is similar to that in our service.

The wire used is a copper-clad insulated wire weighing about 50 pounds per mile. A heavier weight of about 150 pounds per mile is used along roads or crossing streams. Neither of these wires are as satisfactory as that issued in our service.

Buzzer wire is furnished principally for use by the cavalry, although some is carried by companies. This wire is carried on breast-plate reels of aluminum.

Four wagon radio outfits with a radius of about 150 miles and two pack radio sets have been reported on. It is stated that the Telefunken sets are to be increased as rapidly as funds become available.

There are two systems of visual signaling—the semaphore and the wigwag. The equipment is reported as “primitive,” and it is deduced from this fact that a great reliance is to be placed upon buzzers and telephones.

Their night signaling lamps are of French manufacture and are manipulated with key and shutter. The heliographs are also of French manufacture; they are of an old type, heavy, and cumbersome.

The field searchlight, which is handled by telegraph troops, is complete. It is equipped with about 22 and 30 inch projectors. The set inspected had a generator of about 20 horsepower for furnishing 18 amperes at 550 volts, and was mounted on a wagon drawn by 6 horses. The light is mounted on a four-wheel truck, with about 500 meters of cable. It is drawn by four horses. Additional cable is provided on two-wheel horse-drawn carts. Gold-plated brass reflectors are used in place of silvered mirrors, as when struck by bullets the former are merely perforated, while the latter are shattered and rendered useless.

Portable observation towers about 15 meters high, mounted on six-horse trucks, are also provided.

The organizations within the regiments, used for intercommunication between units smaller than an army, are to be instructed at the station of telegraph troops—Nakano. This at present is only carried out with a portion of these troops.

Little, if any, information of value has been reported with reference to the balloon and aeroplane equipment of the Japanese army. We only know that they have both aeroplanes and balloons, and that one Parseval airship of 8.5 tons is in their possession. It will be recalled that balloons for observing artillery fire were used at Port Arthur. As has been noted above, the subject of aeroplanes and their tactical organization is in a formative stage.

THE ORGANIZATION AND EQUIPMENT OF THE
FLYING CORPS OF FOREIGN ARMIES.

NOTES ON THE ORGANIZATION AND EQUIPMENT OF THE FLYING CORPS OF FOREIGN ARMIES.

GREAT BRITAIN.

All matters connected with aeronautics are in the hands of the Royal Flying Corps. This corps is divided into two wings—the naval wing and the military wing.

The naval wing is administered by a director of the air department at the Admiralty. On January 1, 1914, all airships in the hands of the army were turned over to the navy. This policy was adopted mainly for economical reasons, as it was thought that the development of airships could be better handled by the navy. There were (1914) 4 sea-plane stations in England and 2 more in course of erection in Scotland. It was the intention to increase the number of these stations so as to continue the line to the north of Scotland and to fill up gaps along the east coast. One hundred and nine sea planes and aeroplanes were in the possession of the Admiralty, and 20 more had been ordered. These planes were both French and British type. There is a naval flying school at Eastchurch, equipped with some 50 machines.

The military wing is administered by the director of military aeronautics at the war office, who also directs the central flying school, which is used jointly by the army and navy.

In 1912 important changes were announced with regard to the reorganization of the British aviation service. The military wing was to consist of 7 aeroplane squadrons, with the necessary personnel, and an eighth squadron was to be organized and equipped with balloons and kites. The reserve was to be divided into two classes, the first to consist of those who performed a number of flights across country in each quarter and received a retainer fee, and the second to consist of those who did not make the prescribed number of flights but who were available in the time of war. The army and navy

wings were to be placed on a war footing and to be so maintained at all times—in peace and war the establishments were to be the same.

The Naval Annual for 1914 states that Great Britain had 1 battle airship, 7 mine laying and scout airships completed, and 7 building. Some of the completed airships were reconstructed machines and were used for training purposes only. The Annual states that there were about 250 efficient aeroplanes and sea planes in the possession of Great Britain.

Subdivisions of the military wing are attached to divisions, corps, and armies, as circumstances may require. The wing is divided into aeroplane squadrons, which consist of a headquarters of 7 officers and 14 men, and three flights of 4 officers, 7 noncommissioned officers, and 32 mechanics and assistants each. There are 12 planes attached to a squadron. The transportation that accompanies a squadron is as follows:

Light aeroplane tender for headquarters and 2 for each of the three flights...	1
Heavy aeroplane tenders for each of the three flights.....	2
Motor-repair lorries.....	2
Shed lorries, with trailers.....	6
Reserve-equipment lorries	3
Motorcycles	6

With a supply train is 1 motor lorry carrying supplies for headquarters.

There is also a "headquarters detachment" of the military wing, which is attached to divisions, corps, or armies, as circumstances may require, and which consists of 3 officers, 11 men, and 2 motors.

Although in 1914 the airships were transferred to the navy, as has been previously stated, the recent field service regulations indicate the presence of an airship and kite squadron, which consists of two airships and two flights of kites. The headquarters of this force comprises 1 officer and 11 men; to the airships are assigned 8 officers and 98 men, and to the kites 4 officers and 87 men. The transport of the airships is composed of 1 light airship tender for headquarters, and 2 for light 4-motor gas wagons; 2 repair lorries; 2 portable moving mast lorries; 4 heavy airship tenders, and 4 motor cycles. These vehicles are attached to the first line of transportation. With the train is one motor lorry for baggage supplies. For first-line trans-

portation of the kites there are 2 carts, 6 wagons (horse-drawn vehicles), and 4 bicycles.

On the line of communication is established a flying depot, the personnel of which consists of 3 officers and 67 noncommissioned officers and men; 1 motor car, and a gas train consisting of a tractor and 3 trucks are attached to this unit.

FRANCE.

In 1912 France began to make serious efforts to place itself in an advantageous position with regard to military aeronautics. The minister of war during that year made a notable speech before the Chamber of Deputies, outlining the necessity for preparedness in this branch of the military service, and the general plan he proposed to adopt to create an efficient organization. He asked for a total of \$6,400,000, to be spent in the calendar year 1912, \$1,600,000 of which was for dirigibles. This money was granted, and in addition popular subscriptions were received, which during the first month alone netted some \$400,000. The plan as outlined by the minister of war was adopted in its greater part. However, from time to time since that date experience has dictated changes of its organization. These changes have been effected and are incorporated in the last order on organization, which was issued on April 24, 1913. This order is one of the last on organization, and is quoted in toto.

