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NAVAL COMMUNICATIONS
THE NAVAL RADIO-SYSTEM.

by

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I N D E X

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N A V A L C O M M U N I C A T I O N S

THE NAVAL RADIO SYSTEM

INTRODUCTION

This paper is based on the following outline furnished by the War College:

(1) Radio on Battleships, Scouts, Destroyers, Submarines, Aircraft.

(2) Radio in Aircraft.

(4) Tactical Use of Radio.

(3) Radio Direction Finders, Ship and Shore.

(5) Radio in War Operation.

(6) Codes that will be used in War.

To admit of clearer discussion, I have taken the liberty of interchanging subjects (3) and (4), but otherwise the outline has been followed.

I would like to state, however, that one of the guiding principles of our Naval Communications is the coordination of all means of communication. This is a principle which has been carried to a more logical conclusion in our Navy than in any other.

Although radio is our greatest Navy communication system, its use unfortunately conflicts with the principle of concealing one's own position and, therefore, in war, must be reduced to a minimum by taking full advantage of all the auxiliary means we possess, even to the pigeons, which can now deliver messages to ships at sea.

So, although this paper is confined to radio, it must be remembered that radio, vitally important as it is, is only a part of Naval communications.

This is an operational paper and no attempt has been made to go into technical material details. It will be obvious to the reader that certain statements which bear on details of our war plans and on Fleet Standing Orders must be considered secret.

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1. RADIO ON BATTLESHIPS, SCOUTS, DESTROYERS, SUBMARINES, AND AIRCRAFT.

Under this subject, it is assumed that the College is particularly interested in the range of communication which may be obtained with different types of ships.

Unfortunately this is difficult information to give, Some figure must be given for use in chart maneuvers at the College, and this has been done.

As a matter of fact, exact range of radio communication can never be fixed in advance. It is affected by several variable features. First, materiel installation. Identical sets in the same type of ships do not give the same results. Second, personnel. The efficiency of operating personnel is not and never will be standard. Excellent operators will get better results out of a poor set than average or poor operators out of a much better and more powerful set. Third, diurnal and seasonal. In general, radio communication is best by night and in the winter. However, there are exceptions to this, as in the case of the fading away of signals from San Diego as received at Washington for half an hour at sunset each day. Fourth, static. Static is the bete noir of radio communication. It is sometimes used as an alibi by poor operators and sometimes it defeats communication, no matter how perfect the materiel and the ability of the operators. There is still a great deal to be learned about static. It is always present with local electrical storms at the receiving point and is much greater in some geographical localities than in others. One theory is that static is connected with sun spots, and another that it is connected with phases of the moon. There is some evidence to support both theories and both are under scientific investigation at present. Fifth, interference. Interference is the drowning out of the signals which an operator wishes to receive by other signals which come in at or near the same wave length. Proper radio organization,

materiel, and perfection of materiel and personnel reduce interference to a minimum. Proper supervision of watches and officer operators on guardships are also essential.

All of these factors singly or in combination affect the range of radio communication, and that is the reason we are unable to set a definite figure for communication by various types. The figures given are a normal average, and available for the use of the College in chart maneuvering, but in actual operations, the only guide for a Commander is advice at the time from experienced Communication and Radio Officers.

The type installation of sets by types of ships follows:

Battleships

	Range
Arc	800 miles
Spark	300 "
Fire Control	15 "
Aircraft Spotting	15 "
Intra-Fleet	10 "

It is intended to install a tube set in place of the spark set, and in time this tube set may also replace the arc. In addition to the sets given, there is a TC set, which is in process of development. Its use has not yet been determined. There is also an "after-action" set, which is intended for use after battle, when all other sets may have been put out of commission; a field set for landing purposes; and a motor buzzer, used in connection with the spark set and having a range of about 50 miles.

The arc and spark sets are known as main radio, the arc for communication on long waves, which also means long distance; the spark for communication on intermediate waves, and intermediate distances. The fire control set, which also has a telephone attachment, is for the exchange of fire control information between ships of the unit. The aircraft spotting set, which also has telephone attachment, is for communication between a spotting plane and the firing ship. The intra-fleet set is a small set used for communication between ships within ten miles of each other in connection with the guardship system, and in tactical maneuvering.

The ideal development is the simultaneous use of all these sets, thereby obtaining the maximum number of lines of communication. At present, all sets can transmit simultaneously; also they can receive simultaneously, provided no set is transmitting. When the arc is transmitting, none of the other sets can receive, except the intra-fleet. When the spark is transmitting, none of the other sets can receive. The transmitting of the intra-fleet set does not interfere with reception on the arc or spark sets. With the new tube set, it is expected that transmission will not interfere with reception on other sets. The possible combinations in transmitting and receiving by the other sets would cover several pages of discussion, and will not be gone into. In general, we have not yet eliminated interference between sets in the same ship, and this holds in a less degree for ships close by.

Scouts, or New Lightcruisers

The installation for this type is not yet, of course, tried out, but the plans call for:

	Range.
Arc, 20 k.w.	800 miles
Arc, 2 k.w.	500 "
Tube	400 "
Intra-fleet	10 "

This type bids fair to be the most efficient in radio of any type of Naval ship, which is, of course, as it should be considering its mission.

Destroyers.

The type installation for destroyers is:

	Range.
Spark	300 miles
Telephone	10 "
Buzzer	75 "

The destroyer is an efficient radio type and individual destroyers have shown excellent radio efficiency. The shortage of

personnel has adversely affected the radio efficiency of destroyers, as a whole. Radio sets must be used to be efficient, and this has not lately been possible.

Submarines.

Submarines have a tube set with a range varying by classes, but not over 75 miles. A loop cable antenna, running from bow to stern of the hull, is used when operating submerged. This antenna is very directional, both for transmitting and receiving, that is, the range ahead and astern of the ship is a maximum and abeam a minimum. For operating on the surface, a wire antenna with telescopic mast is used, and the directional effects eliminated. Radio development in submarines is not, at present, satisfactory, due to shortage of personnel and resulting lack of use. At present, the Bureau of Navigation is concentrating on furnishing trained radio officer personnel to the submarines.

Submarines can receive entirely submerged to a depth of 10 to 25 feet, but can not transmit without coming to the surface. It is not necessary, however, to open hatches and the boat is therefore ready for a crash dive.

New transmitters being installed are expected to give a range of 250 miles.

Aircraft.

In general, the development of Naval aircraft radio has been very satisfactory. The type of installation is:

	Range.
Scout and Patrol Planes (F5L), tube - - - - - - - - - -	150 miles
Torpedo and Bombing (single engine, 2 seater), tube - - - - - -	150 "
Spotting, observation, photographic (DH), tube - - - - - - - - -	150 "

Combat planes have no radio installation.

