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## “ WIRELESS ” TELEGRAPHY.

BY

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In this article the author gives a short account of his relations with Mr. Marconi, and indicates the progress which has been made in Ætheric Telegraphy. He points out the purposes for which it can best be applied, at the same time discussing its present value as a commercial system.—ED.



THE first preconceived signals forming an alphabet, and thereby rendering the instantaneous transmission of language possible, were sent across the sea from Dover to Calais by electric currents through a copper wire insulated by gutta-percha in 1851. The first practical cable was laid in 1852, and now, fifty years after, we have the world embraced and linked together by 200,000 miles of cable, nine-tenths of which have been laid by private enterprise and by British capital. The British Empire is connected up by a nerve system as complete as that in the frame of each human being. In the morning papers we may read at our own breakfast table the previous day's news from our most distant colonies, and from every part of the world. The laying of submarine cables has become such a matter of fact, and excites now so little surprise, that last year 15,000 miles of submarine cable were successfully laid from

England, *via* the Cape, to Australia without the fact being even chronicled in the daily Press! Compare this with the sensational paragraphs and the gratuitous advertisements so freely promulgated of the so-called “wireless telegraphy.” The first Atlantic cable, laid in 1858, was infinitely more wonderful in its conception and completion. Cyrus Field and the men who severally planted down their £1,000 per share to test a gigantic experiment deserve some historical record. They lost their money, but they solved a practical and commercial problem. Of these shares 106 were taken in London, 88 in the United States, 86 in Liverpool, 37 in Glasgow, and 33 in other parts of England—350 shares in all.

### A STEP NEARER INTER-PLANETARY COMMUNICATION.

On February 21st, 1894, two years before I met Mr. Marconi, I read a paper before the Society of Arts in London on “Electric Signalling Without Wires.” I concluded by saying, “It is something to be able to report that we have now acquired a practical system

of signalling across space without the necessity of using wires. Although this short paper is confined to a description of a simple practical system of communicating across terrestrial space, one cannot help speculating as to what may occur through planetary space. Strange mysterious sounds are heard on all long telephone lines when the earth is used as a return, especially in the calm stillness of night. Earth currents are found in telegraph circuits, and the Aurora Borealis lights up our northern sky when the sun's photosphere is disturbed by spots. The sun's surface must at such times be violently disturbed by electrical storms, and if oscillations are set up and radiated through space in sympathy with those required to affect telephones, it is not a wild dream to say that we may hear on this earth a thunderstorm in the sun. If any of the planets be populated with beings like ourselves, having the gift of language and the knowledge to adapt the great forces of Nature to their wants, then if they could oscillate immense stores of electrical energy to and fro in telegraphic order, it would be possible for us to hold commune by telephone with the people of Mars." On December 6th, 1900, paragraphs appeared in the Press with the startling announcement that Mars was signalling to the earth. Light appeared and vanished on the surface of that planet. But the signals could not be read; they were not consecutive or orderly. It is now believed that they were due to natural effects; indeed, to gigantic clouds floating in the atmosphere of the planet reflecting the light of the sun.

I must say something of the history of this fascinating subject.

#### "WIRELESS" TELEGRAPHY A MISNOMER.

The word "wireless" is an absolute misnomer. Wires are essential and imperative in some part of the plant. It is their position and direction that vary. Every telegraph of every kind requires a transmitter to generate electric disturbances, a medium for their transmission, and a receiver to translate them into comprehensible language. As a medium we may employ, as in ordinary electric telegraphs and telephones, *metallic conductors*, or *air*, or *water*, or the *ether*—the medium that fills all

space, whose existence and properties are so difficult to grasp, but which is as real as the walls of our houses. Hence we have a convenient classification:—

1. Metallic Telegraphy.
2. Pneumatic       "
3. Aquatic           "
4. Ætheric           "

Through metals and water the disturbances are transmitted as electric *currents*; through air and the ether as *waves*. In heliography the waves are light waves pure and simple. The transmitter is mechanical and the receiver is the human eye, the most sensitive and beautiful electric apparatus in nature. There is no electricity and therefore there are no wires. It is a real system of Wireless Telegraphy. In Ætheric Telegraphy, or, as the Germans call it, Spark Telegraphy (Funken Telegraphie), the waves are electric, but there is no difference except in size and frequency between them and the light waves formed by every twinkling star. Light waves measure from crest to crest somewhere about  $\frac{1}{1000000}$  of an inch, but electric waves have a length of from 1 ft. to 1 mile and more. Our great British physicist, Maxwell, established the similarity of electricity and light in 1864. A lighthouse indicates to the mariner its identity by preconcerted groups of light flashes; the heliograph conveys the soldier's despatch from the hill fort by groups of ætheric waves, called light, forming the alphabet; the commander of a fleet directs the movement of every ship by similar flashes of ætheric waves called electric. To comprehend ætheric telegraphy one must know something of waves of light.