In February, 1914, it was stated that the consolidation of the aviation and aerostatic services had been a mistake, and a decree was issued creating two posts of the ministry of war, one to be known as the technical inspector of aviation and the other as the technical inspector of aeronautics. These officers were not to exercise command of troops, but to perform technical duties, such as making inspections of troops and material, making studies of improvements and extensions, and keep in touch with technical instruction. About the same time a decree was issued creating a "superior council of military aeronautics." The duty of this council was to coordinate the efforts of the government and private parties toward securing progress in both the science and technic of military aeronautics. This

council was composed of the following officials: The minister of war, president of the council; 4 senators, 4 deputies; 4 members of the Institute of France; 4 technical representatives of aviation; the chief and assistant chief of staff of the army; the chief of staff and the chief of section of the second staff of the navy; the director of aeronautics; the minister of public works; a representative of the minister of the colonies; the director of postal administration; and the director of military aeronautics of the army, who is made recorder of the council. Two officers of the army aviation service are made secretaries.

As will be seen from the order hereafter quoted, the troops are divided into companies and sections. The aerostatic organizations are divided into sections, while the aviation sections are divided into flotillas or squadrons. The division of the flotilla (or squadron) is the unit assigned to the various tactical organizations in time of war. It consists of four sections, each with 2 aeroplanes, 2 tractors, 1 truck, 1 work truck, and 2 automobiles, with 55 men, who are provided in addition to the observers. A company of aerostatic troops (3 officers and 108 men) is also assigned for use of troops upon mobilization. Aviation detachments are attached to cavalry divisions, army corps, and armies.

Throughout the entire organization the French have never lost sight of the fact that the study of the subject of aviation was in its infancy, and in their plans and in the bills for the furtherance of these plans, the provisions for organization, equipment, etc., have been most general, allowing great latitude in their application. Where experience has shown necessity for change there appears to have been no difficulty in obtaining the necessary legislation and funds.

Continuous effort has been made in the French service to perfect officers as observers. In 1911 corps commanders were directed to select from among the general staff officers under their command those who desired to perfect themselves as observers and recommend them for a course of instruction with the balloon corps. Senior first lieutenants or young captains were to be given preference. The requirements for military aviator certificates are as follows:

The tests are of two kinds, practical and theoretical.

The practical test consists of a triangular flight of at least 125 miles effected on the same machine in not more than 48 hours, with two intermediate landings—this to be obligatory and announced in advance. The shortest side of the triangle must be at least $12\frac{1}{2}$ miles.

A flight of at least 93 miles in a straight line over a course indicated in advance, without landing.

A flight with the same machine of at least 93 miles in a straight line over an itinerary indicated in advance, with landing permitted.

During these tests the pilot must make a flight of at least 45 minutes' duration at an altitude nearly constant of at least 2,600 feet. If atmospheric conditions prevent this flight at high altitude during the course of the other tests, it may take place at some other time on an aerodrome. No test to be made with passenger.

Departure and arrival for each test is established by officials of the civil or military authorities at the places concerned.

The theoretical examination consists of reading maps, meteorology, principles, barometric pressure, temperature, hygrometric conditions, clouds, wind, reading meteorological maps, making use of meteorological information, the resistance of the air and its laws, the laws of air resistance applied to aviation, construction of aeroplanes, tests of acceptance of aeroplanes, regulating of aeroplanes, internal-combustion motors, carbureters, accessory organs, and description, use, and regulation of aviation motors.

Candidates who already have the pilot's certificate of the Aero Club and who have to their credit performances of public notoriety, superior in number and quality to the above, may, at the discretion of the board, be granted the military pilot's certificate.

In March, 1914, instructions were issued stating that the aerostatic corps was no longer able to furnish from its personnel a sufficient number of officers and noncommissioned officers for the manipulation of airships, and applications were called for from officers and sergeants of all branches of the service to undergo a course of instruction. These courses of instruction were divided into three periods; the first contemplated service with a unit, the second would include a course of lectures, practical instructions, etc., while during the third

period those pursuing the course would return to their original units and participate in flights until they were able to qualify.

Prices were obtained from various firms in France for furnishing the transportation for an aeroplane squadron organized similarly to the French squadron. The offers ranged from \$30,000 to \$60,000 per squadron.

Reports from observers since the outbreak of the present war indicate that the importance of aircraft in active operation has not been exaggerated. Their use as scouts for the location of artillery positions and for the observation of fire have been of the utmost importance and have produced most valuable results. The bomb-dropping phase has not so far apparently been of any considerable value.

The French are now equipping their aeroplanes with machine guns and with radio apparatus that is run by a storage battery. Undoubtedly they are also installing bomb-dropping devices on them as are the Germans.

It appears that the type of machine supplied to the French Army before the present war has proven to be practically valueless. The characteristics insisted upon at present are speed, field of view, and protection. Unless a plane can reach a speed of from 75 to 80 miles per hour it is not considered a desirable type. The Farman, Moisant, and Caudron biplanes, and the Morane Saulnier monoplane are the only types now used by the French. It is reported that the Gnome motors are not giving satisfaction.

Captive balloons are being used by the aviation corps along the French front.

The order which gives the organization of the French aerostatic service, with the exception of the changes noted above, follows:

Order relative to the organization of the military aeronautic service in the French army.

The minister of war has signed under date of April 16, the order below, which is an exposition of the law of March 29, 1912, for the purpose of its application:

ELEMENTS OF THE AERONAUTICAL SERVICE.

ARTICLE 1. In the terms of article 2, law of March 29, 1912, the air service comprises a navigating personnel, troops, and establishments.

ART. 2. The navigating personnel includes an instructed personnel (pilots of dirigibles, holding certificates of such, mechanics, with certificates of mechanics of dirigibles, air-plane pilots with certificates of military aviators); an uninstructed personnel (student-pilots of dirigibles and air planes, student-mechanicians of dirigibles). Officers and men of the navigating personnel are attached to units or establishments; they will participate, outside of the aerial service, in the duties of these units or establishments.

