WIRELESS INTERFERENCE

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The part played by wireless telegraphy in the accident to the steamship Republic has called universal attention to the subject of wireless in general, and to the great progress that has been made in this new method of communication in the few years since it has left the laboratory and become of practical use. The accident has also caused a renewal of the discussion relating to the question of Government regulation of wireless telegraph stations. At the last session of Congress a bill to license all stations and thus to place them in a certain measure under Government supervision was defeated. A bill now before Congress provides for the compulsory equipment with wireless apparatus of all passenger vessels, and because of the present agitation on the subject the measure will no doubt become a law.

Although most of the large steamship companies have already found it profitable to install wireless instruments on their boats, the law will bring a large number of new stations into existence and further complicate the problem that the navy has been facing for some time—the problem of interference. Every year the erection of new stations along the coast seriously increases this difficulty, and in the past two years the construction of dozens of amateur stations has brought matters to such a pass that under the present management of the naval stations the efficiency of the naval wireless system has been impaired to a surprising extent.

Probably no station suffers more from amateur interference than the Charlestown Navy Yard, says the *Boston Transcript*. When the Republic was reported in trouble off Nantucket Shoals, and the naval vessels in the vicinity of Boston were ordered to go to her relief, the interference or "butting in" of amateur stations was responsible for a delay of several hours in the reception of the official despatches. Later, when the revenue cutter Gresham was standing by the Republic, the conversation of the amateur operators prevented communication with the shore stations of the navy. To quote the expression of a navy man, the naval stations about Boston are "snowed under" by a number of school boys who take to wireless telegraphy as a pastime, and who have constructed stations equal if not superior to those operated by the navy. The question of how much the navy department is to blame for allowing the "kids" to get ahead of them in this way will be discussed later.

In Europe the matter of interference with Government stations has been easily settled. The building of amateur stations is absolutely prohibited, and every commercial station must operate under a Government license. In this country an attempt to regulate wireless telegraphy by means of legislation was made at the last session of Congress. The bill was opposed by the commercial companies, and by the amateurs. The amateur operators around Boston were especially active against the bill. A wireless association was formed, and the members voted on resolutions denying the right of the Government to secure a monopoly of the ether through legislation. Letters were written to congressmen explaining the position of the association, and although the question of just how much the amateurs were responsible for the defeat of the bill is one that will admit of discussion, the incident gives an idea of their strength and organization.

The Navy Department admits the novelty of the situation. No other problem of this nature has ever been encountered, and there is neither statute nor precedent upon which to attack the problem. The official Government despatches are copied by the amateurs as accurately as by the naval operators. At times, when the naval stations have broken down, the amateurs have obligingly handled the Government business and sent and received messages to and from ships at sea. Several of the amateur stations have succeeded in receiving messages from greater distances than the naval stations were capable of reaching, and during the Republic affair the amateurs were among the first to receive authentic reports by wireless. In order to understand the situation from both the naval and amateur standpoint,

it will be necessary to obtain a general idea of the organization of the naval wireless system.

Early in the development of wireless telegraphy the Navy Department was quick to see the importance of this new branch of science because of its utility in regard to the control of naval vessels at sea in times of peace as well as war. It has been claimed that the attitude of the department has not favored the development of commercial systems, but that it has been inclined to regard wireless telegraphy as being of primary importance in naval work. The ships of the navy were equipped with wireless instruments as rapidly as possible, and plans were made for a chain of naval stations at important points along the coast from Maine to Alaska. Since that time the entire navy, including revenue cutters and colliers, has been supplied with wireless apparatus, and the coast stations are increasing in number every year. On land the Government stations are located mainly at the navy yards, forts and lighthouses. As will be shown later, it cannot be said that the efficiency of the naval system has increased in direct proportion to its growth.

The work of the land stations of the navy is of a varied nature. They are supposed to control, and do control to a certain extent, the movements of the fleets. They are required to accept commercial telegrams from ships at sea, to send out weather reports and storm warnings, and to be ready for any case of emergency. Their work is, therefore, of considerable importance, and it is unnecessary to say that the safeguard of life and property at sea should demand that the naval stations be kept up to date, and that the quality of the work should be the highest obtainable.

Another line of stations numbering about fifty has been erected along the coast parallel with the naval system. These are owned and operated by the commercial companies, and are in some cases located within a short distance of the naval stations. Of these stations the United Wireless Telegraph Company owns or controls the large majority. The Marine Transmission Company of Providence has a number of stations along the Sound and on the Pacific coast, and the Marconi Company, controlling the principal transatlantic lines, operates four stations on this side of the water. A number of new stations for commercial work in the interior are about to be constructed by the United Wireless Company.

