ORIGIN AND DEVELOPMENT OF WIRELESS TELEGRAPHY.

BY G. MARCONI.

THE subject of wireless telegraphy has apparently caused some little interest among my friends and among the inhabitants generally of the vast continent of America; and it is with no small amount of pleasure that I comply with the request to write a few words relative to the experiments and installations which have been carried out under my supervision. I shall endeavor, in as brief space as possible, to place a few facts before my readers to enable them to grasp the means by which these experiments have been brought to such a practical and successful issue.

My first experiments were conducted in 1895, on my father's estate in Bologna, in Italy, and I was much surprised at the facility with which I found it possible to transmit messages without a wire for many miles. On coming to England on private business in 1896, I was advised by my friends and relations to give a demonstration of the capabilities of my invention to the British authorities, who gave me facilities to test the system; and we were soon doing nine miles across the Bristol Channel.

But, perhaps, at this point, it will not be out of place to give a brief description of the apparatus, avoiding technicalities as much as possible.

We will first take the transmitting or sending apparatus.

I used an ordinary 10-inch induction-coil, somewhat similar to the familiar shocking coil, but on a much larger scale. Connected to the terminals of the secondary winding, are two small spheres, about one or two centimeters apart. Between these spheres the spark passes and sets up the oscillations necessary for

the transmission of signals. When long distances are to be bridged, a vertical insulated conductor, suspended by means of a mast, is attached to one sphere, and the other sphere is connected with the earth. If an ordinary telegraphic key connecting a battery with the coil be pressed, the current from the battery is allowed to actuate the induction coil which charges the vertical conductor, and discharges across the gap separating the two spheres. This discharge is an oscillating one, and the insulated conductor becomes a powerful radiator of electric waves. It will be easy to see how, by pressing the key for long or short intervals, it is possible to emit a long or short succession of waves, which, when they influence the receiver, reproduce on it a long or short effect according to their duration, in this way reproducing Morse signals.

The principal point in my receiver is the sensitive tube or radio-conductor, or, as it is generally termed, the coherer. It consists of a small glass tube, about four centimeters in length, into which two silver plugs are tightly fitted. A small gap separates them, and in this gap a mixture of nickel and silver filings is placed. Under ordinary conditions, the resistance of this gap is too high to allow of any current passing from the local cell or battery; but, under the influence of electric waves, these filings instantly cohere, and the tube becomes a comparatively good conductor. Connected to this tube is a cell and a relay. By the cohesion of the filings, the current from the cell is allowed to pass through the tube and actuate the relay. When once this is achieved, it becomes a very simple matter to make a bell ring, or work an ordinary Morse inkwriter.

But one peculiarity with this cohesion of the filings, under the influence of an electric wave, is their power of remaining cohered unless tapped or shaken up. I have overcome this difficulty by using an automatic tapper or discoherer, which is somewhat similar to an electric bell tapper *minus* the bell. This is so adjusted as to tap the tube and shake the filings up, thus decohering them and bringing them to their normal condition, when they are again in a state to receive another impulse. This is worked by the relay and another local battery.

It will now be easy to follow the various actions which take place. The oscillations set up by the transmitter at the distant station act on the vertical conductor or resonator which is con-

nected to the sensitive tube at the receiving station, cohere the filings in the tube, and allow the local cell to actuate the relay. The relay, in its turn, causes the larger battery to pass a current through the tapper or interrupter, and also through the electro magnets of the recording instrument. The practical result is that the receiver is actuated for a time equal to that during which the key is pressed at the transmitting station.

With apparatus as thus explained, and with the addition of a few important details which for brevity I shall not describe, I have made most of my experiments and worked numerous important installations.

After the experiments across the Bristol Channel, I gave some important demonstrations to the Italian naval authorities at Spezia. With the transmitter on shore and the receiver on board an Italian warship, a distance of twelve miles was bridged. A series of trials were also carried out with other ships, and between ship and ship, and the Italian Navy was not slow in permanently adopting my system.

On Salisbury Plain, I introduced kites as a means of raising and suspending the vertical conductor to a considerable altitude. In these experiments I attained my greatest distances—between Salisbury and Bath, a distance of thirty-four miles.

Immediately after this, I set up two experimental stations, one at Alum Bay, in the Isle of Wight, and the other at Bournemouth, the distance between them being fourteen miles, in order to test the practicability of the system under all conditions of weather, and also to afford an opportunity of proving that "Wireless Telegraphy" was not a myth but a working reality.

It has, apparently, been thought that the weather, or varying conditions of atmospheric electricity, may interfere with or stop the signals transmitted by this system; but experience of over fourteen months of continual every-day work has brought me to the conclusion that there is no weather which can stop or seriously interfere with the working of such an installation.

We have given demonstrations to several eminent scientists who came down, often when we did not expect them, but on no occasion have they found any difficulty in the work of transmitting and receiving messages between the two stations. Among others who inspected these stations, was Lord Kelvin; and he was kind enough to express himself as being highly pleased with what

he saw. He sent several telegrams to his friends and insisted on paying one shilling royalty on each message, wishing in this way to show his appreciation of what was done, and to illustrate its fitness at that time for commercial purposes.