ART. 3. Aeronautical troops include companies and sections. In principle, the companies are assigned to aerostation and the sections to aviation. Each aeronautical company assigned to aerostation assures the service of the home port; it is charged with the operation of the balloons of the home port (spherical and dirigible), with the upkeep of the aeronautical matériel stored there and the handling of dirigibles touching there.

The company attends to the instruction of its personnel with the exception of certain specialists who can be brought together for certain periods of instruction at an establishment designated for this purpose.

The crews of dirigibles (pilots and mechanics, as also the student-pilots and student-mechanicians) are assigned to the aerostation company serving the home port. They are supplementary to the regulation strength of this company.

The commanding officer cares for the matériel entrusted to him, with the aid of his crew and the personnel furnished by the aerostation company, according to the orders of the commandant of the home port.

Each aviation section is divided, for the purposes of discipline, interior service, and instruction, into flotillas. It attends to the instruction of its personnel, with the exception of certain specialists to be assembled for courses of instruction at an establishment named for the purpose. The section is charged with the maintenance of the matériel and its keeping.

Detachments and, as the case may be, aeronautical units are assigned for the service of establishments.

ART. 4. The establishments are made up of the schools, the special establishments, the administrative branches, the depots, and workshops.

1. The schools are intended for the formation of the navigating personnel and specialists. Each school has a cadre of officers, noncommissioned officers, and students; it has an aeronautic section. The schools act as depots and have workshops for this reason.

2. The special schools are in charge of construction and they purchase the material, the execution of certain repairs, and the study of everything relating to aeronautics. They comprise the administration of the military aeronautical matériel under which are the central establishment of the military aeronautical matériel and the military aeronautical laboratories.

3. The administrative bureaus (at the rate of one for each army corps where there are one or more aeronautical establishments) direct the supervision of the aeronautical matériel.

4. The depots with workshops attend to the distribution and upkeep of the matériel in use and in reserve.

Each establishment has a personnel of its own attached to it, the strength of which is determined by the minister of war.

GROUPING OF ORGANIZATIONS.

ART. 5. The assembling of one or more units with the depot operating near them is called home port, as it relates to aerostation; center of aviation as it concerns aviation.

The home stations consists of the crew of dirigibles, a company of aerostation troops, a matériel depot, and workshop. The command of a home port is exercised by one of the officers attached to said station in time of peace and detailed by the minister of war.

The center of aviation is composed of one or more aviation sections; a matériel depot with workshop. The command of a center of aviation is performed by the chief of section, when the center allows but one section, and in the case of several, by an officer of the aviation service designated by the minister of war and distinct from the chief of section.

ART. 6. When a home station and a center of aviation are at the same place they are placed under the orders of a field officer of the aeronautic service. In such a case there is but a depot with a workshop. The workshops can be distinct for aerostation and aviation.

In the case of an isolated home port or center of aviation the commanding officer fulfills the functions of chief of the aeronautical service. In all cases the chief of the aeronautical service exercises the function of chief of depot.

ART. 7. The home stations, centers of aviation, schools, and special establishments of the mother country and North Africa are served by units apportioned according to decree of August 22, 1912, into three groups forming corps (regiments), and each placed under the order of a colonel or lieutenant colonel.

Each one of the groups constitutes the organizations existing or to be created¹ in the territories of the army corps indicated below:

First group (central portion of Versailles): Military government of Paris, 3, 4, 5, 9, 10, 11, and 20, regions, North Africa.

Second group (central portion at Reims): 1, 2, and 6, regions.

Third group (central portion at Lyons): 7, 8, 12, 13, 14, 15, 16, 17, and 18, regions.

HIGHER COMMAND AND INSPECTION OF MILITARY AERONAUTICS.

ART. 8. Aeronautical organizations are placed under the authority of military governors or army corps commanders in whose territory they are stationed.

¹ The detailed table of the composition of the groups will not be established until after the fixation by decree of the number of sections to be created in 1913, by application of article 4 of the law of Mar. 29, 1912.

Army commanders exercise directly their authority as concerns the general discipline, the exterior service, the measures of public order, and the tactical instruction of officers and units, as far as they relate to special ministerial instructions. They give their orders through the group commanders relative to the interior discipline, the personnel, administration of the units, and mobilization, and through the directors for the management of the technical matériel, as is indicated in article 10 below.

They can prescribe expenditures only within the limits of the credits passed on by the minister and for the purpose for which these credits are intended.

They solely exercise a general supervision over the special establishments and schools in the terms indicated in the instruction on the daily routine service (arts. 9 and 10).

Governors of fortified places have, under the authority of army corps commanders, the same powers as the general officers as they pertain to the special organizations assigned for the defense of the place.

ART. 9. The permanent inspector of military aeronautics is to: (a) Inspect the technical personnel and matériel of military aeronautics and to rate the personnel. (b) To direct the formation of the navigating personnel and the technical instruction of the entire personnel. (c) Exercise command of schools and special establishments, organs which are directly under his orders.

As technical inspector he effects all useful changes for his mission; however, the changes for North Africa are authorized by the minister. He informs organizations through the corps commanders of the dates and programs of his inspections; in the case of an unlooked for inspection he conforms to the regulations of routine garrison duty.

Corps commanders will give such orders as will enable him to have the personnel, matériel, and documents necessary for the fulfillment of his duties.

As concerns the formation of the navigating personnel and the technical instruction of the whole personnel, he prepares and submits for approval by the minister all necessary regulations and instructions; he gives all orders of detail for their application. He sends always to the corps commanders a copy of the orders or technical instructions given to the personnel placed under their command; he forwards to the minister all propositions suitable on the subject of assignment and distribution of instructors and students; he sees that the students who do not present the required aptitude be returned to their troops as soon as their unfitness has been established; and transmits to the minister his plans for arranging the courses of study, as provided for in article 3, and for the assignment of the personnel that is to participate.

As head of the schools he issues his orders directly to the commanders of each one of them. As superior of the special establishments he communicates his instructions directly to the director of aeronautical matériel.

