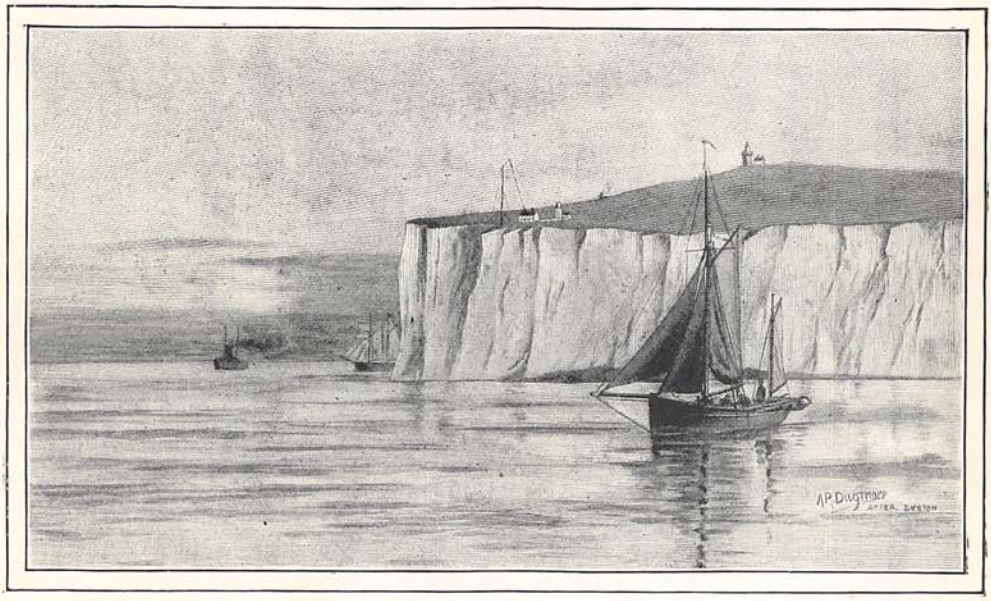
SIGNOR MARCONI AND WIRELESS TELEGRAPHY.

A CHRONICLE AND AN INTERVIEW.

By Cleveland Moffett.*

SIGNOR MARCONI began his now famous endeavours at telegraphing without wires in 1895. When in the fields of his father's estate at Bologna, Italy, he set up tinned boxes, called "capacities," on poles of varying heights, and connected them by insulated wires with the instruments he had then devised — a crude transmitter and receiver. Here was a young man of twenty hot on the track of a great discovery, for presently he is writing to Mr. W. H. Preece, chief electrician of the British postal system, telling him about these tinned boxes, and how he has found that "when these were placed on top of a pole two metres high signals could be obtained at thirty metres from the transmitter," and that "with the same boxes on poles four metres high signals were obtained at one hundred metres, and with the same boxes at a height of eight metres, other conditions being equal, nearly up to a mile and a half. Morse signals were easily obtained at four hundred metres." And so on, the gist of it being (and this is the chief point in Marconi's present system) that the higher the pole connected by wire with the transmitter, the greater was found to be the distance of transmission.

In 1896 Marconi came to London and conducted further experiments in Mr. Preece's laboratory, these earning him followers and supporters. Then came the signals on Salisbury Plain through house and hill, plain proof for doubters that neither brick walls nor rocks nor earth could stop these subtle waves. What kind of waves they were Marconi did not pretend to say. It was enough for him that they did their business well.



SOUTH FORELAND, THE ENGLISH STATION FROM WHICH MESSAGES WERE SENT WITHOUT WIRES TO BOULOGNE, FRANCE, THIRTY-TWO MILES AWAY.

The mast supporting the vertical wire is seen on the edge of the cliff.

And since they acted best with wire supported from a height, a plan was conceived of using balloons to hold the wires, and March, 1897, saw strange doings in various

WILLIAM MARCONI.
From a photograph taken at South Foreland Lighthouse, March 29, 1899.

parts of England; ten-foot balloons covered with tinfoil sent up for "capacities" and promptly blown into slivers by the gale; then six-foot calico kites with tinfoil over them and flying tails; finally tailless kites, under the management of experts. In these trials, despite unfavourable conditions, signals were transmitted through space between points over eight miles apart.

In November, 1897, Marconi and Mr. Kemp rigged up a stout mast at the Needles, on the Isle of Wight, 120 feet high, and supported a wire from the top by an insulated fastening. Then, having connected the lower end of this wire with a transmitter, they put out to sea in a tug-boat, taking with them a receiving instrument connected to a wire that hung from a sixty-foot mast. Their object was to see at what distance from the Needles they could get signals. For months, through storm and gale, they kept at this work, leaving the Needles farther and farther behind them as details in the instruments were improved, until by the New Year they were able to get signals clear across to the mainland. Forthwith a permanent station was set up there at Bournemouth, fourteen miles from the Needles, and was subsequently moved to Poole, eighteen miles.

An interesting fact may be noted, that on one occasion, soon after this installation, Mr. Kemp was able to get Bournemouth messages at Swanage, several miles down the coast, by simply lowering a wire from a high cliff and connecting on a receiver at the lower end. Here was communication established with only a rough precipice to serve and no mast at all!

Let us come now to the Kingstown regatta, which took place in July, 1898, and lasted several days. The *Daily Express* of Dublin set a new fashion in newspaper methods by arranging to have these races observed from a steamer, the *Flying Huntress*, used as a movable sending station for Marconi messages which should describe the different events as they happened. A height of seventy-five to eighty feet of wire was supported from the mast, and this was found sufficient to transmit easily to Kingstown, even when the steamer was twenty-five miles from shore. The receiving mast erected at Kingstown was 110 feet high, and the despatches as they arrived here through the receiving instrument were telephoned at once to Dublin, so that the *Express* was able to print full accounts of the races almost before they were over, and while the yachts were out far beyond the range of any telescope. During the regatta more than seven hundred of these wireless messages were transmitted.