Last, but by no means least, are the stations owned by amateur operators, numbering two or three times the combined forces of the navy and the commercial companies. Most of these stations have been designed by schoolboys who started building their apparatus out of all kinds of electrical junk, and who by experimenting and improving, have made remarkable progress. Around Boston alone there are about fifty such outfits that are capable of putting the near-by naval stations completely out of business as far as receiving messages is concerned. In addition, there are probably two hundred smaller amateur stations not powerful enough to make trouble for the navy. A number of firms in Boston make a business of selling wireless telegraph apparatus to amateurs guaranteed to work up to several hundred miles.

The term "interference" as used in connection with wireless telegraphy should be clearly understood. Wireless messages are sent through space in the form of electric waves or vibrations in the ether. The transmitting part of a wireless station contains apparatus for the production of these electric waves, while the receiving part has instruments to detect the presence of the waves and to convert them into readable signals. The propagation of a vibratory disturbance in the ether may be compared with what takes place when a stone is thrown into the water. A series of ripples growing weaker and weaker spread out in all directions. A chip of wood placed near to the centre of the disturbance will be vigorously agitated, while another chip where the ripples can barely be seen will move very slightly.

In much the same way the electric waves fly out from the aerial of a wireless telegraph station in all directions. If the chips of wood are represented by receiving stations, it may be seen that the instruments nearer the transmitting apparatus will be more strongly affected by the electric waves than those at a distance. Thus a message sent from the

Charlestown Navy Yard to a ship at sea will also be received by every other wireless station in the vicinity, and the nearer the station the clearer will be the message.

Now, suppose the navy yard is receiving a message from a ship some distance away, when suddenly a nearby amateur starts to transmit a message. Two separate series of waves will now reach the receiving apparatus at the naval station, as a result of which the incoming message will be rendered unintelligible. While the amateur station is sending, the naval station finds it impossible to receive an outside message. This, roughly speaking, is what is meant by wireless "interference."

In practical work other conditions enter into the question of interference, as the distance and power of the opposing station, together with another factor called the wave length. When the wave lengths of conflicting stations differ by a certain amount, it is possible with the old forms of apparatus still used by the Government, to "tune out" one station at the expense of the other; that is to say, when other conditions are favorable. As a general rule, however, only one station in a vicinity can transmit messages at a time.

The naval and commercial stations, wherever they are situated close together, avoid interference by awaiting their turn. The commercial stations do not "butt in" when the navy is working, and the naval operators respect the rights of their neighbors. In New York harbor, the busiest wireless spot on the coast, the naval and commercial stations carry on their work without difficulty.

With the amateurs, however, the Navy Department meets an entirely different proposition. From early in the afternoon until late at night the navy stations are practically at the mercy of the amateur operators, who call up each other's stations and carry on long conversations on every conceivable topic. Some of the navy operators have copied down pages of this aerial chat, and a portion of the record reads as follows:

"How do you get me today? I am using my new transformer and my helix is hitched up different. How are your batteries holding out? Say, old man, I get you fine as silk. You have the navy skun a mile. My aerial came down last night, but I fixed it up again. Did you go to that show last night you spoke about? I have been too busy to go to town this week. Have you got any number 32 copper wire? Thought you would drop over last week. Say, old man, I met your lady friend yesterday. Ha, ha! Quit your kidding. Say, do you know the fellow who is putting up a new station out your way? I think he is a ham. Will call you up in ten minutes. Say, old man, must go to supper now, but will be on the rest of the night. O K, O K, will see you later."

This goes on hour after hour, during which time the naval stations are cut off from communication except for very short distances. When important messages are expected at the navy yard, the operator tells the amateurs to "keep out," and if they understand what he says, they will as a general rule stop working for a few moments. But where there are a great number of stations in one locality, as in Boston and at other points along the coast, serious interference is inevitable. The naval operators never know when to expect an emergency call, and it has been stated by navy men that while the amateurs are working a dozen ships might send out the international "C Q D" and never be heard at the Government stations.

A few weeks ago, when the naval stations were anxiously awaiting news of the Republic accident from the naval vessels at the scene, the amateurs were especially active. Several times the navy operators sent out this message: "Will you fellows please stop working for a few hours. A ship out there is in distress." Some of the amateurs did stop as requested, but a number worked their apparatus continually. When the navy objects to the interference in more forcible language, the answers run like this: "Say, you navy people think you own the ether. Who ever heard of the navy anyway? Beat it, you, beat it."

It is only fair to say that many of the amateurs try not to bother the navy, and have at times been of assistance to the naval operators. Yet there are so many chances for unintentional interference that all amateur stations in operation interfere more or less.