In July of last year, we gave an interesting demonstration at Kingstown Regatta, in reporting from a tug the results and incidents of the several yacht races. The relative positions of the various yachts were thus wirelessly signalled, while the races were in progress, sometimes over a distance of ten miles, and published long before the yachts had returned to harbor. On one of these excursions we had the company of several stock brokers and business men of Dublin, who transacted business on the receipt of the daily Stock Exchange quotations sent off from our shore station, much to the amusement of all on board.

After finishing at Kingstown, I had the honor of being asked to install wireless telegraphic communication between the royal yacht, "Osborne" and Osborne House, in the Isle of Wight, in order that Her Majesty might communicate with H. R. H. the Prince of Wales, who at the time was suffering from a fractured knee. Although quite hidden from one another by intervening hills and trees, constant and uninterrupted communication was maintained. These obstructions would have rendered direct signalling between the two positions impossible by means of any flag, semaphore or heliograph system.

In December of last year, it was thought desirable to demonstrate that the system was quite practical, and available for enabling telegraphic communication to be established between lightships and the shore. This is a matter of great importance. By the kind permission of the officials of Trinity House, we connected the East Goodwin Lightship—the outermost lightship guarding the dangerous Goodwin Sands—with the South Foreland light house, twelve miles apart. The apparatus was taken on board in an open boat and rigged up in one afternoon.

The installation started working from the very first without the slightest difficulty, and it has continued to work admirably through all the storms which during this year have been so severe. By its means two vessels have already received quick and valuable assistance. Both ran on the sands in a fog. The lightship noted their signals of distress, telegraphed for assistance, indicating the exact spot where it was required, and tugs and life-

boats were soon rendering every aid. Various members of the crew have learned how to send and receive signals, and in fact run the station. Previous to our visit to the ship it is highly probable they had scarcely heard of wireless telegraphy, and were certainly unacquainted with even the rudiments of electricity. Their knowledge is very valuable when the assistant, who is a poor sailor, is unable to attend to the work himself.

The latest installation that I have fitted up is across the English Channel, between the South Foreland lighthouse and Boulogne, a distance of about thirty miles. This has worked with great success from the start, and at the present moment a message is being received respecting a vessel which has run on shore close to Wimereux. The French authorities are most enthusiastic over the results.

All the above experiments have been made with what we term the vertical wire system; but I think it would be desirable, before closing this summary of events, to bring before my readers some observations on the use of parabolic reflectors, as a means of controlling the propagation and intensifying the effects of the waves. As in ordinary optics, so also in the optics of electro-magnetic oscillations, it is possible to reflect the waves radiated from the oscillator in one definite direction only. The advantages obtainable by their use are obvious. With the vertical wire system, the waves have been allowed to radiate in all directions and would affect all suitable receivers within a certain radius, although it is possible by means of syntonising arrangements to prevent this to a certain extent.

By means of reflectors it is possible to project the waves in one almost parallel beam, which will not affect any receiver placed out of its line of propagation. This would enable several forts or islands to communicate with each other without any fear of the enemy's tapping or interfering with signals; for if the forts are situated on small heights, the beam of rays would pass above the position which might be held by an enemy.

The possibilities and importance of the uses to which these reflected radiations can be adapted are enormous. More especially will this system be applicable to enable ships to be warned by lighthouses, lightships or other vessels, not only of their proximity to danger, but also of the direction from which the warning comes.

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SCIENTIFIC HISTORY AND FUTURE USES OF WIRELESS TELEGRAPHY.

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PUBLIC attention, on both sides of the Atlantic, has recently been strongly directed to the possibilities of telegraphy through space, by the remarkable experiments of Signor G. Marconi. Taking advantage of well known scientific principles, together with very important and novel additions of his own, this ingenious inventor has startled the world by flinging telegraphic messages across thirty miles of sea, wrapt, it may be, in fog, or swept by storm, and recording, in the well known Morse telegraphic alphabet of dot and dash, the communications thus conveyed without continuous connecting wires or cables of any kind. Every thoughtful person desires to gain some glimpse of the means by which this feat has been performed, and some little guidance in prognosticating the future of the new telegraphy.

It is very seldom that a new scientific departure is rightly apprehended at first, in regard either to its uses or its methods.

Imagination is often carried captive by a novel process, and a speedy revolution of old methods is anticipated; or, on the other hand, it is decried as containing nothing new, and the inventor is set down as a mere user of other people's ideas. An inventor, be it remarked in passing, is not necessarily a person who does anything new. He is often one chiefly gifted with that poetic insight which enables him to carry out to their true logical issue familiar facts, or he casts a sudden flood of light on well known processes by some simple adaptation of known means.

In the present instance, this wonderful conveyance of intelligence through space by electrical means, between places not con-