EXTRACTS FROM A REPORT ON

EXPERIMENTS IN DIRECTIONAL WIRELESS TELEGRAPHY

CARRIED OUT BY H.M. SHIPS "PRINCE OF WALES" AND "LONDON" BETWEEN 26TH SEPTEMBER AND 1ST OCTOBER 1910.

The principle of directional receiving by using a horizontal conductor near the surface of the ground is well known, it is, however, considered that some additional useful data might be obtained on this subject, working under Service conditions.

The experiments carried out were divided into two parts—

(1) To ascertain the comparative strengths of signals received by a number of horizontal aerials laid out on different bearings.

(2) To determine the reduction in range caused by receiving on directional aerials laid out at a short distance above the surface of the ground.

The first series of experiments were carried out at short range. Transmitting apparatus :—Service Mark II. (on board "Prince of Wales"), "W" tune, 1 per cent. coupling, and a spark of 4 mm. Receiving apparatus :—Magnetic detector and simple resonance with the instruments placed in an open field. The distance between the two stations was ½ mile. From the earlier experiments carried out it was found not practicable to obtain reliable results by revolving a single aerial wire, because the tuning alters considerably with the height above the ground, and, due to uneveness, &c., it is difficult to keep this constant.

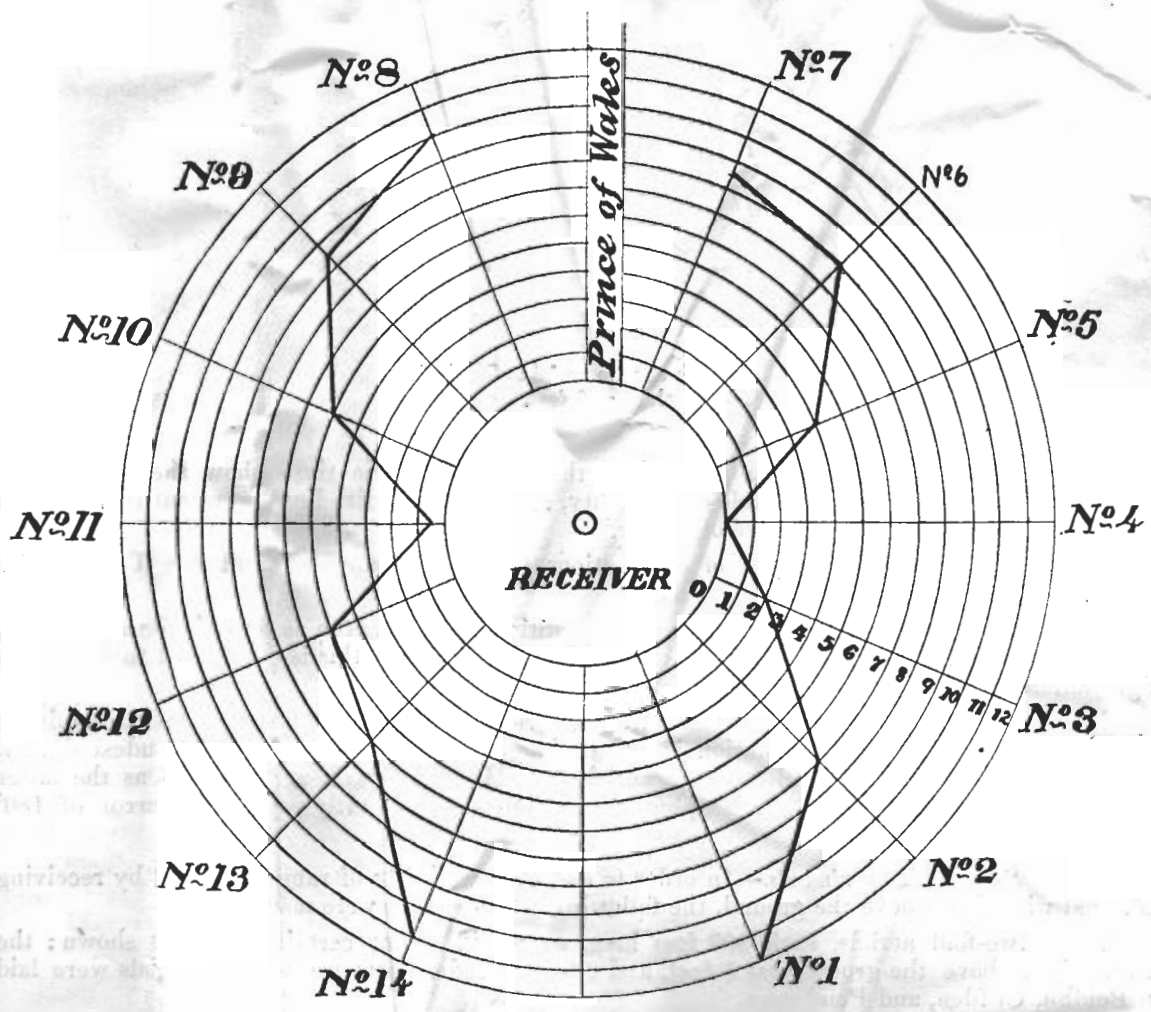
The above was tried with a long aerial, *i.e.*, 200 feet, the length of the aerial was then reduced by experiment to the minimum on which loud signals could be read when the aerial was laid out on the most favourable bearing. This length was found to be 16 yards, and could probably have been considerably reduced if a quiet sheltered place had been used for receiving, but in the open, where the wind, &c. is much felt, it is necessary for the signals to be strong to be readable.