Another form of interference for which

the navy and commercial operators are alone responsible has been a cause for recent complaints. This is the abuse of the stations by the operators, who sometimes carry on long and unnecessary private conversations, thus delaying the work of other stations. Officials of the various navy yards have been inclined to regard the navy stations as provided for their personal convenience, and have at times made use of them for unofficial and trivial matters. A case of this kind occurred on Christmas Day of last year, when a message from one navy officer at a certain navy yard to the commanding officer at another naval station wishing "a merry Christmas and a happy New Year," held up all commercial work in the vicinity for over an hour.

It is clear to those who are familiar with the situation that the question of amateur interference can be met in only one of two ways. Either the operation of amateur stations must be prohibited by law, or the Navy Department must take advantage of the scientific progress made in wireless telegraphy in the last few years and equip the naval stations with the latest devices for the prevention of interference. Apparatus that has proved successful in eliminating interference has been on the market for over three years. This same apparatus has been thoroughly tested by the bureau of equipment, and the reports of the tests made by the Government officials substantiate the claims of the inventors.

Considering the importance of the naval wireless system, it is difficult to understand the slowness of the department in adopting improved apparatus. One of the best operators of the navy stated recently that the equipment of the naval wireless stations was three years behind the times. Amateur stations are provided with instruments that entirely do away with the same interference that is making a farce of the work of the land stations of the navy.

Mr. G. W. Pickard of Amesbury, Mass., who has invented a number of the newest wireless telegraph appliances, treats of the amateur problem as follows:

"There are at present a large number, perhaps, fifty, amateur stations in and about Boston. The situation as regards the Charlestown Navy Yard is at present a serious one, partly because this station is not equipped with proper selective receiving apparatus, and partly on account of the character of the interference.

"Selectivity principally depends upon the number of oscillations in each wave train from the transmitter. In the early days of wireless, each discharge of the transmitting station set up a strongly damped train of perhaps three waves, and tuning, at least in the sense in which the word is now used, was impossible. Modern wireless transmitting apparatus, using the spark system, easily reaches from ten to fifty waves at each discharge, and a receiving station with suitable tuning means should be able to reach a selectivity of one or two per cent, i.e., should be able, when two equally distant and powerful sending stations are in operation, to read one and practically exclude the other when their wave lengths differ by more than one or two per cent. By the use of so-called sparkless or undamped wave methods, in which the wave trains are continuous in the same sense as an alternating current, still greater selectivity may be obtained, even to one-tenth of one per cent.

"Primarily, in order to obtain great selectivity, the transmitting must be accomplished with as persistent wave trains as possible. Unfortunately, the greater number of ship and shore stations at present are either not equipped with apparatus capable of sending long trains of waves, or are not properly adjusted to this end.

"Secondly, the interfering stations should be under some control as regards wave lengths, as it is easy to see that however sharply tuned are the transmitting and receiving stations, an interfering station of the same, or nearly the same, wave length will always cause interference.

"Lastly, the receiving station must be capable of very sharp tuning; that is to say, exclude from its detector circuit all oscillations but those within a per cent or so of the desired wave length. Because the equipment is defective in these respects, the Charlestown Navy Yard probably suffers more from amateur interference than any other station on the Atlantic coast."

Professor R. A. Fessenden, the recognized authority on wireless telegraphy

in this country, whose transatlantic experimental wireless station at Brant Rock was in operation before the Marconi Company began transatlantic work, agrees with other wireless experts that the troubles of the Navy Department are due mainly to the lack of improved apparatus. Professor Fessenden says:

"With reference to interference, the question of interference has now been solved for five or six years. Exhaustive tests were made by the Navy Department at New York in 1904, which demonstrated conclusively that interference could be cut out from a full power station only 226 yards away, while reading messages from a station at a distance.

"At the official hearing last year before the Senate Committee on Foreign Relations, the officers of the navy, in response to direct question from the chairman of the Senate committee, admitted that it was possible to keep out interference.

"Numerous offers have been made to the navy during the last five or six years to supply the department with apparatus guaranteed to prevent interference. Such apparatus is in regular use at our own stations, and we have not been troubled with interference for four or five years. Up to date, however, the navy has declined to purchase such apparatus, although its efficiency has been shown by their own tests above referred to, and was admitted by them at the Senate committee investigation referred to."

The tests conducted by the Government at New York in 1904 concerned mainly the efficiency of the instruments in transmitting and receiving for accuracy and speed, in preventing interference, and in transmitting messages with absolute secrecy. The naval stations in the vicinity of New York, together with several stations on board navy vessels, were utilized for the experiments. Although the conditions of the test were made as difficult as possible, and the apparatus worked under disadvantages such as are seldom encountered in practical wireless work, the results as shown by the official reports were remarkably successful. In the matter of secrecy it was found after the test that the commercial operators in the vicinity had not the slightest idea that wireless messages were being transmitted. Other careful tests taken with the same apparatus on navy vessels at sea verified the first experiments.