Not less interesting were the memorable tests that came a few days later, when Marconi was called upon to set up wireless communication between Osborne House on the Isle of Wight and the Royal yacht with the Prince of Wales aboard as she lay off in Cowes Bay. The Queen wished to be able thus to get frequent bulletins in regard to the Prince's injured knee, and not less than one hundred and fifty messages of a strictly private nature were transmitted during sixteen days with entire success. By permission of the Prince of Wales some of these messages have been made public: among others the following:—

August 4th.

From Dr. TRIPP *to* Sir JAMES REID.

H.R.H. the Prince of Wales has passed another excellent night, and is in very good spirits and health. The knee is most satisfactory.

August 5th.

From Dr. TRIPP *to* Sir JAMES REID.

H.R.H. the Prince of Wales has passed another excellent night, and the knee is in good condition.

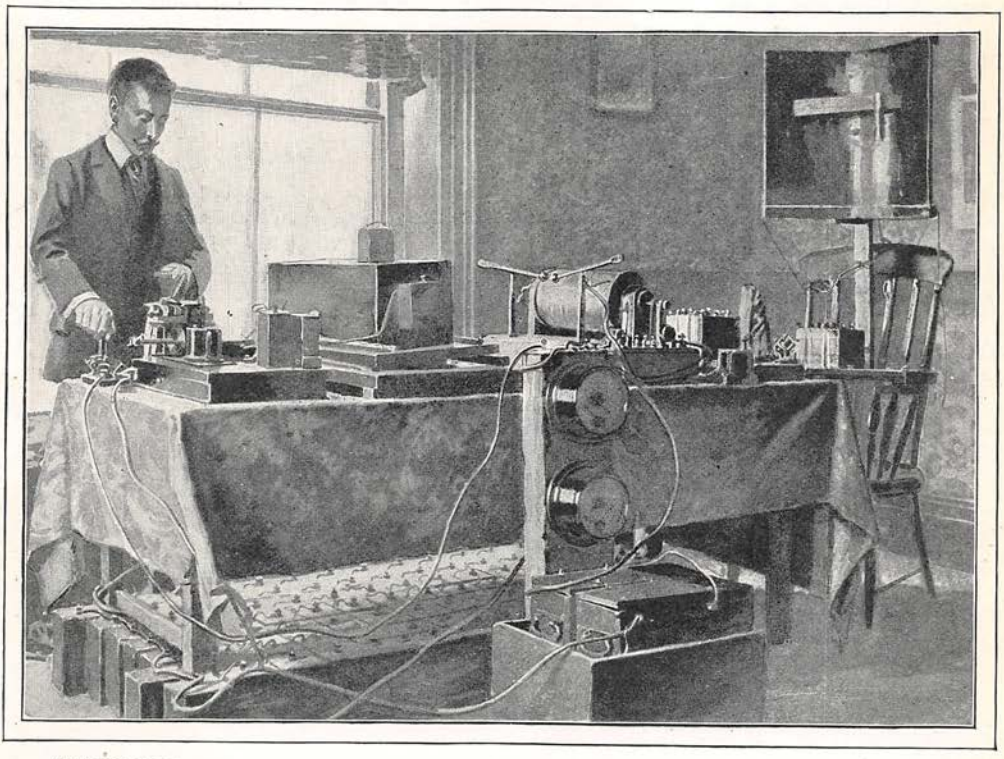
The transmission here was accomplished in the usual way—with a one-hundred-foot pole at Ladywood Cottage, in the grounds of Osborne House, supporting the vertical conductor, and a wire from the yacht's mast lifted eighty-three feet above deck. This wire led down into the saloon, where the instruments were operated and observed with great interest by the various royalties aboard, notably the Duke of York, the Princess Louise, and the Prince of Wales himself. What seemed to amaze them above all was that the sending could go on just the same while the yacht was ploughing along through the waves.

The following telegram was sent on August 10th by the Prince of Wales while the yacht was steaming at a good rate off Bembridge, seven or eight miles from Osborne:—

To the DUKE OF CONNAUGHT.

Will be pleased to see you on board this afternoon when the *Osborne* returns.

On one occasion the yacht cruised so far west as to bring its receiver within the influences of the transmitter at the Needles, and here it was found possible to communicate successively with that station and with



THE WIRELESS TELEGRAPH STATION AT POOLE, SHOWING SENDING AND RECEIVING INSTRUMENTS.

In the right-hand corner is the copper reflector used in directing the waves.

Drawn from a photograph.

Osborne; this despite the fact that both stations were cut off from the yacht by considerable hills, one of these, Headon Hill, rising three hundred and fourteen feet higher than the vertical wire of the *Osborne*.

It was at the extreme west of the Isle of Wight that I got my first practical notion of how this amazing business works. Looking down from the high ground, a furlong beyond the last railway station, I saw at my feet the horse-shoe cavern of Alum Bay, a steep semicircle, bitten out of the chalk cliffs, one might fancy, by some fierce sea-monster, whose teeth had snapped in the effort and been strewn there in the jagged line of Needles. These gleamed up white now out of the waves and pointed straight across the Channel to the mainland. On the right were low-lying, reddish forts, waiting for some enemy to dare their guns. On the left, rising bare and solitary from the highest hill of all, stood the granite cross of Alfred Tennyson, alone, like the man, yet a comfort to weary mariners.

Here, overhanging the Bay, is the Needles Hotel, and beside it rises one of Marconi's tall masts, with braces and halliards to hold it against storm and gale. From the peak hangs down a line of wire that runs through a window into the little sending room where we may now see enacted this mystery of talking through the ether. There are two matter-of-fact young men here who have the air of doing something that is altogether simple. One of them stands at a table with some instruments on it and works a black-handled key up and down. He is saying something to the Poole station over yonder in England, eighteen miles away.

