Shore Stations.

Extract from Report by the Lieutenant in Charge of W.T. Shore Stations.

There are now seven shore stations equipped with W.T., namely Felixstowe, Dover, Culver, Rame Head, Portland Bill, Scilly Islands, and Roche's Point.

The remaining eighteen, as shown on Plate III., are all approved of, and may be expected to be all completed in about two years.

At present all these stations derive their power from a combination of primary and secondary cells, but it is intended eventually to instal a small dynamo and oil engine in each. A trial plant is now being installed at Felixstowe, and consists of a—

4½-H.P. Gardiner oil engine.
1½-K.W. rotary converter.
Battery of secondary cells giving 50 volts pressure.

The station will be lit by electricity.

The staff of these shore stations consists of a Torpedo Instructor rating, and four Signalmen who have passed the higher standard. These men have, however, to keep ordinary visual watch as well as wireless watch.

After many experiments with earth connections, the following form has been adopted.

About 30 galvanised iron plates, each plate 6 ft. × 3 ft., buried vertically (3-ft. side vertical) in the ground in a circle around the instrument hut; each plate is connected to its adjacent plates, and each plate is connected by an insulated lead to a central point. This point is connected by an insulated lead to the main earth terminal of the instrument room.

The ideal position for this earth is immediately under the aerial wire, and as close to the instruments as possible.

Cable earths gave fairly good results in damp ground with plain aerial and "A" tune, but at Scilly Islands the distance that could be worked over varied from 100 miles in wet weather to about 40 miles in a drought, and the station has never been very reliable with cable earths. Again, at Dover, Sheerness signals were never read until the surface earth was put in at the former place, and even now Sheerness (with cable earth) cannot receive from Dover, although a ship in the stream has communicated with Dover on ½-inch plain aerial. Sheerness, by the way, is not a station under the A.C.R., but is attached to the C.-in-C. at the Nore.

The general working of the shore stations tallies very well with the experience of the "Vernon." It has been noted that the "Roof" aerial receives "A" tune remarkably well, but possibly it is not so selective as the ordinary "A" tune aerial.

Effects of Lightning.

Enclosure to Admiralty Letter dated 17th February 1904, N.S. 581/2241.