#### EARLY EXPERIMENTS.

Morse, the inventor of the universal telegraphic alphabet that bears his name, showed in 1842, across the Susquehanna, that the water of broad rivers and channels could be made to form part of an electric circuit without submerging any wire in them. Lindsay did the same thing at Dundee across the Tay in 1854, and in the same year I assisted him in testing his plan in London.

The telephone was introduced in 1877, and it proved to be such a marvellous sensitive



*Photo by Histed, Baker Street.*

SIR WILLIAM HENRY PREECE, K.C.B., F.R.S.  
Late Engineer-in-Chief and Electrician to the British Post Office.  
(The Latest Portrait.)



apparatus, that it brought to our knowledge minute currents of electricity whose existence was known from Faraday's discoveries, but whose presence was not made evident by any apparatus then extant. In 1882 I succeeded by its aid in bridging the Solent on Lindsay's plan. It is to this day a common practice in India to maintain permanent telegraphic communication across rivers by similar means. Water is thus the medium completing the circuit. The wireless portion is a very small fraction of the whole conducting path or circuit. This circuit conveys *currents* of electricity and the underlying principle is that of *conduction*. In such a system the matter of the earth is an essential element.

#### THE DISCOVERY OF INDUCTION.

Faraday, in 1832, discovered the principle of *induction*. He showed when iron was magnetised, or demagnetised, that when currents were formed or ceased, even the movements of magnets or of currents, produced, by influence at a distance, other momentary currents of electricity of definite intensity and direction. The medium for the transmission of these effects is the ether. It was known that every telegraph wire, when conveying currents, disturbed every other telegraph wire in its neighbourhood, but the disturbances were not evident. The telephone, however, made their presence known. An old telegraphist in the Telephone Company's Exchange in London, early in 1884, was able to read telegrams being sent on the Post Office system. This led to an immediate investigation. The cause was discovered in Faradaic induction, and the remedy—the metallic circuit—was adopted. This led me at once to the conception of ætheric telegraphy by induction, and to a long and tedious investigation of the possible distance to which these effects were transmissible. Effects were detected between wires separated by a distance of forty miles, and distinct conversation was held by telephone through a distance of one-quarter of a mile. The subject was brought before the British Association on September 7th, 1886, in Birmingham, and has been discussed at frequent intervals ever since.

#### EARLY APPLICATION OF ÆTHERIC TELEGRAPHY.

In 1892 actual messages were transmitted 3½ miles across the British Channel, from Penarth to Flat Holm. In 1894 speech was transmitted across Loch Ness 1½ miles by telephone. In April, 1895, communication was maintained with the Island of Mull during the breakdown of the cable. The system has since been permanently established at several places and has proved itself to be, for short distances, a practical system of telegraphy.

In 1896 Mr. Marconi was introduced to me, and showed me another and better mode of doing the same thing. He had applied "Hertzian" electric waves and Branly's coherer, with which Principal Oliver Lodge had made us so thoroughly acquainted, to the purpose. The resources of the Post Office were placed at his disposal for experiment and trial. During a discussion upon a paper read at the British Association in Liverpool in September of that year upon Hertzian waves, I was able to announce their successful application to "Wireless Telegraphy" by Mr. Marconi on Salisbury Plain. This created quite a sensation—a sensation that has not yet subsided, for he has very recently, apparently, obtained similar effects by similar means across the Atlantic.

#### MR. MARCONI'S AMBITION.

Unfortunately, Mr. Marconi was captured by a financial syndicate, and his relations with the Post Office were severed. Nearly six years have elapsed, and yet the system has not yet reached the practical stage. It is still experimental. Mr. Marconi's ambition is evidently to conquer great distances. From Europe to America, and from America to South Africa has attractions for him greater than a good, sound practical system between Guernsey and Sark. It is not wanted across great oceans—it is wanted across narrow, rocky channels, and between tide-swept island homes. It is a remarkable thing to say that at the present there is not a single practical commercial circuit established on this system in the world! It was tried in Honolulu for commercial purposes, but was abandoned owing to its defects. Every nation has warmly taken up the development of the system, especially for their naval services. The British Post Office,

the Admiralty, and the War Department are busy experimenting, improving, and testing. Every ship of war is being fitted up, and every colony is watching eagerly for something practical. It was a failure in South Africa. Indeed, it does not work well over land. The sea is its home.