"Brripp — brripp — brripp — brrrrrr. Brripp—brripp—brripp—brrrrrr—brripp—brrrrrr—brripp. Brripp—brripp!"

So talks the sender with noise and deliberation. It is the Morse code working ordinary dots and dashes which can be made into letters and words, as everybody knows. With each movement of the key bluish sparks jump an inch between the two brass knobs of the induction coil, the same kind of coil and the same kind of sparks that are familiar in experiments with the Rontgen rays. For one dot a single spark jumps, for one dash there comes a stream of sparks.

One knob of the induction coil is connected with the earth, the other with the wire hanging from the masthead. Each spark indicates a certain oscillating impulse from the electrical battery that actuates the coil; each one of these impulses shoots through the aërial wire and from the wire through space by oscillations of the ether, travelling at the speed of light, or seven times round the earth in a second. That is all there is in the sending of these Marconi messages.

"I am giving them your message," said the young man presently, "that you will spend the night at Bournemouth and see them in the morning. Is there anything you would like to add?"

"Ask them what sort of weather they are having," I suggested, thinking of nothing better.

"I've asked them," he said, and then struck a vigorous series of V's, three dots and a dash, to show that he had finished. "Now I switch on to the receiver," he explained, and connected the aërial wire with an instrument in a metal box about the size of a valise. "You see, the aërial wire serves both to send the ether waves out and to collect them as they come through space. Whenever a station is not sending it is connected to receive."

"Then you can't send and receive at the same time?"

"We don't want to; we listen first and then talk. There, they're calling us. Hear that?"

Inside the metal box a faint clicking sounded, like a whisper after a hearty tone. And the wheels of a Morse printing apparatus straightway began to turn, registering dots and dashes on a moving tape.

"They send their compliments, and say they will be glad to see you. Ah, here comes the weather—'Looks like snow. Sun is blazing on us at present.'"

It is, perhaps, worthy of note that five minutes later it began to snow on our side of the Channel.

"I must tell you," went on my informant, "why the receiver is put in this metal box. It is to protect it against the influence of the sender, which you observe rests beside it on the table. You can easily believe that a receiver sensitive enough to record impulses from a point eighteen miles away might be disorganised if these impulses came from a distance of two or three feet. But the box keeps them out."

"And yet it is a metal box?"

"Ah, but these waves are not conducted as ordinary electric waves are. These are Hertzian waves, and good conductors for everyday electricity may be bad conductors for them. So it is in this case. You heard the receiver work just now for the message

from Poole, yet it makes no sound while our own sender is going. But look here, I will show you something."

He took up a little buzzer with a tiny battery, such as are used to ring electric bells.

"Now listen. You see, there is no connection between this and the receiver."

He joined two wires so that the buzzer began to buzz, and instantly the receiver responded, dot for dot, dash for dash.

"There," he said, "you have the whole principle of the thing right before you. The feeble impulses of this buzzer are transmitted to the receiver in the same way that the stronger impulses are transmitted from the induction coil at Poole. Both travel through the ether."

"Why doesn't the metal box stop these feeble impulses as it stops the strong ones of your own sender?"

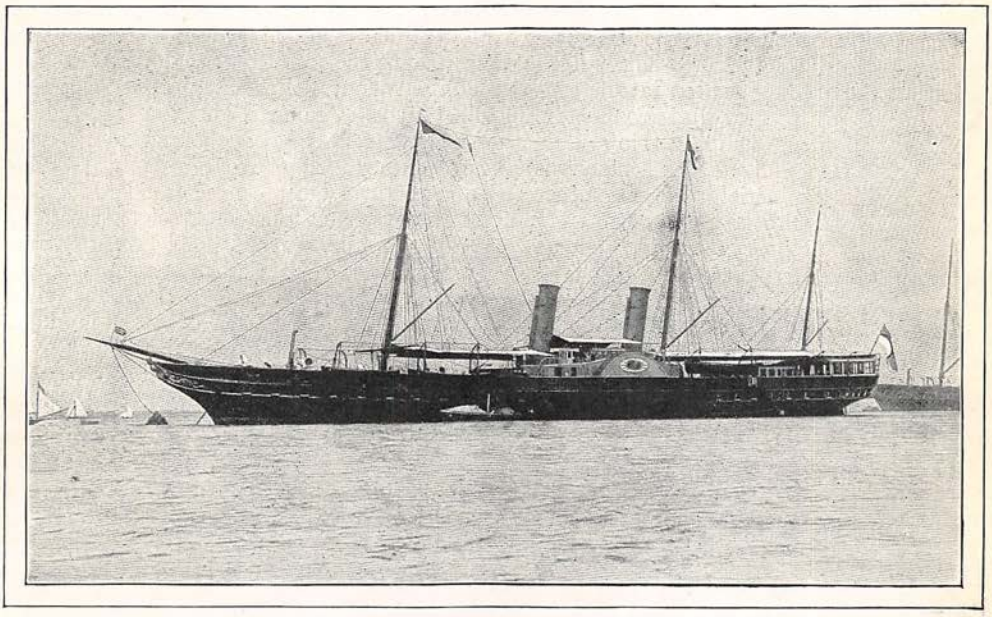
"It does. The effect of the buzzer is through the aërial wire, not through the box. The wire is connected with the receiver now, but when we are sending it connects only with the induction coil, and the receiver, being cut off, is not affected."

"Then no message can be received when you are sending?"

"Not at the very instant, but, as I said, we always switch back to the receiver as soon as we have sent a message. So another station can always get us in a few minutes. There they are again."

Once more the receiver set up its modest clicking.

"They're asking about a new coherer we're putting in," he said, and proceeded to send the answer back. I looked out across the water, which was duller now under a grey sky. There was something uncanny in the thought that my young friend here, who seemed as far as possible from a magician or supernatural being, was flinging his words across this waste of sea, over the beating schooners, over the feeding cormorants, to the dim coast of England yonder.