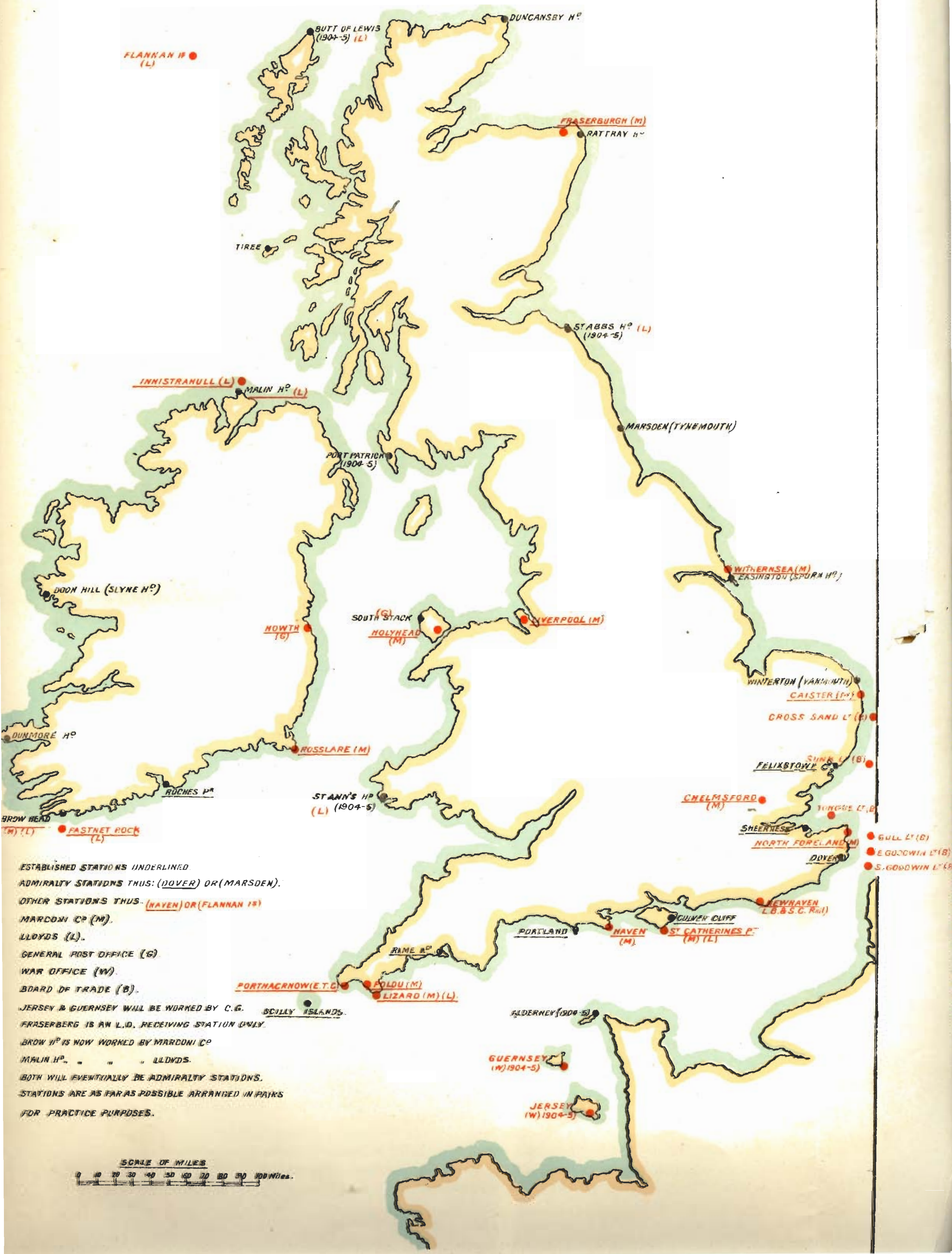
Copy of Report from H.M.S. "Formidable," dated 23rd December 1903.

I have the honour to report that on the afternoon of Tuesday, the 22nd instant, during a thunderstorm, considerable damage was done to the aerial wire, cowtail, &c. of this ship.

2. As the storm approached, it appears that the aerial wire, which was earthed through the balls of this coil to the sending earth, became electrically charged. The whole of the ship was similarly charged, but a silent discharge was taking place through the lightning conductors and wire rigging, but not through the aerial wire owing to it being insulated. The upper insulator was further protected by a cone designed to keep the insulator dry in wet weather.

3. On the discharge of the cloud overhead, which was accompanied by a very vivid flash of lightning, and a report like that of a heavy gun, the charge in the aerial wire broke through the insulation at the weakest point, viz., the insulated earth terminal on the bulkhead. The ebonite block in which the terminal was fitted was split into small fragments, and the terminal thrown across the wireless office, breaking a lamp on its way, but the two parts of the wire remained connected. Both the earth and the aerial wires were burned where they joined the balls of the coil, and the ebonite columns

SHORE WIRELESS TELEGRAPHY STATIONS
1904-1905.



supporting the balls were burnt opposite these wires. The balls were slightly burnt where they touched one another. The aerial ball was thrown across the office, grazing the ear of the Chief Torpedo Instructor, who was seated at the table. The free end of the aerial apparently struck the turret armour three times. The greater portion of the charges escaped to earth about half way up the deck tube, where the cowtail was burnt through and wire destroyed. A similar break occurred just above the deck tube where the diver's canvas is secured to the cowtail. The top of the deck tube with this short piece of wire was blown off, probably by the heated gases in the deck tube, and was found lying on the deck, having apparently struck the turret. The junction of the aerial wire and the cowtail was burnt through, the damage being on the cowtail below the junction. A small portion of the charge got to earth from the top of the loop in the aerial wire, where the insulation is burnt through, by jumping the interval between the wire and the lower edge of the shield cone mentioned above, the outside of which was wet. The cone, which was constructed of parchment and paper stiffened by rings of ebonite and coated with Japan varnish, was completely destroyed. This portion of the charge partially fused the wire strop of the halyard block, and ran along the wet gaff, blackening the paint till it reached the first iron band, escaping to earth through the wire span and vangs. Another small portion escaped through the receiving wire to the key. The back of the key was insulated by a leather pad, a small hole was burned through this leather by a spark passing to earth through the brass casing. No damage was done to the instruments except what has already been mentioned. The wireless office was filled with smoke from the burnt insulation in the deck tube.