## THE SYSTEM IN GERMANY.

Germany, under the immediate auspices of the Emperor, has exhausted every effort to ensure success. Messrs. Slaby and d'Arco have developed a very promising system, which is fitted up on every German warship—forty in all. They seem nearer practical success in that commercial country than the Marconi Company is in England. It is now placed upon the market in Germany, and its services are guaranteed by the Allgemeine Elektrizitäts Gesellschaft. There are two systems, one like Marconi's based on the coherer and electric waves, the other based on Hughes' microphone receiver acting as a relay. The latter is said to be more sensitive than the former. The signals are dependent on the variation of current and not of potential. The following appeared in the *Times* recently from the pen of its Berlin correspondent: "The Emperor has published an order to the effect that the Slaby-Arco telegraphic system, the efficiency of which for military purposes has been demonstrated by exhaustive experiments, shall be exclusively employed, until further orders, on board all vessels of the Imperial Navy and in all coast signal stations. The *Post* points out that the Imperial order is of wider significance than is at first apparent, since the commercial marine will also of necessity adopt the system which has been rendered obligatory for the navy. The same journal states that thirty-two German ships of war already possess the necessary apparatus, and that the Hamburg-American line has at Dülmen, and the North German Lloyd at Bremerhaven, experimental stations with which telegrams have been exchanged at a distance of 150 kilometres. In engineering circles it is stated that the German Government is preparing a law regarding wireless telegraphy, the object of which is to protect German engineers. The erection of stations after the Marconi system,

it is declared, will not be authorised on the German coasts. Mr. Marconi is endeavouring to establish a world monopoly, and the attempt must be frustrated, a task which will present the less difficulty, inasmuch as experts are fully agreed that the Slaby-Arco system is in all respects equal to that of Marconi."

## EFFECT OF EXTRANEEOUS DISTURBANCES.

Etheric telegraphy has by no means reached its practical stage yet. It is full of troubles—troubles due to foreign disturbances, to imperfect apparatus, and to want of experience.

The principal source of foreign disturbance is atmospheric electricity and lightning, which set up in the æther electric waves precisely similar in character to those which are being used. In fact, not only is the same kind of apparatus used as a thunderstorm recorder, but when atmospheric electricity is about, letters of the alphabet are received, especially *c*, *i*, and *s*. These currents also break up the conventional signals of the Morse alphabet into an undecipherable language. On many stations in foreign parts the present system installed on our men-of-war becomes absolutely unworkable for several hours during the day, and during last autumn's naval manœuvres each night for three nights in succession the system was unworkable.

How far tuned systems are clear of these disturbances remains to be seen. With a properly fitted up oscillator a train of waves may be sent out by the transmitter, which may act on the receiver only when it is in tune. A train of such waves may be accumulative in its effects. If so, a single impulse would not affect the coherer.

There are terrestrial as well as solar effects which produce disturbing elements in the æther. The extraneous sounds that are occasionally heard in the telephone during the stillness of the night are remarkable. They have been mistaken for the screech of sea fowl and the cry of a baby. Loud whistles, sharp pistol shots, are frequent. These are due to stray waves which are at present fatal to reliable ætheric telegraphy. It is hoped to render them harmless by syntonising or tuning, but no known system of tuning will prevent the sudden inrush



of the front of a practically instantaneous intense wave set up by a lightning flash.

#### SYNTONY AS A REMEDY

The disturbances caused by neighbouring ships upon each other is perhaps remediable by syntonising, but no real practical system of tuning is yet general. The eye is an electric organ tuned to one series of ætheric waves and blind to all others. We can even tune the eye to receive only one colour. The ear hears all air vibrations between 32 and 5,000 per second and is deaf to all others, and it can also be tuned to hear one note. Similarly, each ship can be tuned to one series or note of electric waves and be quite oblivious to all others. This will render tapping difficult, but it will not remove the much more serious defect of distorted signals. It would have more serious inconveniences with fleets and with signalling stations. There may be some advantage in tuning a private circuit, but syntonity would be useless if a vessel in distress wished to communicate with another ship provided with a differently tuned system, and signalling stations would be paralysed if every nation or every shipping company had its own tune.