THE ROYAL YACHT "OSBORNE," FROM WHICH THE PRINCE OF WALES TELEGRAPHED WITHOUT WIRES.

The sending and receiving wire is suspended from the rope connecting the two mastheads, and can be distinguished by the wire cone near the top.

From a photograph by A. E. Beken.

"I suppose what you send is radiated in all directions?"

"Of course."

"Then anyone within an eighteen mile range might receive it?"

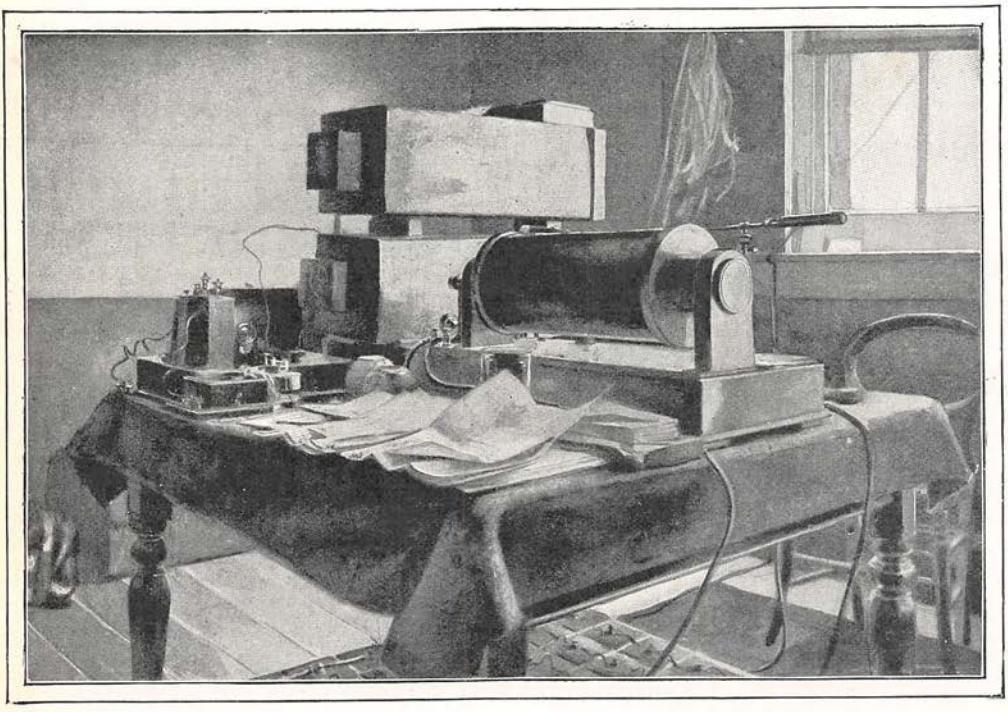
"If they had the proper kind of receiver." And he smiled complacently, which drew further questions from me, and presently we were discussing the relay and the tapper and the twin silver plugs in the neat vacuum tube, all essential parts of Marconi's instrument for catching these swift pulsations in the ether. The tube is made of glass about the thickness of a

thermometer tube and about two inches long. It seems absurd that so tiny and simple an affair can come as a boon to ships and armies, and a benefit to all mankind, yet the chief virtue of Marconi's invention lies here in this fragile coherer. But for this, induction coils would snap their messages in vain, for none could read them.

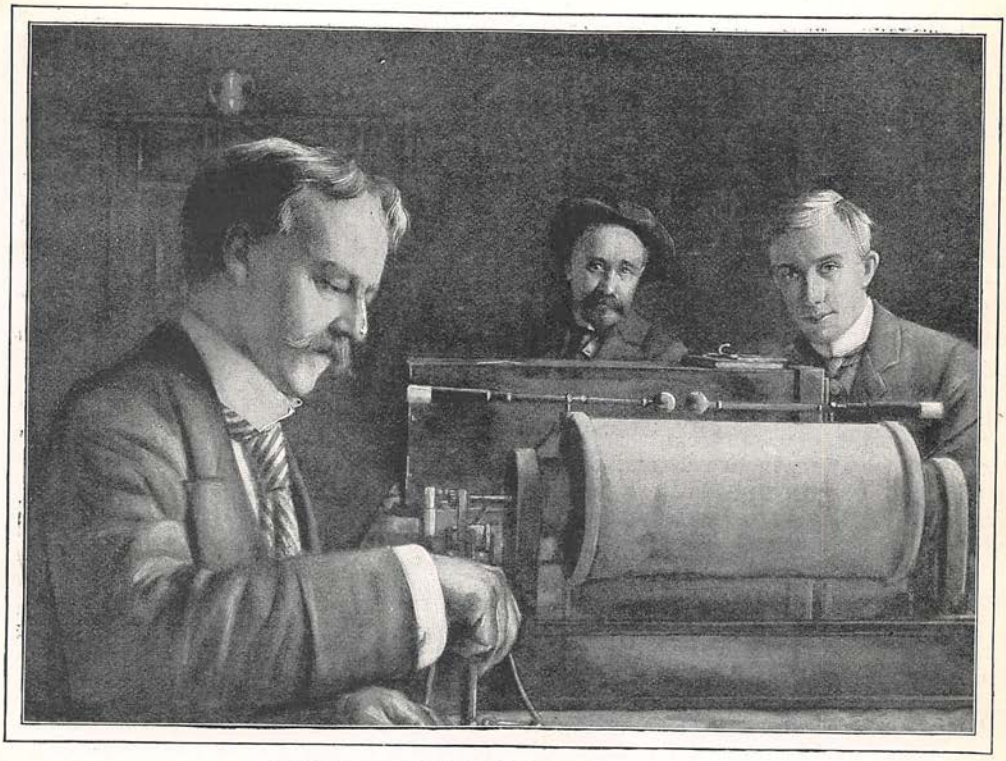
The silver plugs in this coherer are so close together that the blade of a knife could scarcely pass between them; yet in that narrow slit nestle several hundred minute fragments of nickel and silver, the finest dust, siftings through silk; and these enjoy the strange property (as Marconi discovered) of being alternately very good conductors and very bad conductors for the Hertzian waves—very good conductors when welded together by the passing current into a continuous metal path, very bad conductors when they fall apart under a blow from the tapper. One end of the coherer is connected with the aërial wire, the other with the earth and also with a home battery that works the tapper and the Morse printing instrument.