4. In order to prevent the recurrence of the accident, it is proposed to lower the aerial wire during a thunderstorm and trice up a bare wire connected with wire rigging or hull, to form a lightning conductor for the gaff. This would be quicker than lowering the gaff, and the aerial could be as quickly replaced after the storm had passed.

General Memorandum.

Protection of Wireless Telegraphy Instruments during Thunderstorms.

During a severe thunderstorm, if the wireless gaff be not lowered as directed in Admiralty letter dated 28th October 1901, G. 7989/01, a double lead of wire, patt. 600, is to be triced up to the wireless gaff, the lower end of the lead to be well earthed, and the upper end to be fitted with a pointed metal rod long enough to project at least 6 inches above the point of the gaff.

2. If the aerial wire proper be not lowered, it is to be entirely disconnected from the wireless apparatus, and the lower end well earthed in the wireless office.

ABSTRACTS OF REPORTS.

LONG-DISTANCE RECEPTION FROM POLDHU.

Abstract of Captain Jackson's Report (dated 8th November 1903) to C.-in-C., Mediterranean, on Long-Distance Signalling carried out in "Duncan," by Mr. Marconi on passage from England to Gibraltar.

Results.

At night signals were correctly received during the whole passage. Maximum distance being 836 nautical miles, of which 430 were land.

By day signals were received up to 480, but not up to 700 miles.

Ordinary receiver recorded messages strongly up to 230 miles, but was afterwards of little use on account of the rolling of the ship.

After very careful adjustment and tuning, however, it recorded a signal at 830 miles. Mr. Marconi estimates that had no land intervened daylight signals would have been taken in up to 900 miles, and night signals up to about 1,600 miles.

On arrival at Gibraltar, a four-fold aerial 180 feet in length was tried at the shore station, signals being received clearly. A similar aerial was then fitted on board, but on the occasion when this was tried, both the four-fold aerials on board and on shore gave signals which were barely readable, the fan-shaped aerial giving better results than either.

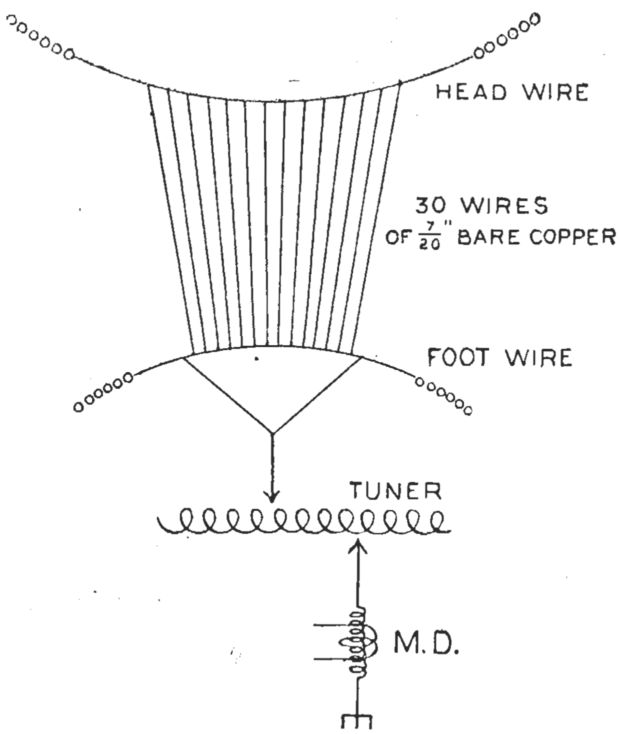
Receiving apparatus employed :—

(*a*) **Ordinary Marconi receiver, with special jigger outside box**

(*b*) Magnetic detector of usual form.