From the experiments of the aerial in hand it is also found to be important that each aerial should be exactly the same height above the ground throughout.

A number of wires, 16 yards long, were then laid out on the ground on different bearings, as shown in Fig. 1.

FIG. 1.

Diagram showing Directional Receiving. Range = ½ Mile.



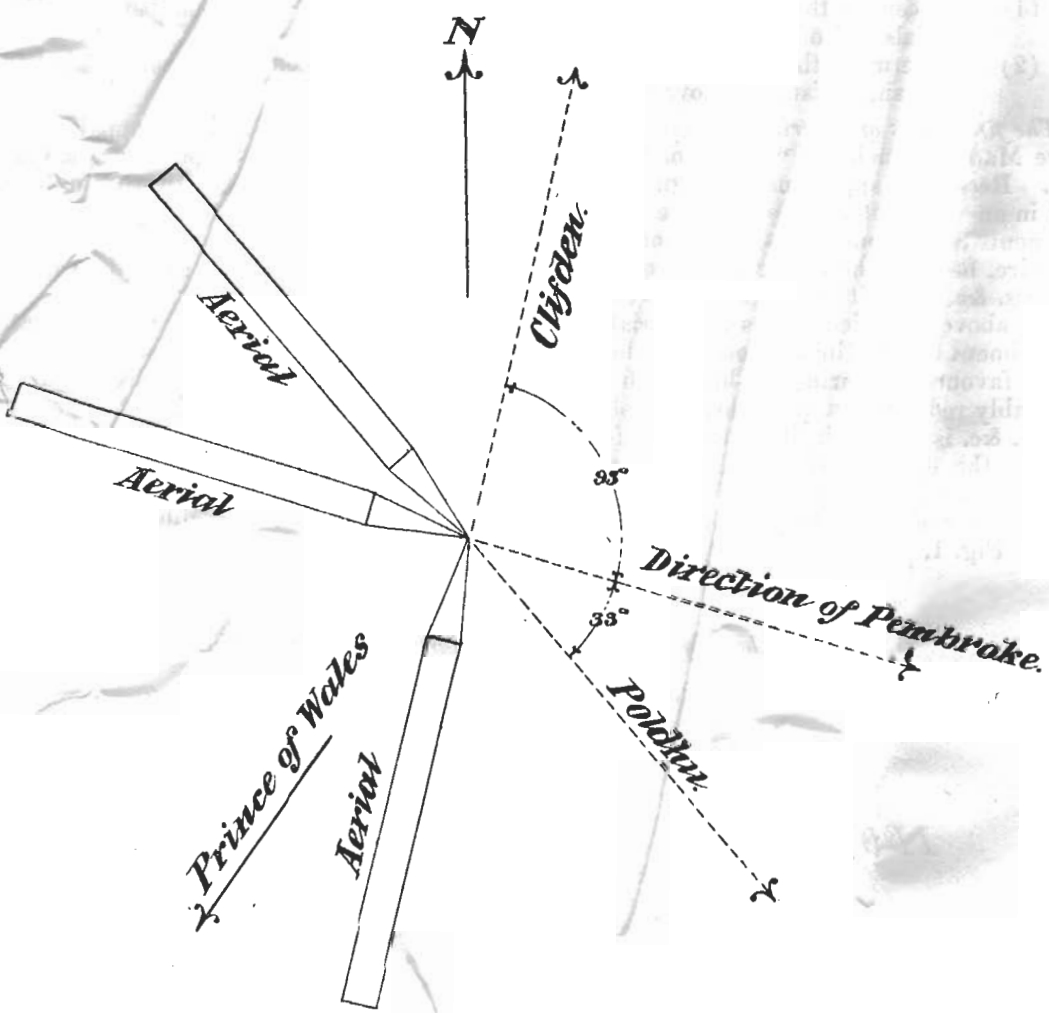
Radial lines = Fourteen aerials — 16 yards long.
Concentric rings = Service audibility — 0 to 12.