And the practical operation is this:—When the impulse of a single spark comes through the ether down the wire into the coherer, the particles of metal cohere (hence the name), the Morse instrument prints a dot, and the tapper strikes its little hammer against the glass tube. That blow decoheres the particles of metal and stops the current of the home battery. And each successive impulse through the ether produces the same phenomena of coherence and decoherence, and the same printing of dot or dash. The impulses through the ether would never be strong enough of themselves to work the printing instrument and the tapper, but they are strong enough to open and close a valve (the metal dust) which lets in or shuts out the stronger current of the home battery—all of which is simple enough after someone has taught the world how to do it.

Twenty-four hours later, after a breezy ride across Channel on the self-reliant side-wheeler *Lymington*, then an hour's railway journey and a carriage jaunt of like duration over gorse-spread sand dunes, I found myself at the Poole signal station, really six miles beyond Poole, on a barren promontory. Here the installation is identical with that at the Needles, only on a larger scale, and here two operators are kept



THE APPARATUS EMPLOYED AT SOUTH FORELAND LIGHTHOUSE FOR COMMUNICATING WITH THE GOODWIN SANDS LIGHTSHIP AND WITH BOULOGNE.
Drawn from a photograph.



TRANSMITTING-INSTRUMENT AT BOULOGNE STATION.
Drawn from a photograph.

busy at experiments under the direction of Signor Marconi himself and Dr. Erskine-Murray, one of the Company's chief electricians. With this latter I spent a couple of hours in profitable converse.

"I suppose," said I, "this is a fine day for your work?" The sun was shining and the air mild.

"Not particularly," said he; "the fact is, our messages seem to carry best in fog and bad weather. This past winter we have sent through all kinds of gales and storms without a single breakdown."

"Don't thunderstorms interfere with you, or electric disturbances?"

"Not in the least."

"How about the earth's curvature? I suppose that doesn't amount to much from here to the Needles?"

"Doesn't it, though? Look across and judge for yourself. It amounts to 100 feet, at least. You can only see the head of the Needles lighthouse from here, and that must be 150 feet above the sea. And the big steamers pass there hulls and funnels down."

"Then the earth's curvature makes no difference with your waves?"

"It has made none up to twenty-five miles, which we have covered from a ship to shore. And in that distance the earth's dip amounts to about 500 feet. If the curvature counted against us, then the messages would have passed some hundreds of feet over the receiving station; but nothing of the sort happened. So we feel reasonably confident that these Hertzian waves follow around smoothly as the earth curves."

"And you can send messages through hills, can you not?"

"Easily. We have done so repeatedly."

"And you can send in all kinds of weather?"

"We can."

"Then," said I, after some thought, "if neither land, nor sea, nor atmospheric conditions can stop you, I don't see why you can't send messages to any distance."

"So we can," said the electrician, "so we can, given a sufficient height of wire. It has become simply a question now how high a mast you are willing to erect. If you double the height of your mast you can send a message four times as far. If you treble the height of your mast you can send

a message nine times as far. In other words, the law established by our experiments seems to be that the range of distance increases as the square of the mast's height. To start with, you may assume that a wire suspended from an eighty-foot mast will send a message twenty miles. We are doing about that here."

"Then," said I, multiplying, "a mast 160 feet high would send a message eighty miles?"

"Exactly."

"And a mast 320 feet high would send a message 320 miles; and a mast 640 feet high would send a message 1,280 miles; and a mast 1,280 feet high would send a message 5,120 miles?"

"That's right. So, you see, if there were another Eiffel Tower in New York, it would be possible to send messages to Paris through the ether, and get answers, without ocean cables."

"Do you really think that would be possible?"

"I see no reason to doubt it. What are a few thousand miles to this wonderful ether which brings us our light every day from millions of miles."

"Do you use stronger induction coils," I asked, "as you increase the distance of transmission?"

"We have not up to the present, but may do so when we get into the hundreds of miles. A coil with a ten-inch spark, however, is quite sufficient for any distances under immediate consideration."

After this we talked of improvements in the system made by Signor Marconi as the result of experiments kept up continuously since these stations were established nearly two years ago. It was found that a horizontal wire, placed at whatever height, was of practically no value in sending messages. All that counts here is the vertical component. Also that it is better to have the wire conductor suspended out from the mast by a sprit. It was found, furthermore, that by modifying the coherer and perfecting various details of installation, the total efficiency was much increased, so that the vertical conductor could be lowered gradually without disturbing communication. Now they are sending to the Needles with a sixty-foot conductor, whereas at the start a wire with 120 feet vertical height was necessary.

So much for my visits to these pioneer etherial stations (if I may so style them), which gave me a general familiarity with the method of wireless telegraphy and enabled me to question Marconi with greater pertinence during several talks which it was my privilege to have with him. What interested me chiefly was the practical and immediate application of this new system to the world's affairs. And one thing that came to mind, naturally, was the question of privacy or secrecy in the transmission of these aërial messages. In time of war, for instance, would communications between battleships or armies be at the mercy of anyone, including enemies, who might have a Marconi receiver?