He corresponds directly with the minister (military aeronautic section), safeguarding the general powers of military governors and corps commanders

as indicated in article 8. It is obligatory to consult him for the use of budgetary means.

ORGANIZATION AND OPERATION OF GROUPS AND DEPOTS.

ART. 10. The commanding officer of the group is at the same time colonel and director. As colonel he is invested, in relation to troops under his orders and detached personnel or supernumerary, with rights and prerogatives attached to these functions, such as are defined in Title I, of decree of May 25, 1910, containing regulations on the interior service of regiments.

As director he performs his duties distinctly for each of the administrative branches existing in the army corps in the territories of which the units of his groups are stationed.

The personnel, in a subordinate capacity, of the administrative subdivisions include, at the actual residence of the director, an officer of administration, an assistant, and the number of civil employees and military clerks necessary.

In the bureaux where the director does not reside the bookkeeping is attended to by one of the administrative officers of the aeronautical service employed in the place chosen as seat of the administration, or by an administrative officer specially designated, if the importance of the service demands it.

The group commander can undertake journeys to the extent of his command whenever he thinks it opportune for the inspection of troops and establishments under his orders. However, without special orders of the minister or the respective corps commander, his journeys of more than 150 kilometers (going and coming) are limited to eight per year and place; except in an urgent case, they are the object of a previous report.

With reference to north Africa, the journeys of the commandant of the first group are authorized by the minister.

ART. 11. The chief of the aeronautical service in a place transmits the orders and makes sure of their execution; he is responsible for the discipline, the administration, mobilization, and the observation of diverse general rules relative to the service and the progress of instruction. As concerns the interior service, he has the powers of a chief of detachment; for the administration of the matériel, he exercises, as has been stated in Article 6, the functions of chief of depot.

ART. 12. *Depots and shops.*—Depots under the authority of directors are charged:

1. With the care of the matériel and supplies stored in the place where they are.
2. To assemble all expendable matériel necessary for instruction and to purchase certain objects of routine service.
3. To regulate the expenses in connection with purchases or repairs or for instruction.

The depots execute repairs to apparatus outside of those which can be made in the units and those requiring an equipment or special workmen and must be

intrusted to special establishments or constructors. They will comply, with respect to the latter, with the instructions of the minister.

The personnel attached to the depot, under the orders of the chief of the aeronautical service—chief of depot—includes one or several officers' assistants, one or two officers or administrative officials, foremen or chief workmen, a civil personnel (skilled and unskilled laborers and employees). The strength of this personnel is determined by the minister.

The chief of the aeronautic service fixes the number of the noncommissioned grade and troop class which must be furnished by the units to perform the depot service; from among the whole of the personnel attached to the depot service are the master workmen and operators of the workshops picked.

ART. 12. Temporarily and while the instruction of the navigating personnel can not be given entirely in the military schools of aviation, the military personnel and matériel detailed to a civil school are attached again to a military school designated by the minister.

When the matériel is stored outside of the aeronautic troops station it is managed by a depot assigned by the minister.

SPECIAL ESTABLISHMENTS.

ART. 14. Special establishments operate in conformity with special regulations and instructions concerning them; the composition of their cadre is determined by the table below. The troop personnel is furnished them by the units designated for taking care of the service.

ART. 15. Decree of August 22, 1912, relative to organization and apportionment of military aeronautic groups and establishments is abrogated.

Table showing composition of cadres in special establishments.

Administration of military aeronautics matériel: 1 colonel or lieutenant colonel, 1 captain or lieutenant, 1 administrative official, 1 assistant administrative official.

Central establishment of military aeronautic matériel: 1 superior officer, 6 captains or lieutenants (plus an additional number of aviator officers or pilots of dirigibles), 4 administrative officials, 2 assistant administrative officials, 2 foremen or chief workmen.

Laboratory: 3 superior officers or captains, 9 lieutenants or sublieutenants (plus a certain number of officers as above), 6 administrative officers, 4 assistants, 5 skilled mechanics.

GERMANY.

The Naval Annual (for 1914) states that the German army at that time had 9 battle airships, and 2 more were available, privately owned but subsidized. The navy had 1, with another hired, and 2

building. Five mine-laying and scout airships were in the hands of the army and 1 building for the navy.

There were at that time about 8 sheds in Germany capable of holding the new model 32-ton ships and 13 capable of holding the 22-ton ships, with a total of 32 sheds built and 4 building in various parts of the country. The new type of sheds adopted for the housing of aircraft cost 70,000 marks. Sea-plane stations were established at Putzig, Kiel, Wilhelmshaven, and Heligoland.

There were about 500 aeroplanes of all descriptions in Germany in 1914. The sea planes used were the *Albatross*, *Euler*, *Avro*, and some other types.

The aeroplane sections of the German army are organized as complete units. Each army corps has its section and each army one or two sections. A section normally consists of six machines, each machine having two officers—an observer and an operator—with a chief of section in charge. The fliers are generally lieutenants, while the chiefs of the detachments are captains. About 6 noncommissioned officers and 100 men are assigned to each section. From 7 to 12 trucks are provided for carrying the spare parts, supplies, workshop, baggage, etc. Reports from the observers indicate that automobiles are furnished for the transportation of the personnel, but the aeroplanes themselves, as a rule, fly to their destination. There is one type, however, with folding wings, that by the insertion of a forward axle and wheels can be attached to a motor truck and pulled along the road.

A report from the eastern front states that an inspection of a section showed that one machine was a light single-decker, built for speed, for reconnoitering, and the remaining machines were of the double-deck type, designed to have a certain weight-carrying capacity. The single-deck type seen was a Fokkor machine with a Gnome revolving engine. The double-deckers had Mercedes engines. The offensive weapons carried by the machines were steel darts and high-explosive bombs. The steel darts are issued in packages of 50, and, as a rule, are thrown out a pack at a time. There are several sizes of high-explosive bombs furnished, the largest weighing 15 kilograms. The heavier types are carried suspended from the body of the aero-

plane and released by a trigger. The aeroplane has four attachments for carrying bombs. The lighter bombs are carried in the body of the machine.

Reports indicate that the bombs are pear-shaped, and fixed with a propeller attachment that arms the fuse after a certain number of revolutions.