(*c*) Tuning coil, of 400 feet bare copper wire, $\frac{3}{22}$, on a former one foot square. Turns $\frac{1}{4}$ inch apart. Connections for receiving signals when no atmospheric disturbances are prevalent.

FIG. 2.



Total length of Æ, from head wire to instruments 260 feet.

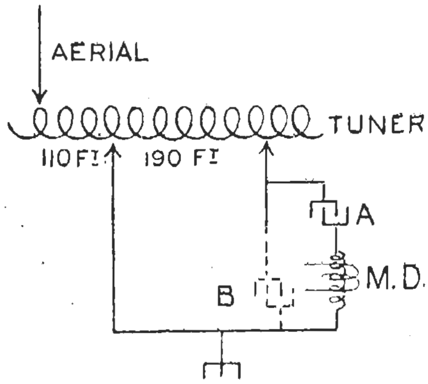
Number of turns of tuner found to give best results, 21 or 84 feet of wire.

Node of potential is in primary winding 8. This method is termed the *quarter wave* method.

Half wave method, used to reduce interference from atmospheric effects.

The anti-node of potential is in the small adjustable condenser A.

FIG. 3.



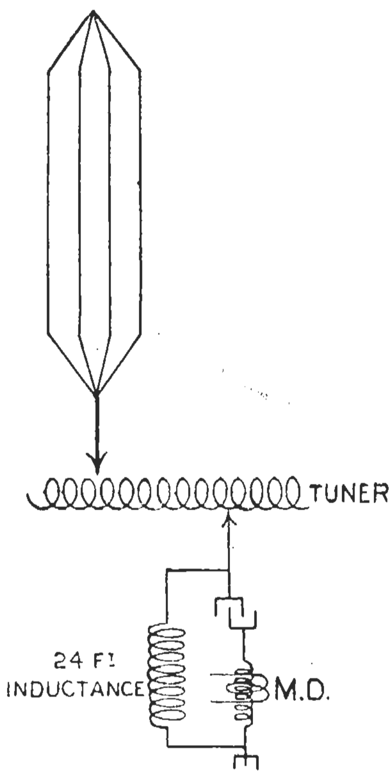
Details of adjustable condensers :—

A.—Cylinder 2 inches diameter, 5 inches long. One larger paraffin paper.

B.—3 cylinders, joined to make three plates each side; length 6 inches, diameter $2\frac{1}{2}$ inches, 2 inches, $1\frac{1}{4}$ inches approximately.

Other methods:—

Fig. 4.

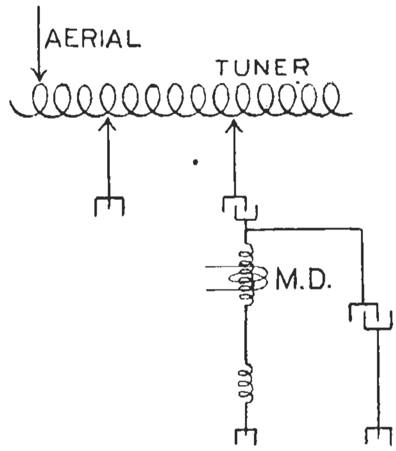


24 feet inductance = 2 primaries of receiving jigger in series.

Both methods reduce interference, but weaken signals.

Signals were obtained clearly at moderate distance, with magnetic detector in series with the ordinary receiver.

Fig. 5.



Abstract of Captain Jackson's Report to Commander-in-Chief, Mediterranean, on Experiments in Long-Distance Reception, carried out in "Duncan," May 7th–13th, 1904.