On this point Marconi had several things to say. In the first place it was evident that generals and admirals, as well as private individuals, could always protect themselves by sending their despatches in cipher. Then, during active military operations, despatches could often be kept within a friendly radius by lowering the wire on the mast until its transmitting power came within that radius.

Marconi realises, of course, the desirability of being able in certain cases to transmit messages in one and only one direction. To this end he has conducted a special series of experiments with a sending apparatus different from that already described. He uses no wire here but a Righi oscillator placed at the focus of a parabolic copper reflector two or three feet in diameter. The waves sent out by this oscillator are quite different from the others, being only about two feet long instead of three or four hundred feet, and the results, up to the present, are less important than those obtained with the pendant wire. Still, in trials on Salisbury Plain, Marconi and his assistants sent messages perfectly in this way over a distance of a mile and three-quarters, and were able to direct these messages at will by aiming the reflector in one direction or another. It appears that these Hertzian waves, though invisible, may be concentrated by parabolic reflectors into parallel beams and projected in narrow lines just as a bull's-eye lantern projects beams of light. And it was found that a very slight shifting of the reflector would stop the messages at the receiving end. In other words, unless the Hertzian beams fell directly on the receiver there was an end of all communication.

"Do you think," I asked, "you will be able to send these directed messages very much farther than you have sent them already?"

"I am sure we shall," said Marconi. "It is simply a matter of experiment and gradual improvement, as was the case with the undirected waves. It is likely, however that a

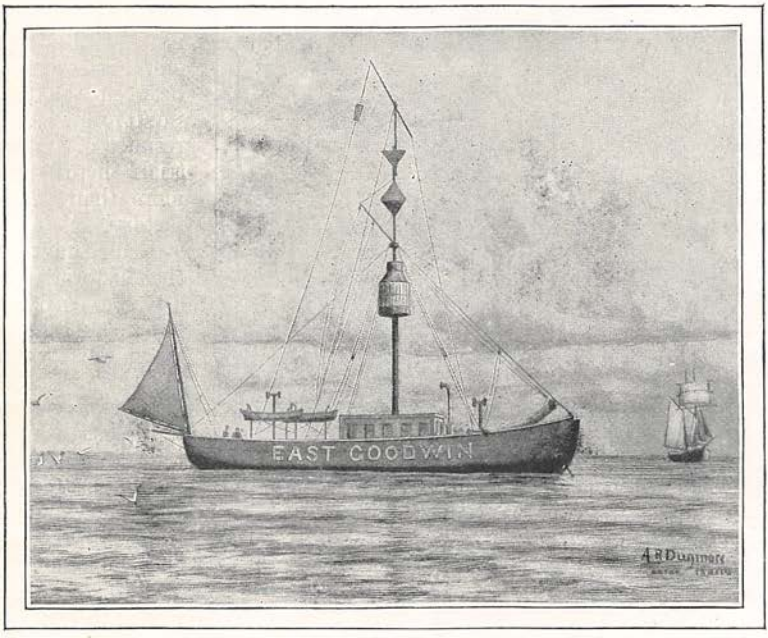
limit for directed messages will be set by the curvature of the earth. This stops the one kind, but not the other."

"And what will that limit be?"

"The same as for the heliograph, fifty or sixty miles."

"And for the undirected messages there is no limit?"

"Practically none. We can do a hundred miles already. That only requires a couple of high church steeples or office buildings. New York and Philadelphia, with their sky-scraping structures, might talk to each other through the ether whenever they wished to try it. And that is only a beginning. My system allows messages to be sent from one moving train to another moving train, or to a fixed point by the tracks; to be sent from one moving vessel to another moving vessel or to the shore, and from lighthouses or signal stations to vessels in fog or distress."



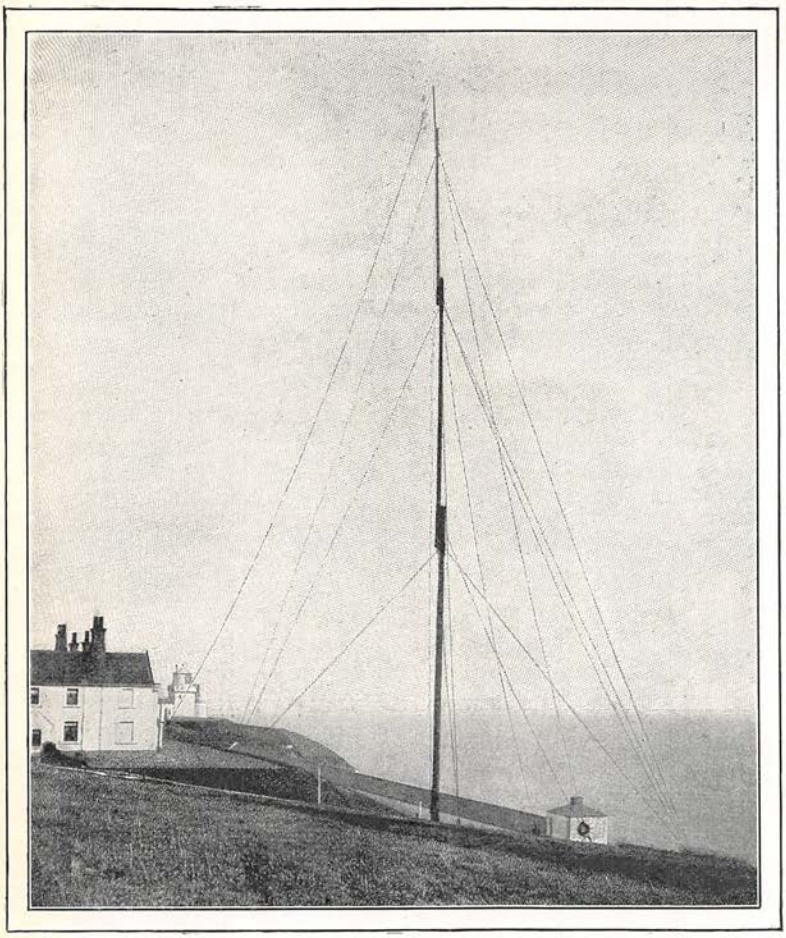
THE EAST GOODWIN LIGHTSHIP.