Of the lighter than aircraft, rigids and non-rigids have radio, K.B. have no radio, wire telephone communication being used. Planes have received up to 1500 miles, and have transmitted up to 500 miles, but this is a maximum.

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2. RADIO IN AIRCRAFT

The radio sets assigned to aircraft have just been described. In addition, radio compasses are supplied to scouting and patrol planes, and will be supplied to rigids.

Our general plan of aircraft communication contemplates the fitting in of the Air Forces to our Naval radio system in the same manner as any other forces. The British, with their unified Air Service, have a separate radio system for aircraft, operating their own stations on their own wave lengths. I do not think this is entirely a success, even with the British system, and in any case it would not be practicable in our country with its great extent of territory. Our Air people have now accepted this principle, and our development of Aircraft communication will be along the lines indicated. An Aircraft will call a Naval radio station or Naval ship in the same manner as a destroyer would call. They will, of course, have their assigned wave lengths in the same manner as the destroyers.

One question which we have not settled is the coordination of Aircraft work with the Army. If the Navy confined itself to the planes operating from ships, the problem would be simple, but many Naval planes operate from shore with Army planes operating in the same general vicinity. The coordination of the two services in now under consideration.

The mission of Aircraft requires that all types, except combat planes and kite balloons, should have efficient sending and receiving radio facilities. A scouting plane is, of course, useless unless it can immediately communicate its reports to a base, and without efficient radio the value of all aircraft is largely wasted. In the case of Combat planes, the necessity for saving in weight and the gunnery and maneuvering required, makes it necessary to sacrifice the radio. Communication with kite balloons is provided by wire telephone stopped down the mooring cable.

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The importance of immediate radio communication has been recognized by requiring all pilots to become proficient as radio operators, and in the smaller planes, the pilot actually does his own sending and receiving.

Results of Aircraft work with the Fleet Air Forces has been very satisfactory. At the time of the bombing exercises off the Capes, the Commander of the Atlantic Fleet Air Force reported that he had no trouble in handling his planes by radio from the SHAWMUT, and in utilizing services of the Norfolk shore system.

Very valuable exercises in radio communication with planes in flight have been held at Honolulu and Coco Solo, and development is continually being made at Pensacola and Anacostia.

Good radio communication was maintained by both the Atlantic and Pacific Air Fleet Forces in their cruises to the Canal and return, during the last joint Fleet maneuvers. Without radio communication, it is probable that these flights could not have been made without the loss of planes and personnel.

Good results have also been obtained in communication between aircraft and submarines, which has an improtant bearing on combined operation.

A kite antenna has recently been developed which enables a plane forced to land on the water to communicate considerable distances by radio. This is a most important development.

An interesting scouting problem involving the use of aircraft radio and radio compass was carried out off the Virginia Capes recently. U.S.S. OHIO was in an unknown position within a radius of 150 miles from Cape Henry, with unknown and varying course and speed. A single plane left Hampton Roads to locate OHIO and within an hour and a half was circling over OHIO. Subsequent plotting of positions showed that the plane had by means of her radio compass correctly headed for OHIO each time OHIO transmitted by radio. The plane returned to Hampton Roads by use of her radio compass on the Norfolk transmitter. At all times during the experiment, the plane was in communication with

Norfolk by radio.

At Pensacola, a method of landing in fog has been developed. A transmitter near the landing field transmits as a radio beacon. The plane brings the beacon sharp on the bow and on this course stands in till the beacon is abeam. She then shuts off her engine and glides to a landing. At Anacostia landing in fog by means of a piloting cable is also being developed.

Another development is the discovery of a cone of silence directly above a radio transmitter, which enables an aircraft to fix position above a transmitter by the fading away of the signals.

3. RADIO DIRECTION FINDERS, SHIP AND SHORE

The principal war missions of the radio direction finder, ship or shore, are:

(1) Coastal piloting with lighthouses not lighted.

(2) Entering harbor in fog or at night.

(3) Plotting of enemy positions.

Our radio direction finder stations are of two classes - ship and shore. Shore stations at present established are, in general, grouped at harbor entrances in three unit groups, one station controlling all three stations. This makes it possible for a ship to obtain a three bearing fix of its position by calling the control station. In some cases independent stations are established from which a single bearing may be obtained and used as a line of position or to form a fix in connection with a bearing from another independent station. The maximum wave length on which these stations operate is 1000 meters. The maximum operating range is 500 miles and the normal operating range 150 miles. Their positions are known and published, and in peace time they are open to commercial use. In general, they cover harbor entrances of use to the Navy in peace and war. In war time, by means of radio compass code, their use would, of course, be restricted to friendly ships.

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In addition to these stations already established, the Bureau of Engineering has developed a long range direction finding equipment covering wave lengths from 500 to 7500 meters, and a range up to 1000 miles. The primary mission of these sets is the cutting in of enemy ships, and the Department contemplates establishing them in the following outlying possessions: San Juan; Guantanamo; Virgin Islands; Atlantic and Pacific side of Canal Zone; St. Paul, Alaska; Honolulu; Midway; Guam; Tutuila; seven stations in the Philippines; and Peking. In addition to these new stations, the same type of equipment will be supplied to certain existing stations on the Atlantic and Pacific coasts. Since it is desired to keep the location of these stations secret, the equipment will be assembled at designated bases and installed only upon the outbreak of war. The Hydrographic Office is preparing great circle charts for use in connection with these long distance bearings, and each station will have a transmitter capable of communicating with the nearest district center high power station.

At long distances the harbor entrance group bearings are useless, due to the acute angle of cut, and a method is being devised of combining bearings from several groups for long distance work in the same manner that individual bearings are combined in a group for the short distances.

It is expected that valuable information of enemy movements will be obtained from these long range direction finding stations. In addition, valuable checks on the navigation of our own fleet may be obtained. However, the disadvantage exists that high power radio transmission will have to be used by the ship desiring the bearing.

Ships.

Long wave long range receivers are to be installed in all battleships, battle cruisers, scouts, and the T class of submarines. These sets will be useful for determining enemy positions and for making contact with friends. A ship may fix her own bearing on any known station while that station is

transmitting.

The radio direction finder may be made most useful in bringing to a common origin the reckoning of ships at sea operating together without visual touch. Had it been fully utilized at Jutland, the twelve mile difference in dead reckoning between the battlecruiser flagship and the flagship of the Commander in Chief could have been eliminated, and a correct estimate of the enemy's actual position and bearing thereby made by the Commander in Chief. The Admiralty could have given the Commander in Chief simultaneous true positions of IRON DUKE and LION, as well as that of the German flagship.

The Department of Commerce is installing radio beacons at certain points on shore. This is the reverse of our shore direction finding system in that the beacon sends out at varying intervals, radio transmission of distinctive characters similar to the flashes of a lighthouse. Any ship within range, and having a radio direction finder, may take its own bearing from the beacon. The advantage is that no transmission is required by the ship. On the other hand, it will probably never be possible to calibrate ship radio compasses to the same accuracy that is possible with installations on shore. In the Navy, we, of course, have the advantage of the combination of both systems.