A study of the reports at hand indicates that the Germans have made strenuous efforts to place large numbers of aircraft in the field, and that owing to the conditions existing it has been impossible to equip each section exactly alike. Nor is it at all probable that the supply of aircraft is limited to army corps, where circumstances appear to warrant the advisability of other assignments.

The following contains the latest detailed information on the subject up to January, 1915:

My previous reports on German aviation show what a high state of development it has reached. No one knows or no one will say how many aviators they have, but there are evidently 75 or more detachments, or, as they call them, *Abteilungen*. Two months ago I was told there were over 50 such detachments, but there now must be over 100, as it is probable that Germany has about 90 army corps. There are 60 army corps of which I have been able to get track, and there are many more in process of training. The highest number that I noticed on the sleeves of such detachments as I have seen was 29.

As the flyers can work within a radius of 100 miles, it is not necessary for them to be immediately up in the front, and therefore they frequently occupy very good quarters many miles in the rear of the lines, where they are connected by telephone with the army headquarters. In fact, so good is the line of telephone communication now that all of the infantry and artillery, companies, batteries, squadrons—everyone is connected by telephone and information can be transmitted immediately.

A *Flieger Abteilung*, or detachment, consists as a rule of 6 flyers, with the necessary machines and spare parts—usually 7 machines in each *Abteilung*, with the extra parts in the hangars. There are also observers with each *Abteilung*, and the latter is commanded by, I think, a captain, who is generally a flyer. As seen by the late organization tables of the German Army, the flyers are divided up into battalions. While on a visit recently to the headquarters of the second army met there a major of the flying corps, who was in command of all of the flyers of that army, and perhaps more. He had a few days before made a flight over Amiens with 10 aeroplanes. They had been able to drop a number of bombs on the town, trying to put the gas works out of commission, and they were then awaiting with some interest the French reports as to the result of their flight.

There are some 14 motor trucks to each Abteilung for the carriage of the aeroplanes, benzine wagon, repair wagon, two—now generally three—automobiles for the use of the officers and one or two automobile busses for the enlisted personnel. In this case an autobus had been arranged as an office and resembled a good deal an officer's room aboard ship, as it was fitted with every convenience improvised, including maps, map cases, tables, telephone, lavatory, stove, and both electric lights and oil lamps. Each Abteilung has all of its machines from the same factory, and the factory thus becomes the base of that detachment and supplies direct or through advance bases all of the extra parts needed. This Abteilung had the usual cartridges for the firework signals, red, blue, white, and other lights which when fired look like so many stars and are fired from a kind of pistol. They also had the photograph apparatus, descriptions of which have been forwarded, which has a pistol grip and photograph is taken in the same manner that a pistol is fired. The photographs that have been taken during the war are excellent and have been of great value. The detachment also had the various kinds of bombs which I have described in previous reports. They also had the bomb-dropping apparatus, though most of the bombs were dropped by hand.

I was struck by seeing a detachment of enlisted men belonging to an Abteilung and quartered about three-quarters of a mile from their hangars marching the distance in as orderly a manner as guards through the streets of Berlin. This is only indicative of the absolute good order that is kept by the German Army everywhere in the field; one never sees any slouchiness about the way in which they perform their military duties. One becomes convinced that this precision, eagerness, and orderliness of doing things in war exactly as they are done in peace, with the same precision as the drill of the West Point Cadets, is a very good thing for the proper training of a nation which goes to war as a nation where every man of suitable age is a soldier.

It is claimed that some 50 Zeppelins are being built and that airship halls are being constructed through Belgium for their accommodation. It is also claimed that large numbers of heavier aeroplanes are being constructed.

At the beginning of the war many of the expert pilots wanted to go to the front. The pilot instructors, however, were kept on duty at the various manufactories and aerodromes, where they have been continuously instructing new flyers. I am told that comparatively few of the flyers have been lost. Members of a number of detachments have told me that they had lost none. The commander of another detachment told one of my companions that he had none of his original flyers with him now, but I don't know whether they were all lost or had been transferred to other detachments.

The following is the method described to me by a major of artillery who has a group of batteries in the garde corps as to the use that he has lately made of the aeroplanes: Knowing that so many aviators were assigned to his brigade or division, he would ask for one or more of them to be placed under his orders for

certain work; the flyer or flyers would come to him in his place of observation, generally a dugout up in advance of the batteries, and there he would very carefully explain to the aviator a system of signals so that he would know exactly what the aviator saw; he said that these signals would, as a rule, consist of a turn by the aviator to one side or the other, his circling in a certain manner, a figure 8, etc.; after giving his instructions and agreeing upon the signals, the latter would be written down in duplicate, he retaining one copy and the aviator taking the other; the aviator would then at once proceed to carry out the instructions, which generally related to the detection of some position of the enemy, such as that of the hostile artillery or as to where his own shells were dropping. By means of the telephone the artillery major could inform the infantry lines as to what the aviator was going to do. The artillery major laid emphasis upon the one thing that all German officers seem to consider of the greatest importance, i. e., that instructions should be clear, thoroughly understood, as simple as possible, and every means taken to prevent their being forgotten, so that they may be carried out exactly as given.

The following standards have been set by the German war office for inspection and acceptance of aeroplanes:

The apparatus must be so stable that it is able to resist sudden squalls and that the pilot, even during the longest flight, is not exhausted. When the motor ceases to work the apparatus must be able to proceed to a gliding flight without interference of the crew. The carriage must possess guidable wheels; the steering has to be done by pedals. Besides, there must be two more pedals by which merely the horizontal rudder can be worked. As steering device, the military system of steering has to be built into such aeroplanes. The vertical lever works the vertical rudder, the volant with chain wheel the transverse stability. The steering wheel must be parallel to the pilot.

Gas throttle and all levers in connection with the motor must be solid and large and have to be adjusted on the right of the pilot's seat about 50 centimeters in front of the back of the seat. All steering cables have to consist of easily flexible, unextensible steel-wire ropes, the ends of which have to be spliced without being soldered.