Poldhu sending to "Campania." "Duncan" receiving in Mediterranean, distant 850–900 miles, with France intervening.

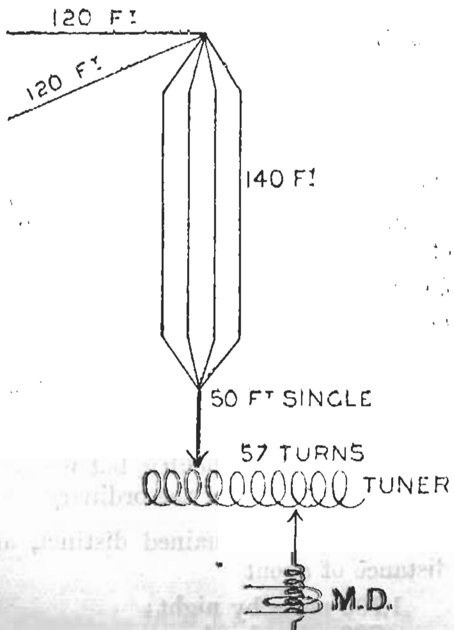
Experiments carried out under great difficulties, "Duncan" having no previous information as to exact times, wave lengths, nature of messages, &c.

Only single letters appear to have been sent, which were at first mistaken for broken signals, and so not accurately logged.

The results were therefore not so good as may be expected later on.

Various arrangements of Æ were tried, the most successful results being obtained with following arrangement:—

Fig. 6.



The prolongers were taken out to fore topsail yardarms on each side.

Summary of Results.

(*a*) Co operation between the sending and receiving stations is absolutely necessary, *i.e.*, organisation of system.

(*b*) Ordinary operators are not sufficiently expert at present to be sure of recording cypher messages, unless the same are repeated frequently, at the distance at which the experiments were carried out.

(*c*) The signals were as loud at 850 or 900 miles from Poldhu as they are at 100 miles from a ship using B tune with maximum spark.

(*d*) Signals made by ships over a few miles distant can generally be cut out, but the Poldhu signals are weakened thereby. The same applies to atmospherics, which are the principal drawback to the reliability of the system at very long distances.

(*e*) Ordinary 180 feet Æ should always be used for receiving when within limit of distance at which this can be done, it being more under control for cutting out local signals and atmospherics than the longer Æ used.

(*f*) If possible, two ships in company should receive at same time, on two Æ wires to separate instruments, thus ensuring that no mistakes are made.

Remarks by "Vernon" as to para. (*d*).

These difficulties have now been surmounted.

Abstract of Report on Marconi Company's Station at Glace Bay, by Lieut. Donaldson, H.M.S. "Ariadne," 4th August 1904.

A Canadian Marconi Company has been formed, distinct from the American Company, but also managed by the English Company.

In addition to the Glace Bay long-distance station, small power stations are to be erected at Vancouver and other places on the Pacific coast; also seven stations in the St. Lawrence. The small-power stations will be fitted with tune "A," and are for reporting shipping, &c.

The equipment of the station is in general similar to that of Poldhu, described in the Annual Report of 1903, p. 123. There are two alternators of 50 K.W. 4,000 volts and 200 K.W. 2,000 volts, and the transformers are capable of working up to 80,000 volts.

Mr. Vyvyan, the Chief Engineer of the station, states that he believes the towers to be unnecessarily high, as he has transmitted a distance of 750 miles with an aerial 30 feet high.

Abstract of Report by Lieuts. Loring and Yeats-Brown, R.N., dated 7th July 1904, *on Mr. Marconi's attempt to maintain a Service of Press News on the Cunard Liner "Campania" from Liverpool to New York.*

1. Wireless communication was maintained the whole way across the Atlantic from Liverpool to New York.

2. Arrangements were made that Poldhu, Cape Breton, and Cape Cod should each send press messages at definite times.

To ensure the reception of these messages they were repeated four times.

This programme was carried out without any difficulty.