Aircraft.

Aircraft are being fitted with radio compass covering waves up to 1000 meters. These have been found useful in air navigation, and at Pensacola methods have been developed of landing planes in a fog depending entirely on radio compass bearing. Aircraft are also able to obtain enemy bearings in the same manner as a ship.

Efforts have been made to furnish aircraft in flight with bearings from shore radio compass stations. Due to the high speed and altitude of aircraft this requires special methods, but progress is being made.

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In connection with the radio direction finding system, mention should be made of the radio piloting cable. This is now a practical success, and a cable is actually in use through Ambrose Channel into New York harbor.

4. TACTICAL USES OF RADIO

I have found some trouble in fitting the discussion under this heading to the definitions of strategy and tactics.

The Navy Regulations gives the following definitions:

"Strategy applies to the distribution of naval forces, their armament and supplies in preparation for war or in the prosecution of war. It includes logistics. It refers to naval movements and dispositions made before contact with the enemy's forces."

"Tactics applies to all naval movements and operations made after contact with the enemy's forces. The term "contact" is here employed in a broad sense, meaning such proximity to the enemy as affects fleet formation and renders a battle imminent."

The line drawn in the above definitions between strategy and tactics is not a satisfactory one from a communication point of view, since it is impracticable to change the system upon contact, and, therefore, the uses of radio in tactics, as defined above, are made the basis and are applicable at all times in the handling of Naval forces, whether before or after contact.

As a matter of fact, the endeavor has been to determine the system best suited for handling Naval forces in action, and on that as a basis, to build up the system of handling other communication, or what is commonly known as traffic.

It was very appropriate that this subject should precede the one which follows, because on it and particularly on the first one of the tactical uses to be discussed, is built up the whole fabric of the Navy Radio System.

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The tactical uses of radio are four in number. For want of better definitions, we have called them:

(1) Major tactical command and reports.

(2) Minor tactical command and reports.

(3) Fire control.

(4) Aircraft spotting.

Major Tactical Command

Under Major Tactical Command is included the handling of major forces under one command and usually outside visual touch, together with the resultant reports. It covers the disposition and control by the Commander in Chief of his offensive and defensive scouts, screens, and other forces, - the handling of the Fleet as a whole. It also covers the all important contact and enemy Battle Fleet report.

For Major Tactical Command, radio is the primary means, and conversely, this may be said to be the primary mission of radio, so far as the Fleet is concerned.

The general rules for radio communication are based on this function, so it is only necessary to describe the organization required to allow simultaneous handling of several forces, with the minimum of delay and interferance.

This organization consists in general of the assignment of separate non-interfering wave lengths to the forces involved. The present development of radio limits the number of lines of radio communication which a single ship can maintain simultaneously. To provide these simultaneous lines, particularly necessary to the flagship of the Commander in Chief, use is made of the radio facilities of certain ships in company, which are known as guardships. Each guardship is assigned a wave, and so far as that wave is concerned, the guard ship is a part of the radio room of the Commander in Chief. If another ship calls the Commander in Chief on that wave, the guardship answers, using the Commander in Chief's call. If the Commander in Chief has a message to transmit to a task group or force, the guardship

for that groups wave transmits the message, using the call of the Commander in Chief. The messages are passed between the flagship of the Commander in Chief and the various guardships by an auxiliary means of communication - intra-fleet set, telephone, visual, etc.

The Commander in Chief is, of course, at liberty to transmit direct to any task group, when he so desires, but the guardship system allows him to use practically simultaneous transmission to several forces, when the several messages would otherwise have to take their turn. The radio room of the flagship of the Commander in Chief guards as many waves as possible, and copies incoming messages direct, but this is in addition to the prescribed system.

The same principle may be worked out in the subordinate forces, the Commander assigning guardships, which care for the transmission and reception on any particular wave.

Minor Tactical Command.

The second general use, Minor Tactical Command "includes the tactical handling of minor units, usually within visual touch, and in formation - i.e., the "ships right 15°", "take Battle formation No. 1", etc. of the battle line.

Due to less reliability, and to the interference which would result with its use for Major Tactical Command as given above, radio is not considered, at present, the primary means for Minor Tactical Command.

The type maneuvering is, of course, that of the Battleships in the battle line, and for it, visual, which includes flags and searchlights, is, at present, considered the primary method. However, low visability, due to fog, smoke, intervening ships or night, may at any time make radio the most reliable, and, perhaps the only means of tactical communication. It has, therefore, become standard practice to duplicate visual maneuvering signals by radio, and the intra-fleet set, previously described, has been installed in battleships primarily

for this purpose. Interior communications are so arranged that maneuvering signals transmitted by radio are received directly at the Captain's or Flag Officer's battle station, and with the radio signal of execution corresponding to the haul down of a flag hoist, maneuvering is theoretically possible without the use of visual signals.

I say theoretically because, although maneuvering has been performed time after time by the Fleet by radio without the use of visual signals, the auxiliary sets have not yet reached the state of perfect dependability, under which a Commander in Chief would voluntarily dispense with visual signals as a duplication.

The best solution for sometime to come seems to be the present one, of duplicating maneuvering signals by such means of communication as are available without interference with other functions, and thus providing every safeguard for the all important operation of ship maneuvering during action.

What has been said of Minor Tactical Command by radio has been in connection with auxiliary radio - specifically provided for that purpose. There is another means available, which, however, has certain disadvantages. This is the use of main radio for Minor Tactical Command. The power available for main radio and the greater dependability of the sets, makes it practically certain that maneuvering by this means could be safely and surely accomplished. However, to use main radio for this purpose interferes directly with the first of the tactical uses of radio given above, that is, the handling of the forces out of visual touch, and the general lines of Fleet communication.

This is, of course, a great disadvantage at any time, and particularly so before the enemy forces have been fully developed. Later on in the action when the two battle lines are decisively engaged, and all enemy forces have been definitely placed, conditions might arise which would cause the Commander in Chief to sacrifice Fleet communication for the immediate

necessity of maneuvering his battle line by main radio. Such a contingency is provided for in Fleet standing orders.

Fire Control.

The third tactical use of radio is fire control. Capital ships are fitted with a set for the specific purpose of fire control - primarily for use in the fire unit, that is, the Battleship Division. Over this set is transmitted between the Division Commander and ships of his Division or between individual ships of a Division, fire control information, general and divisional bearings lines, distribution of fire orders, ranges, deflections, spots, etc.

To avoid interference, it is necessary to assign definite wave lengths to each fire unit, and this set is, therefore, not available for general communication between the Commander in Chief and the Battle Fleet. On the other hand, when the Division Commander considers it appropriate, this set may be used by him for divisional maneuvering signals. As previously stated, the intra-fleet set is reserved for communication from and to the Commander in Chief.