The Marconi apparatus is seen suspended from the spar at the masthead.

Marconi pointed out one notable case where his system of sending directed waves might render great service to humanity. Imagine a lighthouse or danger-spot in the sea fitted with a transmitter and parabolic reflector, the whole kept turning on an axis and constantly throwing forth impulses in the ether—a series of danger signals, one might call them. It is evident that any vessel fitted with a Marconi receiver would get warning through the ether (say by the automatic ringing of a bell) long before her look-out could see a light or hear any bell or fog-horn. Furthermore, as each receiver gives warning only when its rotating reflector is in one particular position —that is, facing the transmitter—it is evident that the precise location of the alarm station would at once become known to the mariner. In other words the vessel would immediately get her bearings, which is no small matter in a storm or fog.

Again, the case of lightships off shore gives the Marconi system admirable opportunity of replacing cables, which are very expensive and in constant danger of breaking. In December, 1898, the Trinity House Brethren authorised the establishment of wireless communication between the South Foreland lighthouse at Dover and the East Goodwin lightship twelve miles distant; and several times already warnings of wrecks and vessels in distress have reached shore when, but for the Marconi signals, nothing of the danger would have been known. One morning, for instance, in January, during a week of gales, Mr. Kemp, then stationed at the South Foreland lighthouse, was awakened at five o'clock by the receiver bell, and got word forthwith that a vessel was drifting on the deadly Goodwin Sands, firing rockets as she went. At this moment there was so dense a fog-bank between the sands and the shore that the rockets could never have been seen by the coastguards, who were now, however, informed of the crisis by telegraph and were able to put out at once in their lifeboats.

At another time, also in a heavy fog, a warning gun sounded from the lightship, and at once the receiver ticked off:—"Schooner headed for sands. Are trying to make her turn."



MAST AND STATION AT SOUTH FORELAND, NEAR DOVER, ENGLAND, USED BY MARCONI IN TELEGRAPHING WITHOUT WIRES ACROSS THE CHANNEL TO BOULOGNE, FRANCE.

From a photograph.

"Has she turned yet?" questioned Kemp.

"No," came the answer. "We've fired another gun."

"Has she turned yet?"

"Not yet. We're going to fire again. There! she turns."

And the danger was over without any call upon the lifeboat men, who might otherwise have laboured hours in the surf to save a vessel that needed no saving.

Another application of wireless telegraphy that promises to become important is in the signalling of incoming and outgoing vessels. With Marconi stations all along the coast it would be possible, even as the discovery stands to-day, for all vessels within twenty-five miles of shore to make their presence known and to send or receive communications. So apparent are the advantages of such a system, that in May, 1898, Lloyds began negotiations for the setting up of instruments at various of their stations; and a preliminary trial was made between Ballycastle and Rathlin Island in the north of Ireland. The distance signalled over here was seven and a half miles, with a high cliff intervening between the two positions. The results of many trials here were more than satisfactory.

I come now to that historic week at the end of March, 1899, when the system of wireless telegraphy was put to its most severe test in experiments across the English Channel between Dover and Boulogne.

These were undertaken by request of the French Government, which is considering a purchase of the rights to the invention in France. During several days that the trials lasted representatives of the Government visited both stations and observed in detail the operations of sending and receiving. Signor Marconi himself, with his chief engineer, Mr. Jameson Davis, explained how the installations had been set up and what they expected to accomplish.

At five o'clock on the afternoon of Monday, March 27th, everything being ready, Marconi pressed the sending key for the first cross-Channel message. There was nothing different in the transmission from the method grown familiar now through months at the Alum Bay and Poole stations. Transmitter and receiver were quite the same; a seven-strand copper wire well insulated, and hung

from the sprit of a mast 150 feet high, was used. The mast stood in the sand just at sea level, with no height of cliff or bank to give aid.

"Brripp — brripp — brripp — brripp — brrrrrr," went the transmitter under Marconi's hand, the sparks flashed, and a dozen eyes looked out anxiously upon the sea as it broke fiercely over Napoleon's old fort that rose abandoned in the foreground. Would the message carry all the way to England? Thirty-two miles seemed a long way!

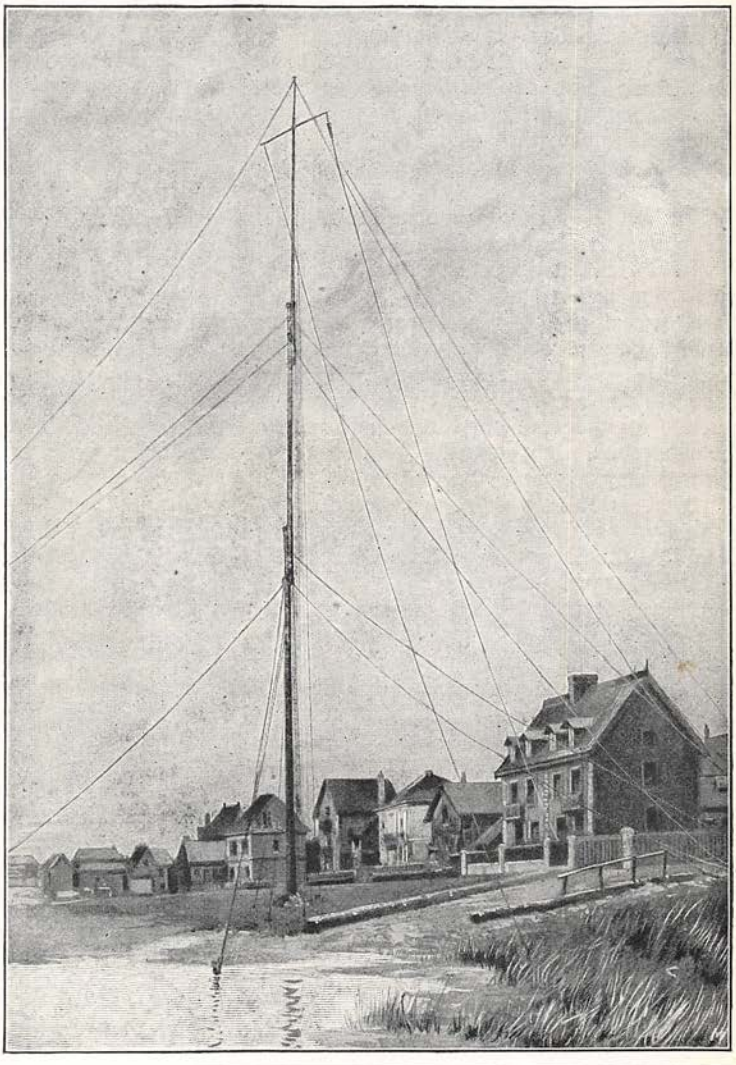
"Brripp — brripp — brrrrrr — brripp — brrrrrr — brripp — brripp."