The apparatus has to be built for two persons, pilot and observer. Their seats have to be arranged in such a way that the observer is not at all and the pilot as little as possible prevented from looking forward and sideways, and also downward, for the purpose of landing or inspecting the tension wires. (The apparatus can also be manned with two pilots, who relieve one another, and pilot and observer.) The motor must not be placed behind the pilot and observer. On both seats elastic leather belts 10 centimeters broad must be fitted up, and it must be possible to untie it with one grip of the right or left hand, even when pilot and passenger are hanging in the straps. The seats must be so arranged that pilot and observer can be seated in a position as normal as possible and that they are protected from draft of air as much as is feasible.

It is further demanded that the apparatus can be taken to pieces for transportation on road within half an hour, and after such transport can be mounted for use in likewise half an hour by six soldiers. The taking to pieces has to be preceded by a flight, and the mounting must also be followed by a flight. It must be possible to transport the apparatus without the aid of a vehicle even over rough country, when it must also be able to pass through a rectangular opening of 2.30 by 3.50 meters.

The conditions for trial flights before an apparatus is accepted on behalf of the war office are as follows:

The commission selects one apparatus out of a number of aeroplanes of the same type which has to make a long-distance flight of 450 kilometers in an average height of 500 meters. The pilot, after flights of two hours each, is allowed to land and take rest, but must not touch apparatus or motor during the pause. The minimum weight of pilot and observer is 160 kilograms. If this actual weight is smaller, the difference has to be made up. The length of the run before the flight must not exceed 60 meters in the case of one occupant, and the start is not to be made against the wind. One landing has to be effected by means of a gliding-down flight from at least a height of 100 meters, when the motor must be completely stopped.

Another long-distance flight has to be made with an apparatus selected by the commission out of a number of aeroplanes of the same type. This flight must last 7 hours, must take place in an average height of 50 meters, and two occupants of a minimum weight of 160 kilograms must be in the flying machine. Besides, the apparatus must carry a load of 100 kilograms. The run before the ascent must not exceed 100 meters.

In the third place the speed is tested by a flight at which the apparatus, carrying the same weight as in the 7 hours' flight, must fly in a maximum height of 50 meters along a marked line of 2 kilometers twice to-and-fro. The average speed must be at least 80 kilometers.

A further condition is that the apparatus, with the before-mentioned weight of 260 kilograms, is able in calm weather within 15 minutes after the start to rise to a height of 1,000 meters.

Finally, the reliability has to be shown by a flight of 15 minutes' duration without passenger in a wind whose intensity is at least 15 meters per second.

In order to test landing and ascent under unfavorable conditions, as in the field—that is, on or from field, stubble-field meadow, pasture land, etc., and within a narrow compass, as well as without any assistance—the commission selects a place on which the apparatus, with the load as above, has to land and to rise again.

AUSTRIA-HUNGARY.

The service of aeronautics in Austria-Hungary, while not as well developed and organized as the service of Germany and France, is

nevertheless of importance. The service is performed by the detachment of aeronautics and the detachment of fortress balloons. The detachment of aeronautics is divided into the commander, the detachment of instruction, and the technical detachment. To the latter the gas factory, workshops, and storehouses containing technical equipment are assigned. The commander of aeronautics is in command of its parks.

The service was, in 1914, in a formative state as to organization. At that time, including the 4 flying parks in the navy, there were 14 of the parks in the monarchy. A flying park consists of 6 machines, 2 of which are for reserve; 2 wagons for each machine—1 wagon for body, engine, spare parts, tools, etc., and 1 for 2 sets of wings, 1 set being for reserve, spare parts, tools, etc.—4 automobiles for use of the company; 1 automobile equipped for making repairs. The personnel of the organization is 1 officer, 4 observers, 6 pilots, and 100 men. The wagons are drawn by horses.

It was the intention to assign one of these parks to each company. Two battalions, each of four companies, with four or five flying parks per company, were to be organized in May, 1914, and others were to be organized later, so that the total would be about 38. This reorganization was to be completed in 1915.

In November, 1913, the aeronautic detachment was organized as follows: A lieutenant colonel in command; a staff; a property division, with a major as chief; a motor-testing station and experimental detachment; a balloon detachment; and a workshop. At Fischamend are two large hangars and workshops for air craft, as well as a motor repair shop and a gas-generating plant. It was the intention to erect barracks and quarters at this place for the headquarters of the aeronautic detachments and attached departments. In 1914 there were 40 licensed military pilots, 4 of whom were noncommissioned officers. At that time there were 50 noncommissioned officers undergoing instruction as pilots, many of whom would shortly become available for duty.

Both line and staff officers are employed as observers. It was planned to call for 100 volunteers, two-thirds of whom would be line officers and one-third staff officers, for duty as observers. These

officers were to be attached to flying parks and accompany flyers on each flight.

At Fischamend is installed a central radio station for use of the aeronautic service.

It was the intention to establish a meteorological station to furnish information by radio to the War Department for use of air craft. In furtherance of this project all flying parks were to be equipped with radio stations.

Reorganization of the airship battalion contemplated the establishment of a staff at Fischamend, and three companies, one at Graz, one at Budapest, and the third at Fischamend. The company stationed at Fischamend was to be the training company. Each company was to be supplied with an airship of a different type.

The following remarks, furnished in February, 1915, by an observer in Austria, are of interest:

The number of machines attached to a flying park is now 8 instead of 6.

One park is supposed to be attached to each corps headquarters, which would make the total number 18. It is thought, however, that only army headquarters are actually supplied.

At the beginning of the war there were probably 150 aeroplanes available.

Experience has shown that one aeroplane per park per week is necessary to keep the equipment up to full strength.

The Naval Annual (1914) states that Austria had 3 mine laying or scouting airships.

RUSSIA.

In 1912 aeronautics in the Russian Army were transferred from the engineer department to a newly formed aeronautical section of the general staff, which is charged with the supervision of the technical equipment and the training of the aviation corps. There is also a permanent aeronautical committee which deals with this subject. An aviation school has been established in which it is proposed to train 15 officers each year as pilots.

In 1911 the sum of 200,000 rubles was raised by public subscription for the promotion of aeronautics, and it was officially stated in the

press in 1911 that the formation of the flying sections of air companies would be completed in 1912. It is not known exactly what state this reorganization was in at the outbreak of the present war, although it was estimated in January, 1912, that some 170 aeroplanes were then on hand, and that by the end of 1912 about 50 civilians of varying degrees of efficiency and 100 officers would be qualified as pilots.