Aircraft Spotting.

The fourth tactical use is Aircraft spotting. Aircraft spotting by radio is a special branch of fire control radio, and independent of the latter, so far as communications is concerned. Excellent progress has been made in the development of this method of spotting, and in future maximum use is expected. In this method, an aircraft keeps the air above the firing ship or division and its spotter - either pilot or passenger - transmits his spots to the firing ship.

When kite balloons are used, the spots are transmitted by telephone through a wire telephone, the conductor being led down the mooring cable of the balloon. Radio is not used.

Due to helplessness of the kite balloon and its immobility in comparison with heavier than air spotting planes, the latter are preferred and radio becomes essential. A special type radio set is installed in these planes, and in the Battleships, by means of which communication is maintained between the spotter and the ship. Originally it was intended to use radio telephone for this purpose, but recent developments have indicated the advisability of the use of radio telegraph. Communication from plane to ship has proved more efficient than from ship to plane, but as the former is the most important, and, in fact, the essential direction of transmission, development is considered satisfactory.

The preceding discussion has been based on the capital ship and the maneuvering of the Battle Fleet. The destroyers, often operating in smoke screens, or at night, and with high speed and quick maneuvering qualities, have further developed the exercise of Minor Tactical Command. The basic signal is the whistle. The radio operator duplicates the whistle signal by radio telegraph on spark or buzzer, and through a telephone transmitter on the bridge, the sound of the whistle is also transmitted by radio telephone. The signal is thus received in the individual boats of the command by four means:

(1) Whistle by eye.

(2) Whistle by ear direct.

(3) Whistle by ear by radio telephone.

(4) Radio telegraph.

5. RADIO IN WAR OPERATIONS

The following is an extract from an office memorandum of the Director Naval Communications:

"Mission

"In all plans of the Naval Communication Service, it must be remembered that the interests of the Navy are of primary importance and that in the Navy the

Fleets are of primary inportance. The Primary Mission of the Naval Communication Service must always be "TO FURNISH EFFICIENT COMMUNICATION FOR OUR FLEETS." Any permanent plan adopted must fulfil the requirements of the Fleets for war."

The Naval Radio System is a part, and doubtless the most important part, of the Naval Communication Service. The following doctrine for radio communication is quoted from the Communication Instructions:

"Doctrine

"Radio doctrine requires that all radio communication be governed by the following considerations:

"(a) Paramount importance of the radio communication of the commander in chief.

"(b) Resrtiction to essentials.

"(c) Utmost brevity, consistent with clarity.

"(d) Maximum use of short range, noninterfering methods.

"(e) Denying the enemy information of our forces.

"(f) Securing all enemy information possible.

"(g) Maintenance of apparatus supplied at maximum availability.

"(h) Maximum duplication of routes, with minimum duplication of messages.

"(i) Effective supervision of all methods.

"(j) Maximum rapidity in dissemination of information and orders.

"(k) Radio transmission is interference.

"(l) Radio transmission discloses presence and location.

"(m) Strict observance of operating procedure.

"(n) Maximum use of I method.

"(o) Use of minimum power for effective communication."

The present discussion applies only to radio but it must not be forgotten that our basic principle is co-ordination of all means of communication and that no one system is independent of the others.

Based on the preceding mission and doctrine, the Naval Radio System has been built up on the following lines.

First, the basic requirement of tactical use of radio by the Fleet was worked out and was made the basis of the entire system. This has been discussed in the preceding section.

Next, the shore organization was developed, having always in mind the basic requirements of the Fleets.

Last, the two were joined together and operation of the system as a whole developed. The process might be compared to constructing a bridge which must be built from both ends and joined together in the middle. After its completion, provision must be made for so controlling traffic that it is never overloaded beyond its capacity.

The building up of the Fleet end of communication has already been discussed in tactical use of radio.

Shore Organization

The guiding principle in establishing the shore organization has been to provide a net-work of radio communication which would meet the requirements of communication with our Fleets in any possible theater of war. This has been practically accomplished as may be seen from a study of the communication chart furnished the College.

As an indication of the development of the system, a Shipping Board ship recently made a trip around the world and at no time was she out of communication (for reception only) with a U. S. Naval radio station, with the exception of eight days in the vicinity of Aden.

Secret A plan has been under consideration for some time to establish one more shore high powered station, perhaps in Liberia,

which would close this gap, in addition to accomplishing other useful strategic requirements, particularly in the South Atlantic.

The primary consideration in the location of shore radio stations is their value to the Fleet and particularly to the Fleet in war.

Since the war, and the general shortage of personnel resulting from demobilization, there has been some criticism of the Naval Communication Service on the question of handling commercial radio traffic and radio traffic of other Government Departments. The situation is this. The Navy does not attempt in any way to compete with private radio companies. The inherent characteristics of radio make the question of control of its use a most important one, and at one time the Navy Department was in favor of Government control of all radio -- that control to be vested in the Navy Department. Congress did not look with favor on the plan and that policy has been abandoned. The Law now requires that the Navy may only handle commercial traffic where no private station is able to fulfill local normal communication requirements. The obligation remains with the Navy, however, to handle efficiently such commercial and other Government traffic as come to it.

It must not be forgotten that the handling of commercial traffic in peace time is of considerable advantage to the Navy. Any communication circuit which is busy is better than one which is not, and by handling in peace time commercial traffic, the Navy is enabled to maintain in efficient condition the maximum number of circuits which would be necessary to the Navy in war. On the outbreak of war, the commercial traffic would automatically cease and these circuits would be available for the greatly increased Navy traffic.

Another point of interest to the Navy is that if commercial traffic and Naval traffic are to be handled from the same point, less interference is caused to the Navy by handling both through its own station than by having to divide the air with a commercial station alongside the Naval station.

The Fleet radio system and the shore radio system having been developed, there remains the linking up of the two.

"Intercept" Method

One of the inherent defects of radio is the danger during war of disclosing the presence and disposition of ships whenever they transmit. This is particularly true with the constantly improving methods of radio direction finding. For transmission of messages from shore to ship, the "intercept" method has been adopted as the normal procedure. This method consists in transmitting between two shore stations, at scheduled times, messages intended for ships at sea. A message is transmitted by the first station and repeated back by the second station. The stations are chosen to cover the general area within which the ship may be at the time, and the ship is neither called nor does it answer, but merely listens, having two chances to copy the message. If the second station repeats back correctly the message sent by the first station, it is assumed that the ship for whom the message is intended has received it. This method does not preclude the calling of a ship direct for an important message.

For ship to shore messages, some ship must, of course, transmit. This is usually done by a guard ship detailed by the Commander-in-Chief, to whom are passed by visual or auxiliary radio the messages destined for shore. The control of this communication rests, of course, with the Commander-in-Chief, who must decide whether the importance of communicating with shore outweighs the disadvantage of radio transmission, with the consequent possible revealing of the position of the transmitting ship.