Wire Pattern 519 was used. The inner ends of the aerials were taken up to a switch supported at a height of 3 feet above the ground. The receiving instruments were arranged so that contact could easily be made to each aerial in turn.

The earth was composed of 12 galvanised steel wires, 17 feet long, and equally spaced and radiated from the centre; the surface of the ground was level and quite damp.

FIG. 2.

Diagram showing Arrangements of Long-distance Aerials.



Length of each aerial = 300 feet.
Mean height = 3 feet.

Referring to Fig. 2, it will be noticed that the concentric rings show the strength of signals according to the Service table of audibility, and that the radial lines represent the bearings of the different aerials from "Prince of Wales."

The results given are the mean of observations taken by two officers and five Telegraphist ratings.

Considerable care was taken to ensure the conditions being as even as possible for each aerial, but it will be noticed that the diagram is not quite symmetrical; this is considered to be due to slight differences in the nature of the ground.

In conclusion, from the results obtained, it is evident that the best method of ascertaining the bearing of the transmitting station is not to judge by the aerial giving the loudest signals, but to take a line at right angles to the aerials on which no signals are received, as the latter point is quite sharply defined. Geographical conditions will generally prevent an error of 180° being made in the result.

Second Series of Experiments.—In order to ascertain what loss of range is caused by receiving on aerial wires just above the ground, the following arrangements were made:—

Three two-fold aerials, each 300 feet long, were laid out at certain angles as shown; the mean height above the ground was 3 feet, and 2 feet spreaders were used. The aerials were laid on Poldhu, Clifden, and Pembroke.

The earth consisted of 36 galvanised steel wires, average length, 20 feet, arranged radially; the surface of the ground was moist. Receiver as before, but an improvised tent was used.

A series of preliminary observations at short range were taken, and it was found that the "Prince of Wales" buzzer could be just heard, but was very weak. As regards long-distance work, to save time, attention was principally given to the reception of Poldhu, distant 200 miles.

On the night of Wednesday, 28th September, when only 12 earth wires were in use, the message was not heard. Weather wet—no wind.

On Thursday night, 29th September, the message was read in a thoroughly satisfactory manner—the earth wires had been increased to 24. The message was inaudible on either Clifden or Pembroke aerials, and could be heard 3–4 on Poldhu aerial; but the best arrangement was obtained by joining together Poldhu and Pembroke, when the strength came up to 4–5. Weather damp—no wind.

On Friday night, 30th September, the earth wires were increased to 36. The message was again read on the same two aerials as before; but this time signals could just be heard on Pembroke alone, probably due to the increased number of earth wires. Weather dry and cold; sufficient wind to make signals more difficult to read. Signals were probably rather louder than on the previous night. The rating of these signals in the silent cabinet of "Prince of Wales," using M.D., was 7. The signal read ashore would undoubtedly have been rated higher if a better protected receiving station had been used. Very few mistakes were made in the messages, the average number of words being 520.

In conclusion, from the above results I would submit that it would be advantageous to continue the experiments on a larger scale, with a view to eventually ascertaining whether two receiving stations on the east coast, connected by telegraph, could be usefully employed in fixing the positions of ships in the North Sea. I would suggest that 16 two-fold aerials, 500 feet long, might give good results if the ground was quite level, and great care taken to obtain a symmetrical and uniform earth.

Extracts from "Vernon's" Remarks.

The report is interesting as affording further data with regard to the practical working of this principle.

2. It is suggested that the experiments might with advantage be continued on a rather larger scale and actual plotting of positions might be carried out if time can be spared for this work in one of the sea-going fleets.

3. If it is considered that two permanent plotting stations on the east coast would be of value, there is little doubt that all difficulties could be overcome and the stations made reliable.

4. With reference to the possible value of such stations, the following considerations are submitted:—

Assuming, as is probable, that the enemy become aware of the existence of such stations—

(*a*) If they wished to keep their position secret they might be obliged to dispense as far as possible with W.T., either for their own signals or for interfering.

(*b*) If in harbour in one of their own home ports their whereabouts would probably be known, and so there would be nothing to prevent their interfering, since interference would appear to be a weapon for use by a blockaded fleet, which would not need to pass their own W.T. messages, rather than a method to be used by a fleet at sea, which would require a clear passage for its own signals.