So he went on deliberately, with a short message telling them over there that he was using a two-centimetre spark, and signing three V's at the end.

Then he stopped, and the room was silent with a straining of ears for some sound from the receiver. A moment's pause and then it came briskly, the usual clicking of dots and dashes as the tape rolled off its message. And there it was, short and commonplace enough, yet vastly important, since it was the first wireless message sent from England to the Continent: First V, the call; then M, meaning "Your message is perfect"; then "Same here": 2 c m s. V. V. V. —the last being an abbreviation for two centimetres and the conventional finishing signal.

And so, without more ado, the thing was done. The Frenchmen might stare and chatter as they pleased, here was something come into the world to stay there. A pronounced success, surely, and everybody said so as messages went back and forth, scores of messages during the following hours and days, and all correct.

I asked one of Marconi's chief engineers if the Boulogne and Dover installation would remain permanent now. He said that depended on the French and English Governments. The latter has a monopoly in England of any system of telegraphy in



THE MAST AND STATION AT BOULOGNE, FRANCE, USED BY MARCONI IN TELEGRAPHING WITHOUT WIRES ACROSS THE CHANNEL TO SOUTH FORELAND, ENGLAND.
Drawn from a photograph.

which electric apparatus is used, and all cross-Channel cables are of British ownership.

"There must be a great saving by the wireless system over cables, is there not?" I asked.

"Judge for yourself. Every mile of deep sea cable costs about £150; every mile for the land ends about £200. All that we save, also the great expense of keeping a cable steamer constantly in commission making repairs and laying new lengths. All we need is a couple of masts and a little wire. The wear and tear is practically nothing; the cost of running simply for home batteries and operators' keep."

"How fast can you transmit messages?"

"Just now at the rate of about fifteen words a minute, but we shall do better than that, no doubt, with experience. You have seen how clear our tape reads. Anyone who knows the Morse code will see that they are perfect."

"Do you think there is much field for the Marconi system in overland transmission?"

"In certain cases, yes. For instance, where you can't get the right of way to put up wires and poles. What is a disobliging farmer going to do if you send messages right through his farm, barns and all? Then see the advantage in time of war for quick communication, and no chance that the enemy may cut your wires."

"But they may read your messages."

"That is not so sure, for, besides the possibility of directing the waves with reflectors, Marconi is now engaged in most promising experiments in syntony, which I may describe as the electrical tuning of a particular transmitter to a particular receiver, so that the latter will respond to the former, and no other, while the former will influence the latter and no other. That, of course, is a possibility in the future, but it bids fair soon to be realised. There are even some who maintain that there may be produced as many separate sets of transmitters and receivers capable of working only together as there are separate sets of Yale locks and keys. In that event, any two private individuals might communicate freely without fear of being understood by others. There are possibilities here, granting a limitless number of distinct tunings for transmitter and receiver, that threaten our whole telephone system—I may add our whole newspaper system."

"Our newspaper system?"

"Certainly; the news might be ticked off tapes every hour right into the houses of all subscribers who had receiving instruments tuned to a certain transmitter at a news-distributing station. Then the subscribers would have merely to glance over their tapes to learn what was happening in the world."

We talked after this of other possibilities in wireless telegraphy, and of the services Marconi's invention may render in coming wars.

"If you care to stray a little into the realm of speculation," said the engineer, "there is no doubt our instruments could be made to operate a cable at sea-bottom, just as they could be made to blow up a powder magazine in a beleaguered city, or steer a ship from a distance, or——"

"Steer a ship from a distance?" I interrupted.

"Certainly; a small one—say a lightship—with no one aboard her."

"How could you steer her?"

"Oh, by a simple arrangement of commutators and relays. It isn't worth while going into the thing, but you could send one signal through the ether that would part her cables—say by an explosive tube or a simple fusing process. Then you could send another signal that would open her throttle valve and start her engines. Of course I'm assuming fires up and boilers full. Then you could send other signals that would put her helm to starboard or port, and so on. And straightway your lightship would go where you wanted her to. There may not seem to be much sense in steering an empty lightship about, but don't you see the vast usefulness in warfare of such control over certain other craft? Think a moment."

He smiled mysteriously while I thought.

"You mean torpedo craft?"

"Exactly. The warfare of the future will have startling things in it; perhaps the steering of torpedo craft from a distance will be counted in the number. But we may leave the details to those who will work them out."

And here, I think, we may leave the whole fascinating subject, in the hope that we have seen clearly what already is, and with a half-discernment what is yet to be.