"Fleet 'Intercept'" Method

The intercept method is also applied in messages within the Fleet. A message intended for a Commander or a ship, whose position it is particularly desired to conceal, is passed by

visual to a destroyer or other small type of vessel for radio transmission to any designated ship other than the one actually addressed. The transmission must be made on a wave which the actual addressee is guarding. The ship apparently addressed repeats back the message but the actual addressee maintains silence. In this way secrecy as to the position of any particular ship may be maintained.

The present shore intercept circuits are Washington-Cayey-Balboa and San Diego-Honolulu.

It is planned, eventually, to extend these intercept methods so that the entire area of the Pacific will be covered.

In addition Washington and Cavite have "F" schedules on which messages for ships are broadcasted but are not repeated back by other shore stations.

Fanning Relay

A Naval invention, which is being rapidly developed and which has immense possibilities, is the Fanning Relay. This device permits the automatic operation of a radio transmitter by the received waves from another radio station. In other words, the principle of the telegraph relay is applied to radio waves. Before long, it is hoped that messages may be transmitted, practically instantaneously, from Washington to Cavite under the direct control of the operator at Washington, each succeeding radio transmitter in the chain being operated through the Fanning Relay by the preceding station. It is even contemplated that all U.S. Naval radio stations throughout the world may be lined up at a designated hour by the Fanning Relay and a message originating in Washington be automatically transmitted by each station simultaneously.

Returning to the Fleet, reference must be made to the traffic system. In war, the Fleet must still be administered and administrative messages must be handled in the Fleet until a short time before an action. The method of handling this traffic is based on the tactical system previously described

and is entirely under the control of the Commander-in-Chief. When an action is imminent, the Commander-in-Chief merely stops administrative traffic and the system is ready for the tactical uses already described. All plans for handling traffic are based on the tactical requirements of the Fleet for war.

Censorship

During the World War censorship was assigned to the Naval Communication Service, principally because the Communication Service had an organization capable of handling it. Now a further study has been made, and the necessity recognized of drawing a line between communications and censorship. The Communication Service exercises no censorship authority over the text of traffic. That censorship is now assigned to the Office of Naval Intelligence. Afloat, the Commander-in-Chief is supreme, and has control over both censorship and communications.

Army

One of the important radio questions which arises during war, is coordination and cooperation with the Army. It is recognized that in war the Navy's interest in radio is paramount on the sea and the Army's interest is paramount inland. There remains the coast where both services are vitally concerned.

Recently the functions of the Signal Corps of the Army have been increased so that they correspond to those of the Naval Communication Service, and it is hoped shortly to come to an agreement on all communication question which will insure cooperation and a minimum of interference during war.

Already the following principles have been agreed upon between the two services:

First, that the Army's communication interests in the interior are paramount.

Second, that the Navy's interests in communications within 100 miles of the coast, at sea and in over-seas possessions are paramount.

Third, that for aviation and coast defense, local radio is necessary to the Army within the Navy's coastal zone.

Fourth, that if an attacking force appears off the coast and the Naval forces present are such as to offer a successful chance of opposition, the control of communication belongs to the Navy. If the Naval force should be defeated or forced to retire, the control of communication will be turned over to the Army. If no Naval force is present offering a successful chance of opposition to the enemy, the control of communication will immediately be taken over by the Army.

War Plans

In the Department's general War Plans, definite tasks are assigned to the Naval Communication Service for the various campaigns. Every effort is made to maintain the Naval radio system in such a manner that practically no changes are required to meet war needs. All private stations will be taken over on the outbreak of war by either the Army or the Navy and such as are useful will be fitted into the Navy system. Another step is the establishment of radio stations following the advance of the Fleet, which obviously cannot be accomplished until after the outbreak of war, as it involves the capture of enemy territory. Radio repair ships are assigned in the mobilization plan which will be capable of erecting these stations. Plans are also made for the duplication of cable facilities in order that the radio may be relieved of all possible point to point work, leaving it free for its primary function of serving the Fleet.

Plans are ready for the increase of listening stations and long distance direction finding stations for gathering all possible useful information of enemy movements as previously described.

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Progress of Campaign

The use of radio during a campaign may be divided into the following phases:

1. Preliminary
2. Mobilization of Fleet
3. Advance of Fleet
4. Scouting
5. Contact
6. Approach
7. Action
8. After action

Preliminary

The preliminary steps are taken at the declaration of war. It may be possible, in a case of severed diplomatic relations preceding the declaration of war, to have them all in effect before war is actually declared.

The first step is mobilization of communications. Necessary action to be taken is covered by instruction which are put into effect upon the receipt of an ALNAV message "MOBILIZE COMMUNICATIONS." All routine administrative Naval traffic is held up for transmission without interference with command traffic. Commercial and press traffic is stopped. Traffic of other Government Departments is vised by a responsible Naval officer. Maximum use is made of land lines. In general, the radio system is cleared for command traffic with the Fleet, later these restrictions may be modified.

There is also a drill message "MOBILIZE NAVAL COMMUNICATIONS" which enables a rehearsal of the procedure during peace time without interference with commercial work or the business of other Government Departments. Previous to the last war, opportunity offered to carry out this rehearsal several times during peace and as a result, when diplomatic relations were severed with Germany and it was desired to "mobilize communication for war", everything moved very smoothly. Unfortunately,

at the present time, the necessity for economy forbids us this mobilization exercise.

Other steps in this phase are the establishment of the war direction finding stations previously described, the closing of the shore direction finding service to other than U.S. or Allied ships and the putting into effect of reserve codes and ciphers of each class in order that the greatest security may be obtained during this important period.

Mobilization of Fleet

Under present conditions, with the Fleet divided in two oceans, the first strategic step is in general the concentration of all major forces afloat in one ocean. During this phase, the control of traffic becomes particularly important. Traffic other than Fleet traffic must be diverted away from Fleet Operating Bases to other routes in order to assist in every way the communications of the Fleet. Traffic over the Intercept circuits previously described must be so controlled as to avoid any peak loads which might be analyzed by an enemy to determine the general progress through succeeding areas of the major fleet forces. The endeavor will be to maintain, by the use of point to point traffic, and when necessary, the introduction of dummy messages into a circuit, an apparently similar load on all circuits so that the actual area in which the major forces of the Fleet may be at the time is not given away. This distribution of traffic loads is maintained throughout the war.

Advance of Fleet

During this phase, the shore establishment will be of particular value to the Commander-in-Chief in connection with his logistics and information service. As advance bases are occupied new radio stations will be erected to shorten the necessary communication lines of the Fleet. Every effort should be made by the Commander-in-Chief to reduce transmission from ships since the enemy with his direction finding facilities

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will certainly benefit from such transmission. The old adage "Silence is Golden" is never more applicable than during this period.