In July, 1905, Professor Fessenden offered to supply the Navy Department with wireless apparatus as follows:

1. Apparatus for measuring wave lengths accurately to ¼ per cent.
2. Apparatus for wireless telephony up to a distance of ten miles or more.
3. Apparatus for wireless telegraphy for use up to distance of 1000 miles.
4. Apparatus for secret sending which is guaranteed to send and receive messages without possibility of their being read by other vessels not equipped with this apparatus.
5. Apparatus for locating the positions of ships at sea at all distances within 200 miles of shore.
6. Apparatus for indicating the position and course of ships within range of three miles in fog.
7. Apparatus guaranteed to prevent interference.

Strange as it may seem, the bureau of equipment refused these offers, just as they have refused to purchase improved apparatus from other inventors. Since then the department has done little except to duplicate and replace the old style instruments.

Not until January of this year has the navy offered to erect a wireless station that will fulfill the conditions outlined above. Nearly four years after the proposition was first submitted, a contract has been awarded to Professor Fessenden providing for the construction of a wireless telegraph station to be located in the vicinity of Washington, D.C., and equipped with the most modern instruments:

"The station to be capable of transmitting messages at all times and at all seasons to a radius of 3000 miles in any navigable direction from Washington, D. C. Such messages must not be interrupted by atmospheric disturbances, or by intentional or unintentional interference by neighboring stations. The station to be capable of transmitting and receiving messages with entire secrecy."

This same station might have been erected two or three years ago, and the apparatus with which it is to be equipped might have been installed in the important naval stations where the most serious interference has been experienced.

It is plain, from these facts, that legal action providing for the control by the Government of wireless telegraph stations is at the present time immature and unnecessary. Wireless apparatus guaranteed to prevent interference has for some time been at the disposal of the Navy Department. Moreover, any attempt to eliminate amateur stations would simply ward off for a time a problem, the solution of which must finally be found by the scientist, not the lawyer. The future development of wireless telegraphy in this country will mean the building of hundreds of new stations, and the further complication of the question of interference and secrecy. Considering, however, the progress already made there is every reason to believe that the laboratory will be equal to the future demands. The interests of all concerned demand every freedom from legislative restraint.

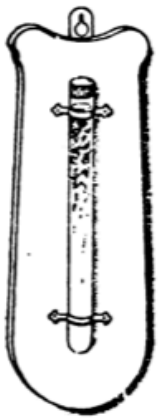
A Home-Made Chemical Weather Glass

Many different types of weather glasses which may easily be made at home have been recommended from time to time, but unquestionably the most popular is that which consists of a tube of cloudy liquid and sometimes called a camphor barometer. This pattern is often to be seen in opticians' shop windows, and the weather is forecasted by the appearance of the solution in the glass tube. This type of glass, devised it may be said nearly 200 years ago, cannot ever be looked upon as strictly accurate but rather as a scientific toy, for temperature rather than atmospheric pressure is the main factor in altering the appearance of the liquid. The liquid is made up of the following:

Water	2 oz.
Absolute alcohol	2 oz.
Camphor	2 dr.
Potassium nitrate	½ dr.
Ammonium chloride	½ dr.

A glass tube 10 in. long and ¾ in. in diameter is obtained at a chemist's or elsewhere, and nearly filled with the above solution, and is then hermetically sealed, or otherwise made perfectly airtight.

The tube should then be mounted on a wooden block after the fashion of cheap thermometers. The best and safest way is to cut a bed in the wooden block to hold the tube; a bed of a quarter inch or thereabouts in depth will be sufficient. Two small bands, one at the top of the tube and the other at the bottom will serve to hold the tube in its place.



The tube should be hung where the air can freely get at it, and the weather indications are as follows:

(*a*) In warm weather, if crystals of a small size rise in the liquid, while the latter remains clear, rainy weather may be safely expected.

(*b*) In cold and frosty weather, rain may be expected if the top part of the liquid becomes thick and cloudy.

(*c*) If in moderately cold weather, beautiful fern-like or feathery crystallization develops at the top of the tube or all through the liquid the weather will be colder. The lower the crystallization in the tube the colder the weather.

(*d*) When the upper portion of the liquid in the tube is quite clear and flates of crystals rise to the top and aggregate, very windy and stormy weather may be expected.

(*e*) Sharpness in the points and features of the structure of the crystals may be taken as a sign of fair and summerlike weather, but when they begin to break up or are not very well defined, unsettled weather may be expected.

(*f*) The clearer the liquid as a whole the better will the weather be. During warm and summerlike weather all the crystals dissolve and the solution becomes nearly, if not quite clear. The greater the proportion of clear liquid the greater the probability of fine and very dry weather.