On the subject of aeronautics in the Russian military organization the *Naval Annual* (1914) contains the following:

There are no dirigibles of the battleship class as yet, but the purchase of a Parseval type is contemplated. Two small ones are reported to be building, including one of 13 tons by the Baltic Works, at Riga.

Russia has 13 scouting and mine-laying airships and 3 building. Only 7 of them are of sufficient size to be of much use in war. In view, however, of the number of sheds building and projected, it is very possible that more ships are in existence or building. The whole of Russia is a forbidden area to other air craft, and little information leaks out as to progress made in naval and military aeronautics. It is reported that a condition of the French loans to Russia is that she shall buy her air craft in France, and two 23-ton ships have been ordered.

It is believed that there are eight sheds in European Russia, all of good size, and most of them double sheds. It is also reported that two are in course of erection at Vladivostok and that two more are projected. If this is true, it looks as though Russia did not intend to be left behind in the race for the command of the air. She is probably the third strongest air power, with Italy fourth and Great Britain fifth. Should Russia build airship stations in northern Persia, it will give her a great hold on that part of the world, and doubtless they will be of great value to her in Mongolia, where there are no railways and the movement of troops is slow. Next to Great Britain, no country stands to gain so much by the use of airships as Russia.

There are sea-plane stations at Petrograd, Reval, Sevastopol, and Cronstadt. The Curtiss type appears to be the favorite. There are probably 24 machines of that type in the country, besides a number of machines of French make. The greatest step forward in the design of heavier-than-air craft during the last year has been made by Sikorsky, a Russian designer. He has produced a machine driven by four independent 100-horsepower motors, and which has carried as many as 16 passengers. Five have been ordered for the Russian admiralty to be fitted as sea planes, whilst a number have been ordered for the army. The other machines in use by the army are principally Nieuports and Farmans.

ITALY.

The latest reports on the subject of aeronautics in Italy, dated January, 1914, indicates that a reorganization, begun some years previous, was still in progress. This organization consolidated the aeronautical service under a headquarters at the ministry of war, and divided the service into three divisions, as follows: The specialisti battalion, the aviation battalion, the manufacturing and experimental branch.

The specialisti battalion consists of 44 officers and 900 men, organized into four mobile companies; one company of mechanics; one radio section; one photographic section; and one transport company. This battalion is charged with the details in connection with the balloon parks, dirigibles, searchlights, radiotelegraphy, telephone, and telephotography.

The aviation battalion is formed from two flying companies and a technical subdivision. The flying companies are charged with the management of the aviation schools and the supply of squadrons for the army. The battalion, including the headquarters, consists of 46 officers and 300 men. The reorganization calls for about 20 squadrons of aeroplanes; 12 of these are presumably for the 12 army corps, 2 for the cavalry divisions, and 6 for fortresses. In 1914 there were 4 aviation schools.

The manufacturing and experimental branch is controlled by a director—a lieutenant colonel or major—six officers and four civilian assistants. The company of mechanics from the specialisti battalion is permanently attached, both for technical duties and for discipline, to this branch. The branch has an office and an air dock for experimental purposes near Rome.

The organization of the squadron is about as follows:

Aeroplanes (4 for reserve for mobilization and 3 for exercises and instruction)	7
Commander	1
Pilot observers	4
Observing officers	4
Men	30

The personnel is transported by motor cars. There are 2 auto-trucks for workshop, stores, supplies, etc., and 2 motor tractors to each squadron.

There were 5 dirigibles assigned to the army—1 for experimental work, 2 for instruction purposes, and 2 apparently for reserve. Some of these were fitted with a Clement-Bayard motor and some with Fiat motors. These dirigibles attain a speed of 65 kilometers in still air. Their radius of action is stated to have been a height of 1,000 kilometers.

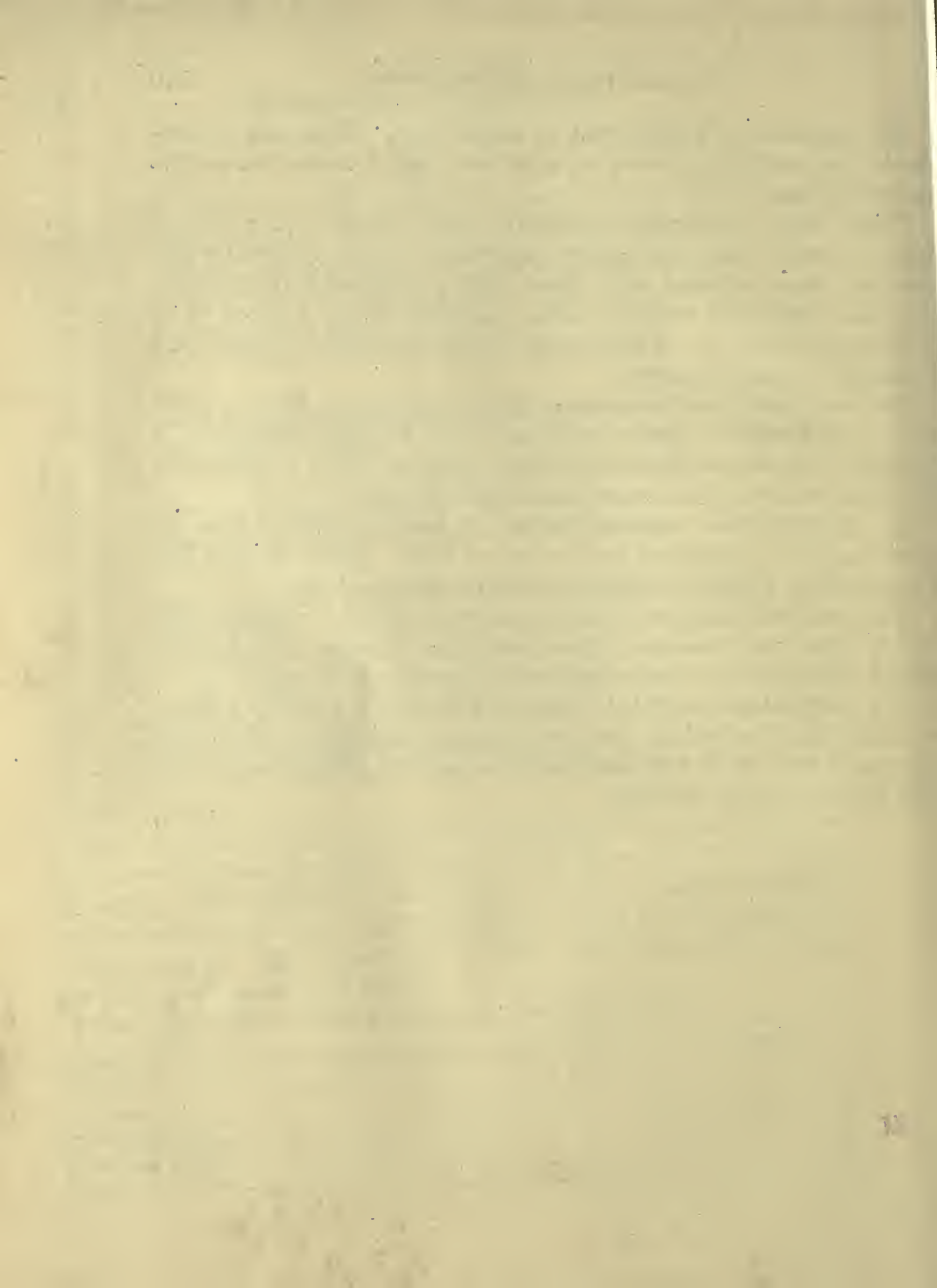
The aeroplanes used are mostly French—Farman, Bleriot, Nieuport, and Breguet. There are also a few English machines. A standard type of machine had not been adopted, but it is apparently the intention to use both monoplanes and biplanes.