(*c*) Whether the fleet is at sea or in harbour, it would be an easy matter for two or three unimportant vessels to be detached in order to mislead the directional stations as to the whereabouts of the main fleet.

5. It might, perhaps, prove more convenient to use two ships instead of two fixed stations for such plotting, but further experiments will in any case be required.

ATMOSPHERIC CONDITIONS ON THE EAST INDIA STATION.

The following report is interesting, and points to the absolute necessity of using a high musical note in these parts. The Mark I*. sets appear to have worked very satisfactorily.

Précis of a Report received from C.-in-C., East Indies.

The year is divided up into two periods by the monsoons, viz., the South-west monsoon, from May to October, and the North-east Monsoon, from October to May. Observations were made to ascertain the conditions during these periods:—

South-west Monsoon.—(With a few exceptions, Mark I. sets were used during these observations.)

The results obtained were as follows:—

It was found that the general daily conditions are—

At 4 p.m. atmospherics start and gradually increase until midnight, when they gradually decrease until 6 a.m.; they then disappear.

They are extremely strong betwen 10 p.m. and midnight, and render signals extremely hard to take in.

Besides the above there are frequnt local electrical storms and disturbances.

During the South-west monsoon the atmosphere is damp, and frequent rainstorms occur, the sky being usually clouded over.

It was found that there was no difference of range between day and night signalling.

With Mark I. sets, although 200 miles was occasionally obtained by various ships, reliance could not be placed on establishing communication at more than 100 miles by day or night.

Signalling conditions at the beginning and end of the monsoon are better, but very variable. The worst period of the year is from the middle of May to the end of July. After this, conditions become better, and occasionally long distances are obtained.

On 11th September last, H.M.S. "Terrible," fitted with a Mark I*. set, gave her position to "Hyacinth" at a distance of 1,135 miles, although the latter could not answer.

On this occasion the strength of atmospherics was logged as 8, while the "Terrible's" signals were given a strength of 6; the musical note enabling the signal to be read through.

North-east Monsoon.—(During these observations Mark I*. sets were employed.)

The results obtained were as follows:—

The conditions of signalling are good. Approximately double the daytime distance can be obtained by night.

Electrical disturbances are met with fairly frequently, but these do not appear to cause much interference except very locally.

Second-class cruisers fitted with Mark I*. sets can establish signals of strength seven at 300 miles by day and 600 miles by night, with certainty, except very occasionally when local conditions are unfavourable.

Conditions at Colombo.—During the course of these observations a considerable amount of signalling was made to various ships from Colombo. It is found that ships coming from or proceeding to the eastward rarely, if ever, establish communication (with Mark I. sets) if to the eastward of Dondra Head—a distance of 93 miles. When it is cleared, a mutual strength of eight is obtainable. This is presumably due to the mountainous land to the S.E. of Colombo, and if a station is to be erected in Ceylon, Dondra Head would be far more suitable, as it has a clear range on all sides, except to the northward, free of land interference. It is in telegraphic communication with Colombo, and already has a signal station for reporting passing vessels.

NEW PATENTS DESCRIBING INVENTIONS PREVIOUSLY BROUGHT OUT AND USED IN H.M. NAVY.

Mr. R. A. Fessenden, in *Patent Specification No.* 10,817, *A.D.* 1910, describes an earth connection in which the conductor carrying the earth current surrounds the aerial wire in the form of a tube, where the aerial is below decks, and is earthed above decks. The system of running earth conductors up the trunk and surrounding the aerial wire, that has been in use for over two years in H.M. Navy with every Mark I*. and Mark II. office below decks, is an anticipation of this idea.

In order that any claim for royalty as regards this invention may be met by proof of prior use, the following facts are being placed on record in "Vernon":—

"The 'Bellerophon' was commissioned on 20th February 1909, the 'Temeraire' on 15th May 1909, and the 'Superb' on 29th May 1909, all previous to the first date of Mr. Fessenden's first application for this patent in the United States, viz., 19th July 1909. Each of the above ships was fitted with this system before commissioning, and the system had then come into general use."

Marconi Patent No. 20,230, *A.D.* 1909, describes an earth connection for use at shore stations where the aerial is horizontal or partially horizontal, in which conductors are connected to the earth terminal and are laid near the surface of the ground under the horizontal parts of the aerial. This idea is anticipated by the present standard arrangement of earth connections described in W.T. appendix to Annual Report, 1908, pages 8 and 9, and used at Naval shore stations.