3. The signals were received on a magnetic detector, and the maximum distance read was 2,000 miles from Poldhu.

Mr. Woodward (Mr. Marconi's assistant), who is a trained specialist in this class of work, apparently experienced no great difficulty, but we consider that the conditions demanded more skill than can be expected of the ordinary operator.

4. Signals may be said to have remained distinct, and easy for the ordinary operator to read up to a distance of about

1,700 miles by night;
700 miles by day.

At these distances the sound in the telephone was still comparatively loud.

5. It appeared to us that the only elements of uncertainty in this long-distance ir eless Telegraphy are introduced by either—

(A) Breakdown of transmitting plant;

(B) Atmospheric effects; or

(C) Wilful interference.

Of these—

(A) Can be provided for by duplication of parts;

(B) A really bad magnetic storm may make communication most difficult, if not impossible. Such conditions are, however, rare, and we would point out that similar difficulties are experienced with land lines and submarine cables;

(C) Is not easily accomplished in long-wave work.

6. The methods adopted by Mr. Marconi are simple and reliable. The receiving apparatus once adjusted remains so, and Mr. Marconi states the strength of signals over water have no variation by day. At night they vary considerably, but we understand from Mr. Marconi they have never been less than the 1,700 miles we mentioned in para. 4.

What has been done to-day, in fact, can be done again to-morrow.

7. We obtained the following information from Mr. Marconi in conversation:—

(*a.*) That the Italian Government are about to erect a power station at Massowah, in the Red Sea.

This station will be about the same size as Poldhu, and will be used in connection with the power station in Italy.

(*b.*) Mr. Marconi does not expect to obtain commercial Transatlantic telegraphy by day and night until he can greatly increase the size of his aerial.

(*c.*) There is no particular difficulty in Transatlantic work by night, but in summer the nights are so short owing to difference of longitude, that this fact has no commercial value. It gives only 1-2 hours working time per diem.

A long wave length is, Mr. Marconi considers, the remedy. This can only be efficiently employed by greatly increasing the size of the aerial. No more ground for this purpose can be obtained at Poldhu.

8. The special long-distance aerial does not interfere with ordinary ship aerial for "A" and "B" tunes, both can be kept permanently up. It is not possible at present to send on "A" tune and receive a long-distance message at the same time on the same ship, but "A" tune can be cut out at a range of 400 yards or less, probably at about 100 yards.

Appendix C.

Aerial used:—

T-shaped aerial.

Horizontal part 350 feet long.

Vertical part 150 feet long.

Height above waterline of horizontal part was about 180 feet.

Office:—

On upper deck between funnels, fitted with silent telephone cabinet.

Connections and Instruments:—

The Tuner consisted of 50 turns of insulated wire closely wound on 1⅜ feet square former, occupying an aerial length of about 1½ feet.

The Former was encased in a box along which a row of metal sockets were fixed, each socket being soldered to a lug connected to one of the turns. Connection to any required turn was made by inserting a plug in the corresponding socket.

Capacity S:—

Glass plate condenser, adjustable from 1 to 20 jars.

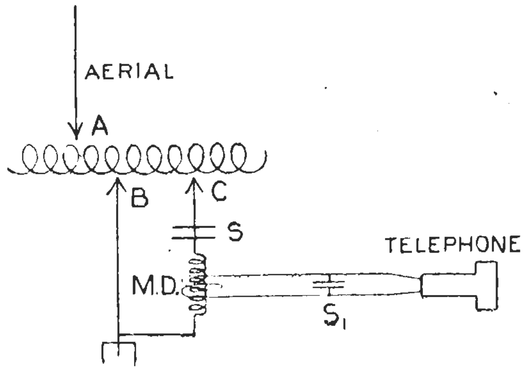
Telephone Capacity S_1 :—

Shellacked paper condenser, adjustable from ·1 m f. to ·3 m.f.

Magnetic Detector :—

Pattern described in Captain Jackson's Report (*see* p. 7), but encased in an outer box with glass lid.

FIG. 7.