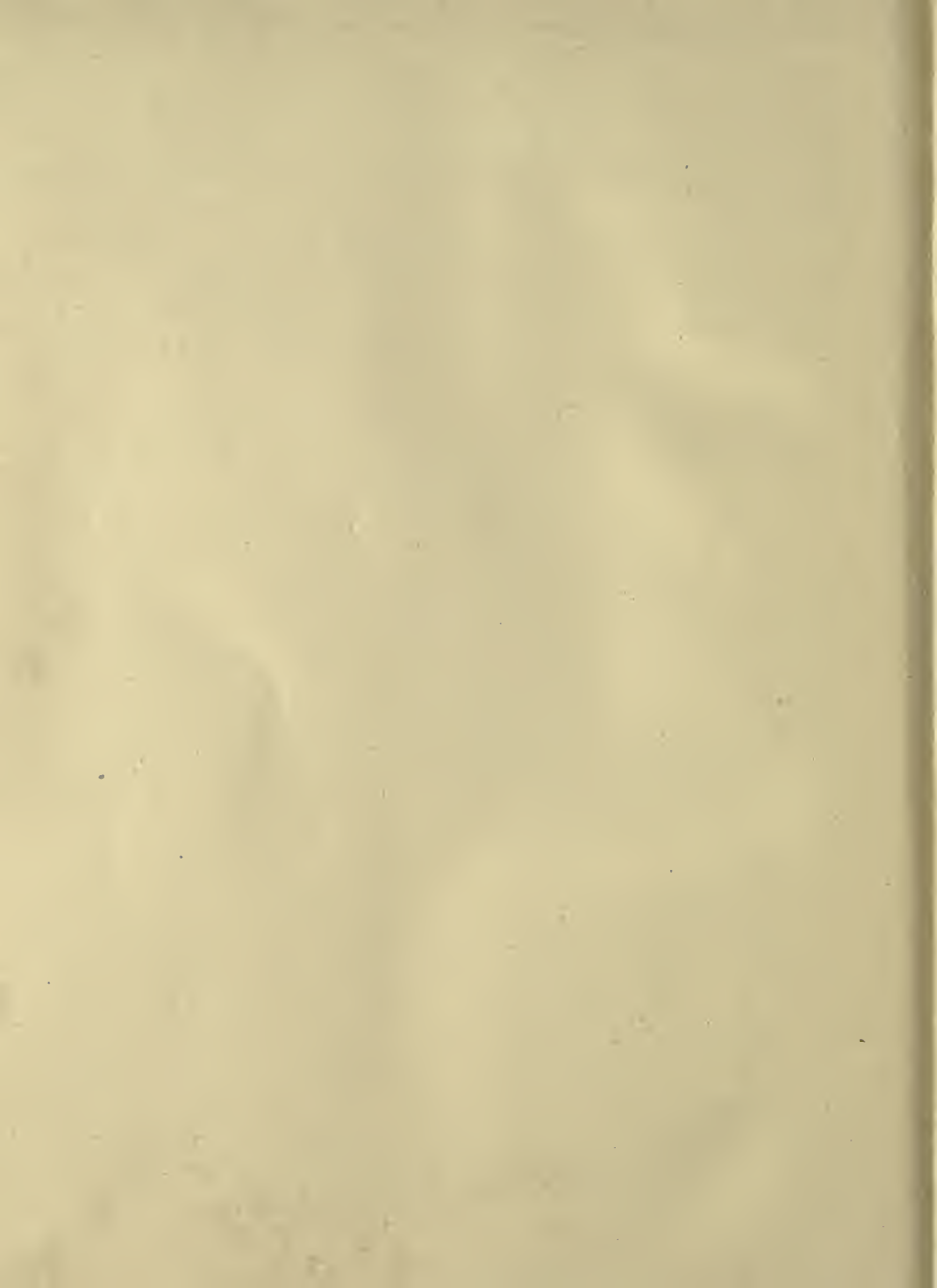
The Italians have featured the use of telephotography from air craft, and have completed an air map of Italy. Their work in this connection in Tripoli has been favorably commented upon.

There are two classes of aviation courses provided for officers—one which lasts a year and one which lasts three months. Noncommissioned officers are also instructed in the three-months' course.

The Naval Annual (1914) states that there are 8 battle airships available for the Italian army and navy, 1 building, and 3 small private ships. It is also stated that about 150 efficient aeroplanes and sea planes were on hand.







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