Scouting

During scouting operations the Commander-in-Chief must, to a large extent, depend on the Fleet radio system for the resultant reports, but much strategic information from scouts in other areas or from the shore intelligence service through the Office of Naval Intelligence must necessarily be transmitted to the Commander-in-Chief through the shore radio system. The Office of Naval Intelligence is charged with the function of sorting this information and determining how much of it will be of value to the Commander-in-Chief. It will be their function to weigh the information and to insure that the Commander's-in-Chief receiving facilities are not burdened with a mass of information that is not of actual and immediate value. It is contemplated that an Intelligence Officer will be placed in every communication office ashore in order that the intelligence service may gather any information of value from the substance of traffic transmitted through the communication system. As our main forces approach the enemy main forces, the Fleet radio system becomes more important and the shore traffic from the Department to the Commander-in-Chief should be correspondingly reduced. At this time the handling of his major forces by the Commander-in-Chief would properly be considered a strategic use of radio (contact not yet having been made), but the principles are the same as those described under Major Tactical Command.

Contact

There is probably no more important single function of radio than its use in reporting contacts. No failure or defect in the radio system at any other time can have such fatal results as then. With normally disposed forces, no other means

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than radio exists to report contacts to the Commander-in-Chief and failure in the immediate transmission of the first and succeeding contact reports may easily result in the loss of a battle. In this connection, Admiral Jellicoe's report of the disadvantage under which he was placed at Jutland by failure to receive proper information of the enemy disposition should be a lesson to us. The actual handling of scouts is not a function of communications but if the scouts are properly handled and obtain the necessary information, the grave responsibility for immediately and accurately transmitting this information rests with communications.

Approach

During the approach the importance of contact reports continues and in addition the use of the radio by the Commander-in-Chief for Major Tactical Command will increase. Cool, level-headed work will be needed on the part of communication and radio officers and radio operators themselves to move the traffic at maximum speed with due consideration for the various classes. Communication from and to the shore will be reduced to a minimum, and traffic officers on shore should assist in every way in holding up all unessential communication to the Fleet. At the same time, any tactical information of value, such as enemy position reports obtained by the long range shore direction finding station must be quickly transmitted to the Commander-in-Chief, as it may be of great importance to him tactically.

Action

A main Fleet action is, of course, the supreme test of the tactical use of radio. Fire control and air-craft spotting commence and the possibility of having to depend on radio for Minor Tactical Command, on account of smoke screens or low visibility, must be kept in mind. It must be remembered that the use of radio for Minor Tactical Command will interfere to

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a greater or less extent with the longer range radio work. Contact reports must be continued until the disposition of all possible enemy forces is clearly known to the Commander-in-Chief. Provision exists in Fleet Standing Orders for the suppression by the Commander-in-Chief of contact reports originating after a given time. This provision is made so that if the Commander-in-Chief feels that his information of the enemy disposition is complete, he may suppress further contact reports in order to clear his radio for other uses. There is a great responsibility in issuing such an order as the position of air, submarine or destroyer units discovered in an unexpected position might have a serious bearing on the Commander's-in-Chief tactical plans. However, this is entirely in the hands of the Commander-in-Chief.

During this phase, the communication people have great responsibility in the prompt handling of all messages. One lost or mislaid message may have most serious consequences to the successful carrying out of the Commander's-in-Chief plans, yet all are in code and all look alike. The contact reports are alone distinctive and they have been made so for the particular purpose of accentuating their great importance.

During action radio touch must not be lost with destroyer, submarine and air forces who may be out of visual touch. The ability of the Commander-in-Chief to direct an immediate attack by one or more of these forces is most important. It must be remembered that whenever doctrine can replace orders, much better results are accomplished, but we have to assume that communication by radio during action will continue to be a necessary evil.

The effects of gun fire will very likely reduce the efficiency of radio communication by bringing down antennae, rattails and even by injuring transmitting sets below decks. Every effort is made in the construction of capital ships to safeguard vital elements of communication but some reduction

in efficiency from gun fire must be expected. The apparatus is so disposed as to make it probable that all means of communication will not be put out of commission unless the ship is actually sunk.

After Action

The contingency of damage by gun fire to the entire radio installation of capital ships is specifically provided for by the installation of an after action set, which is less efficient but more securely safeguarded than any set in the ship. After a successful action, the use of radio becomes most important in the chase of fleeing ships in order that the complete annihilation of the enemy may be accomplished by the coordination of all our forces.

The night following a day action, particularly of long duration, is a most important period. The danger of fatigue to the personnel due to the high tension under which they have been working and a resultant lassitude and tendency to slack down must be strictly guarded against. I have noticed in reports of the Battle of Jutland one particular incident where it appears that an important message bearing on the movements of the German Fleet during the night following the main action did not reach the attention of the Commander-in-Chief.

Strategems in War

The most obvious radio strategem in war is a "false" or "fake" message. In the old days of the infancy of radio and small numbers of ships, experienced operators were able to distinguish the tone and note of the sets of various ships in much the same way that a person recognizes the voice of a friend over the telephone. Now, since the standardization of radio apparatus the introduction of tube sets and the greatly increased number of ships, this sort of identification is very unreliable. On the other hand, our code and cipher system has been developed so that there is much less chance of an enemy being able satisfactorily to construct a "false" message.

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The escape of the Goeben and Breslau at the beginning of the world war has never been entirely cleared up, but there is reason to believe that the German Admiralty had come into possession of a British Code Book, and that a "false" message sent in this code to the British Commander in Chief, Mediterranean, from the German Admiralty, but purporting to come from the British Admiralty, had a bearing on the escape.

Proper safe-guarding of codes and changing of ciphers would appear to be the best safe-guard against this deception. The next best protection against false messages is a rigid adherence to procedure. If our procedure is exactly followed and all operators trained to use it without deviation, it becomes very difficult for an enemy to simulate it in war time, on the same principle that a foreigner, no matter how well he may know the words of the English language, usually finds it difficult to use the exact form of expression that would be used by an American. In war time, any apparent deviation from established procedure in messages received from an apparently friendly ship, should be immediately reported to the Radio Officer, and the message should be looked upon with suspicion until some sort of verification has been made. One check, which may be used when a message is under suspicion for any reason, is as follows:

> Code a message in the most secret code which the supposed sender should have, this code to be different from the one in which the suspected message was received. The subject may be anything of which the supposed sender would have knowledge, and preferably something of which he only would have knowledge. It should also admit of an immediate reply. In the message, refer to the receipt of the suspected message. Call the alleged sender of the first message, and transmit to him this second message. If everything is all right, a reply should be received which

will be very good proof that the original message was authentic. If the original message was false and sent by an enemy, it will be very difficult for him to continue the deception.