#### TO PREVENT A MONOPOLY.

I read in a technical paper that—

It is stated semi-officially that the Imperial authorities at Berlin are considering a proposal for inviting Great Britain, France, and the United States to send representatives to a congress to be held with the object of arriving at an international agreement which will prevent any monopoly in wireless telegraphy on the high seas. The matter is already receiving attention at the hands of the United States Administration at Washington, and the chief of the Army Telegraph Bureau has been appointed to investigate the proposal and report on its advisability. The incentive for Germany's action in this matter is said to be found in the fact that when the *Deutschland*, with Prince Henry on board, was on her way out from New York, she sent a message to the *Nautucket* lightship (Marconi station) from the Prince for the German Emperor. The Marconi operators, however, refused to accept the message because it was transmitted to them by a Staby-Arco apparatus.

#### TAPPING.

Tapping is quite common, but it will probably be diminished with practice and experience. A foreign ship communicating with a consort so affected the electric light circuit of a British

ship 800 yards away that every signal could be read by the blinking of the light on one particular electric lamp. This is a puzzle, but it is a fact, and it shows the wide-spread disturbing influence of these ætheric waves. I read in a daily paper:—

The arrival in Tunis of the French flagship *St. Louis* and the destroyer *Dunois* has resulted in the discovery of a private wireless telegraphic apparatus belonging to a resident. The two ships endeavoured to communicate with the shore authorities, but their messages were intercepted by the instruments of the gentleman in question, who subsequently made himself known, and declared he had fitted up the apparatus with the object of attempting to surmise the messages exchanged between foreign men-of-war, and particularly the British.

On the other hand, the Cunarder *Unbria*, which was following the *Philadelphia* across the ocean at only a day's steaming, was so tuned that she did not receive any of the signals which were flashing over her.

The very powerful induction coils that produce the sparks needed, disturb not only the receiver, but the magnetic compasses of the ship, and even the chronometers. This has to be very carefully watched and guarded against by keeping the apparatus as far away as possible, and by screening.

#### CABLE v. ÆTHERIC TELEGRAPHY.

Whatever ætheric telegraphy may be in the future, it is not at present a practical, reliable, and commercial system. The scientific facts of ætheric telegraphy are quite triumphant, but up to the present its practical results are poor in the extreme. The sensational and really wonderful results across the Atlantic have had an absurd influence on cable stocks in the Money Market. Shareholders, especially of the feminine gender, have been panic-stricken, and have transferred their depressed property to wiser pockets. The value of the submarine cable system has not been shaken one iota. The Atlantic ocean is bridged by fourteen cables always available and rarely disturbed. Each works at a speed far exceeding anything obtainable on an ætheric circuit. Fifteen ordinary words a minute is a high rate of working on such a circuit for short distances, say up to fifty miles, twelve words is about the rate in Germany, but I do not anticipate in practice a normal rate of more than ten words a minute.

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### MARCONI SIGNALS NOT ENCOURAGING FOR ACCURACY

The speed of working is limited by the number of sparks that can be passed per second, and the greater the quantity of energy in the spark the fewer that can be passed in the same time. Moreover, sparks are very capricious things and require much humoring. The signals received by Mr. Marconi are not encouraging for accuracy. Cable messages average nine words each, of which three are service words and six are paid for. They are code words which are very unsuitable for ætheric telegraphy just now. With repetitions, corrections and fatigue, it is impossible to calculate upon getting more words through a cable than 50 per cent. of the maximum carrying capacity of that cable. What percentage will an ætheric circuit carry?

*Wireless telephony* has received very little attention, for it is confined to short distances. I read a paper on the subject at the British Association meeting in Bradford on September 10th, 1900. Communication was established with the lighthouse at the Skerries and Cemlyn in Anglesey and continues.

No one for one moment can, or ever has, doubted that ætheric telegraphy is invaluable for nautical purposes. The demonstrations which the English and German experimenters have been allowed to carry out on the great Atlantic liners, have placed this beyond cavil. It tends to render the navigation of the great deep safer, it places ships in communication with each other when in danger or distress, it prevents collision in fog or at night, it allays the anxiety of the passenger, and it gives confidence to the sailor.

The awakening of the Press to the wonders of scientific progress has spread a sensation throughout the land. Calm judgment has been shaken. It is wise that we should reflect. There have been greater wonders in the past which were not received with the same fervour. The telegraph, submarine cable, the telephone, the phonograph, photography, &c., did not shake men's faith as this "Wireless Telegraphy" has, nor cause the memory of previous successes and previous sensations to be so soon forgotten. The Press of 1892 was quite as wild over the Post Office success to the Island of Mull as it is now over Marconi's triumph across the Atlantic.