Method of Tuning to Wave Length in Use :—

Connect as shown, leaving contact "B" disconnected, however, and capacity "S" short-circuited.

Vary the distance between contacts "A" and "C" until signals are loudest; this gives simple resonance.

Now introduce contact "B" and capacity "S" into circuit, and alter both until signals are again loudest.

The object of this arrangement is to cut down atmospherics as much as possible, and when well adjusted the signals are quite as loud as with simple resonance.

The wave length in use was probably about 5,000 feet, this corresponds to 0·2 m.f. in primary circuit at Poldhu. The corresponding turns at the receiver were :—

From A to B - - -	55 turns (2 tuners in series).
" B to C - - -	4 "
Capacity S - - -	9 jars.
Telephone capacity S_1 - -	·2 m.f.

Telephone Capacity :—

This is adjusted by the operator until the signals appear to him clearest. It is only at long distances that any distinct advantage can be noticed by its use.

It has no effect on the electrical tuning.

Technical Items gathered in Conversation with Mr. Marconi :—

Aerials.—The new "T" shape is a great improvement on the fan type of aerial.

Poldhu will receive on a "T" aerial in future. The greater the size of the receiving aerial the louder the signals; but the louder also the atmospherics. A big aerial is necessary for transmitting; but Mr. Marconi prefers a small one for receiving.

The new L. D. station at Rome will have a T-shaped aerial for sending; with several horizontal parts to the "T," making therefore a gigantic spider's web overhead, with a "feeder" conveying energy to its centre.

It is interesting to note that Muirhead & Co. use identically the same form of aerial, and in the opinion of one of us the problem of the shape of aerial may now be considered to be definitely settled for many years to come.

The Roman station will have 1,000 horse-power available.

The "Daylight" Effect :—

Mr. Marconi gave us the following table of results :—

Capacity in Primary at Poldhu.	Spark, M.M.S.	Distance (Miles). Day.	Distance (Miles). Night.	Rough Calculations. Wave Length.
0·2 m.f. - - -	3	400	400	5,000 feet, ⅓*
	10	600	1,000	" " 2
	40	1,000	2,300	" " 40
2·0 - - - -	3	650	650	15,000 " 2
	25	1,200	1,700	" " 80

* Horse power in use.

The last two columns of this table are not on Mr. Marconi's authority, but are from calculations, &c. Taking them into account, it appears to us that the shorter wave is much the more efficient. For the same horse power the short wave is as good for distance as the long wave in the daylight, and much better than it by night. Now the fundamental wave length of Poldhu (*i.e.*, the wave given off when the Poldhu aerial is sparked into direct) is about 4,000 feet; so that the above results seem to show that the most efficient wave length for a given aerial is somewhere near the fundamental.

With a longer aerial, of course, the best wave length would be correspondingly longer, and thus secure the other advantages of the long wave, the better day distance, and the larger amount of tuning.

It is interesting to observe in the table how little the aerial likes to be "forced" in the daytime. Thus ⅓ horse power signals 400 miles, but it requires 40 H.P. to get 1,000 miles.

A very interesting fact in connection with this is that if a receiving device is placed, say 100 miles from Poldhu, then, when Poldhu is using the 40-m.m. spark, the receiving device will show a certain deflection, and this deflection will *not* alter whether it is day or night; whilst the actual distance to which signals go is (say) twice as great by night as by day. This appears to show that the "daylight" effect is not anything to do with the daylight acting on the receiving or sending aerials, but due to its action on the intervening medium. Assuming that the daylight losses are proportional to the distance in the intervening medium acted upon, and that the signals would, without these losses, fall off inversely, as the distance it has been shown by one of us, that if the strength of signals at 2,300 miles by night is equal to the strength at 1,000 miles by day, then at 100 miles the difference in strength will only be ½ per cent. This fits the observed facts, and if correct, shows that an enormous increase in wave strength will be necessary in order to signal across the Atlantic as strongly by day as by night.

Two stations north and south of each other are therefore preferable to two stations east and west of each other.