False "SOS" Messages

False SOS messages come under the same general heading as the preceding, but deserve particular consideration due to the custom of the sea in giving a privileged character to distress messages. The fact that an SOS may be supposed to come from a merchant vessel in distress, makes the test of correct procedure useless. During the war, the Commander-in-Chief was informed by the Department that operation of German submarines off out coast was to be expected, and that it was considered probable that they would make use of false SOS messages. The Commander-in-Chief was directed to take steps to prevent the decoying of his ships by such false messages. After careful study, the only solution which could be found to this problem was the dividing of all ships of the Fleet into two categories; first, non-anti-submarine, which consisted of those vessels not considered capable of successfully combating submarines. This category included capital ships, transports, hospital ships, fuel ships, supply ships, etc. All other ships were placed in the second category of anti-submarine vessels, whose general mission was the attack and destruction of submarines. It was then ordered that non-anti-submarine vessels hearing an SOS call should not under any circumstances proceed to the position given, their only action being to relay the information to the nearest vessels of the anti-submarine category. On the other hand, anti-submarine vessels were to always take cognizance of SOS calls received direct or by relay. If the call were true, these vessels would be of use in destroying the enemy submarines in the vicinity; if it were false, it was their mission to search out and attack the submarines sending the false call.

Although there was considerable discussion of this order between the Department and the Commander-in-Chief, the order was never revoked, and I believe it is the only solution of this particular question.

In this connection, it may be interesting to note that early in the war, British destroyers showed considerable suspicion of messages received from our destroyers operating with them due to the similarity of tone of our destroyers' radio sets to those of German submarines.

Interference

Radio interference is of two general classes; intentional and unintentional. The unintentional interference is that created by our own forces and shore stations among themselves, and one of the primary objects of radio organization and training is to reduce and eliminate this interference. The question of intentional interference, that is, enemy interference used to be considered most important. Experience, however, tends to the belief that it will not, except in certain cases, be so important as previously contended. To interfere with another, the interferer must temporarily sacrifice his own communications, and during an action the enemy will probably be more concerned in getting through his own communications than in interfering with ours. The International division of wave lengths for use in peace time makes it scarcely practicable to tune ships accurately to enemy wave lengths in addition to their own. With present selective receiving, such tuning would need to be very accurate to be of interfering value.

In general, a ship wishing to interfere with radio reception, must be between the sending and receiving ships and considerably nearer to the receiver. The interfering ship must transmit on the exact wave of the transmitting ship, as otherwise selective receiving apparatus will enable the interferer to be tuned out.

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Detailed plans both for interfering with the enemy and avoiding enemy interference, are made for use in case opportunity offers. To protect ourselves against interference, the "break" system which enables the transmitting ship to discover interference between the elements of his own sending, is most useful.

An exception to the preceding statement of the relative value of interference is found in connection with scouting. In offensive scouting, a scout encountering the enemy's outer-screen and intending to break through to make contact with the main body, or at least the inner-screen, should if possible prevent the enemy scout from reporting his presence and actions. For this purpose, our scout should make every effort to jam the transmission of the enemy scout until he has been able to sink him, if possible.

In defensive scouting or screening, an enemy scout who has made contact should be prevented, if possible, from getting through his report, particularly if he chooses to penetrate the screen instead of retiring.

In both these cases decision must be made as to the relative importance of getting through one's own contact report, or stopping or delaying that from the enemy scout.

6. CODES THAT WILL BE USED IN WAR

Up to 1915, the War Plans of the Navy contemplated the printing in peace time of a code for war. This code was to be issued in sealed packages, to be kept in a safe aboard ship, and the seal broken and the book put in force upon the outbreak of war.

Early in the World War, several instances occurred which brought in question the advisability of this policy. First the Goeben and Breslau escaped from a British squadron, due (so it was reported) to receipt by the British Squadron Commander of a message in British Navy Code, purporting to come from the

Admiralty, but actually sent from the German Intelligence Division by means of a code book which had been stolen. Although this explanation has since been questioned, it was accepted as true at the time.

At the Dardanelles, a German Submarine obtained or broke one British Code. By means of this code she sent a message to a British Submarine, known to be in the general vicinity, asking the latter's position. The British Submarine answered and the German Submarine proceeded to the position given. She found the British Submarine on the surface with hatches open and the crew in swimming. She captured the submarine, together with the full allowance of code books of a British Submarine, including also some French Codes which were being used with the French Forces. This was early in the War.

These two instances, with others, convinced the Navy Department of the impossibility of depending at any time upon the secrecy of a printed book and it was then decided to bend our efforts to the development of cipher communication which would permit the secret use of a code book, even if the enemy had a copy of the book, provided they did not have the cipher.

Much was learned about code and cipher work during the war and the policy stated above has been maintained with the exception that we have learned that it is too much to expect any one cipher to remain secret after considerable use. The policy has therefore been extended to include the continual changing of ciphers, so that the secrecy of messages will be maintained for sufficient time to at least make the information of little value to the enemy.

Another former policy of the department which was changed early in the war was one which forbade any Naval Officer other than the addressee to attempt to break a code or cipher message not addressed to him. The Commander-in-Chief early in the

war pointed out the fact that this was more or less of an ostrich policy because if a code or cipher could be broken, it was much better to discover it through our own people than to have it done by the enemy, perhaps without our knowledge. In other words, if we could not develop a cipher which was secret among our own forces, we could not hope to prevent the enemy from breaking it. An order was therefore issued in the Fleet that every effort should be made by communication personnel to break all intercepted codes and ciphers. If a cipher was broken, the means by which it was done were to be immediately reported secretly to the Department and special warning was given to officers engaged in this work that they must consider secret any information thus obtained.

The result of this new policy was to bring to the Department's attention many defects in the construction of codes and ciphers. As each defect was reported, steps were taken to correct it and the development so continued until finally our code and cipher system was probably as good as any in the world and certainly the best in the United States Government. This fact was shown by the assignment to the Navy of the handling of the communication work of the Peace Conference in Paris and by many other requests received from State and other Government Departments to transmit messages in Navy Codes because their own could not be trusted.

One of the major points developed was the necessity of having a balanced code, that is, a code with no pecularities. The old Sigcode was very defective, in that certain letters of the alphabet were never used as initial letters. This is one of the easiest methods of breaking a code. Our new codes have corrected that defect.

The invention of the Box was another important step in cipher work, the principle being that although it was impossible to make a cipher absolutely safe, yet by multiplying the possible combinations sufficiently, the work of breaking it was made

so voluminous that much time must elapse before it could be accomplished, by which time that particular cipher would have been changed.