In order that any claim for royalty as regards this invention may be met by proof of prior use, it has been placed on record that before 3rd September 1909, the date of application for Patent No. 20,230, the following stations were completed and fitted with this arrangement of earth wires:—

Aberdeen, Ipswich, Pembroke, Horsea, Cleethorpes, and Gibraltar.

INFORMATION *re* FOREIGN SHIPS AND STATIONS,

INCLUDING EXTRACTS FROM THE RETURNS OF INTERCEPTED SIGNALS SENT IN BY THE NAVAL SHORE STATIONS.

GERMANY.—During the year the shore stations at *Nauen* and *Norddeich* have been experimenting with various notes and wave-lengths. *Nauen* (and to a certain extent *Norddeich*) have interfered with our medium-power stations, since they both send approximately on "V" and "W" tunes. *Nauen* now uses the Telefunken system, with a very good musical note; and this station

has also been carrying out experiments with a view to making a high note when the key is pressed and a low one when the key is released. At Aberdeen, the strength of signals from *Nauen*, when received through "W" adjustments, is about 5.

Many men-of-war have been carrying out experiments with musical notes, which our shore stations variously describe as—similar to Mark I*, Telefunken, whistling, rushing, and squeaky. It is reported that the German Admiralty have not taken over the control of the musical note systems in their Navy, but that they are still worked by the Telefunken Company.

Several liners, especially those belonging to the Woermann line, have adopted the Telefunken system.

FRANCE.—The *Eiffel Tower* station uses approximately "W" tune, and interferes seriously with Norddeich, but, as they have only recently commenced experiments with a musical note, they have not interfered with our medium-power stations to any great extent. This station has recently tried sending 7,200 feet wave with an unmusical note.

AUSTRIA-HUNGARY.—*Pola* has been heard using both "Q" and "U" tunes with a musical note. They use the call sign A L R P for "Q" tune and L R P for "U" tune. They have also been heard sending on "W" wave with 25 cycles.

RUSSIA.—The royal yacht "*Standart*" is now fitted to send on "Q" tune. A ship with call sign U R V has been sending "W" tune.

BRAZIL.—The new battleship "*Minas Geras*" has been experimenting with musical notes.

ARGENTINE.—The gunboat "*Parana*" has been heard using a musical note.

JAPAN.—All wireless telegraphy is under the control of the Government. Eleven ships are fitted with 1½ kilowatt sets, which, it is stated, have a range of 400 miles by day. After extensive experiments with two hundred different kinds of minerals, the Kosiki detector, which is the same as our Crystalite, has been adopted as being the most sensitive, though easily damaged by strong signals. A molybdenite-iron-pyrites detector has also been used, since it is not so much damaged by strong signals, but is not so sensitive as the Kosiki.

ADDENDUM.

PORTABLE AND HARBOUR DEFENCE SETS.

Power Generator.—An engine has now been produced which will start with certainty and give the necessary power even with crude paraffin. When using paraffin, however, it takes about ten minutes to a quarter of an hour to start it; it requires a blow lamp to heat the vaporiser, is rather heavier than the limit originally specified, and to keep it running satisfactorily calls for considerable skill on the part of the operator. If it is stopped for even one or two minutes, it will not restart with any degree of certainty without the use of a blow lamp.

It is not therefore a sufficiently practical machine for introduction into the Service. In view of these results it has been approved to use petrol, and the manufacture of suitable engines is being pushed forward as rapidly as possible.

Stringent regulations will be issued with both portable and harbour defence W.T. sets as regards the precautions to be taken in the stowage and use of the petrol. In the case of portable sets the petrol tins are not to be opened on board ship, and when used on board small craft for harbour defence sets the petrol tins are not to be opened or used below the upper deck.

Alternator.—An alternator has now been produced which, though slightly heavier than specified, and liable to get rather hot, is a practical machine. It is hoped that the faults referred to will be remedied shortly, and that suitable machines will soon be available.

BREAKDOWN FUSE.

The insulation of the Litholite bases supplied with some of the earlier fuses was found unsatisfactory. Ships having breakdown fuses with Litholite bases are therefore to fit ebonite bases in lieu. (G 18,195/10.)

W.T. IN TRANSPORTS AND INDIAN MARINE TRANSPORTS.

It has been decided to fit these vessels with a 3,300 foot wave to enable them to communicate with Gibraltar, Malta, and H.M. ships on Service matters.

COMMERCIAL WAVE-LENGTH.

It is under consideration to allow the use of the 600-metre wave-length for commercial purposes in war as well as peace.

Should it finally be decided to allow the wave-length in war time, it will be necessary to modify the present instructions as regards the use of "P" wave-length contained in "Instructions for the Conduct of W.T. Signalling."