There is a very interesting Code and Signal Publication - "Notes on the Use of Codes and Ciphers, C.S.P. 297", which all officers and particularly all officers in command should read. In that pamphlet is pointed out the responsibility of officers drafting messages for safeguarding the secrecy of codes and ciphers. No matter how excellent the code or cipher mechanically, misuse of it and failure to follow instructions can easily give the enemy opportunity to break it. Of course, the primary precaution in preserving codes and ciphers is their physical safeguarding against theft or loss. The fact that a book which has disappeared is ultimately found, does not correct the harm done, as it is possible to photograph the pages of a large book in a few hours. A spy very likely would use this method and then cause the return of the book, hoping that its absence would not have been discovered. If the loss of a book is known, a new code may be issued, but the harm where a code is supposed secret and has actually been compromised, is infinitely more. No matter how excellent our system appears, we must never be over-confident, and particularly in peace time, must we endeavor to guard against laxity in the use and safeguarding of codes and ciphers.

Some criticism has been made of the size of the Code and Signal Library. Every effort is made to reduce the number of codes, but under the most favorable circumstances, numerous codes are necessary. This is particularly the case when working with Allies. One Christmas morning off Nanking, the U.S.S. HELENA hoisted "Merry Christmas" in International Code to the ships present. Most of the ships answered "Thank You", but the Chinese flagship immediately sent a boarding officer to request the meaning of this signal. The Chinese have the International Code, but they have no Christmas, and therefore the signal cannot be expressed in the Chinese version of the code.

An American business man received a telegram from a Spanish Firm, in a Commercial Code. It read "Ship immediately fifty male water sheep". After reference to an expert, the message was finally discovered to refer to hydraulic rams. These incidents illustrate some of the difficulties of International Code Communication.

After the United States entered the war, the question came up as to how Code and Cipher Communication should be handled in case the United States Fleet should operate in conjunction with the British Grand Fleet. We suggested that there were three possible methods:

First: They to use their own code - we to use our own and an additional code to be provided for communication between the two fleets.

Second: Both forces to use United States Codes.

Third: Both forces to use British Codes.

The British realized that the first method was impracticable; would not of course accept the second, (as a matter of fact, at that time their codes were much better than ours, due to three years experience of war); and they hesitated to accept the third method.

Eventually, however, the third method was agreed upon as being the only practicable one. After the Armistice the King of England once remarked to Admiral Mayo that it would be very unfair of the United States to go to war with England until sufficient time had been allowed the British Navy to manufacture a new set of codes and ciphers as we had all their old ones.

The question of code work between allies in war time is a very serious one, particularly when the use of different languages is involved.

Our present system of codes and ciphers is as follows:

There are six codes, lettered from "A" to "F" inclusive and each having its own use. The code books of each code are changed from time to time, the particular issue being indicated by a number. For example, B-Code, the present book in use is B-3.

"A", "B" and "E" Codes are the principle codes for use of the Fleet.

"C" is for Naval Attaches;

"D" is for Naval Transports carrying troops;

"F" is for Intelligence Officers.

A-Code is the most secret and is always enciphered with N.C.B. Ciphers.

B-Code is secret. Secret messages are always enciphered, but confidential messages are not enciphered. A special cipher is provided for use with this code.

E-Code is confidential and is used for confidential work such as routine reports, etc. It may be made more secret by the use of a cipher. It is the only code that can be handled by enlisted personnel.

The N.C.B. Cipher System allows a general distribution of code books, but provides for secret communication between designated officers to the exclusion of others holding the book but not the cipher. For example, Class A, N.C.B. Cipher is used with A-Code, but is distributed only to the Department and to Commanders-in-Chief. A-Code itself is distributed to practically all ships of the Fleet. Therefore, the Department may send a message to the Commander-in-Chief in A-Code, but enciphered with Class A, N.C.B. Cipher, and no one but the Commander-in-Chief will be able to read the message, although all ships of the Fleet hold the code book which has been used. On the other hand, Class G, N.C.B. cipher, is distributed to all holders of the A-Code which includes vessels of the Destroyer Class and above, therefore a message from the Department to the Commander-in-Chief, A-Code, G-Cipher, may be read by any of the vessels above mentioned.

Another N.C.B. Cipher, for use with A-Code is Class F, which is distributed to the Department, all Flags, Commandants of Stations and Naval Port Officers.

Class C, N.C.B. Cipher, is used with C-Code and distributed to Department, Naval Attaches, all Flags and Commandants of Stations.

Class D, N.C.B. Cipher, is used with D-Code and distributed to Department, Naval Troop Transports, all Flags and all vessels engaged in escorting Troop Transports.

In addition to the Box Ciphers, a cipher known as B-Cipher is distributed to all holders of B-Code and a cipher known as E-Cipher to all holders of E-Code.

A Signal Cipher is used to encipher signals from the various Signal Books that are to be transmitted by radio.

The State-Navy Department Cipher is used for official communication between Consular and Naval Officers.

In addition to the above, the "Contact and Enemy Battlefleet Report Code" which is used as its name implies, is used by the Fleet and is not enciphered.

The Radio Compass Code is issued to all vessels of the submarine class and above for obtaining radio compass bearings.

The responsibility of officers who draft despatches is very great. Of course, the Commander does not wish to allow too much latitude to a subordinate communication officer in coding despatches, yet, an insistence on exact phraseology not covered by the code book will often tend to compromise a code. Much effort is spent on the phraseology of our present code books. Careful analysis is made of the English text of all coded despatches sent and in constructing codes, attempt is made to cover all useful phraseology. Officers should study the phraseology of the code books and make every effort to express their ideas in the phraseology given in the books.

In war, code is the general rule for all despatches. It has been found, however, that this may be carried to excess and where the text of certain routine messages contains no possible information of value to the enemy, it is found better to use plain language than to code the message and thereby offer opportunity to the enemy to break the code.

Another fault is the using of too high a class of cipher in transmitting a message to a subordinate, which he in turn must repeat practically verbatim to his subordinates. For example, the Department sends a message to the Commander-in-Chief in the Commander-in-Chief's cipher, which is held by no one else in the Fleet. The text of the message is such that the Commander-in-Chief must repeat it to other ships in the Fleet, or perhaps to different Commanders. In this case the message must be enciphered in another cipher and transmitted. The Commander-in-Chief, should, of course, paraphrase the original English text, but if the message is short, this may be difficult to accomplish, without changing the sense. In any case, no good has been accomplished and the rule should be that no cipher is used of a higher class than is held by the ultimate addressee.

CONCLUSION

The foregoing discussion is an outline of the war uses of the Naval Radio System. It does not exhaust the subject nor does it touch the peace time uses of the system. It does not touch the other systems of communication which must all be coordinated with the radio system.

Communications is an essential and integral part of the Navy, and the Naval radio system is doubtless the most important element of Naval Communications. It is our system and we all help to operate it. We cannot deal with it as we do with the Western Union -- write out a message, pay our money and forget it.

If a ship falls down in Gunnery or Engineering, the Captain is held responsible and all the ships company feel the disgrace. If a ship falls down in communications, the same should hold true.

Naval Communications, including the Naval radio system, will never be one bit better nor one bit worse than the Navy makes it.

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