TREES AS ANTENNÆ IN WIRELESS TELEGRAPHY.

BY A. FREDERICK COLLINS.

The antennæ utilized in picking up waves emitted by a distant wireless telegraph radiator have been the subject of much investigation since the early experiments of Popoff and Marconi, and as a result the laws relating to the forces set up in a vertical receiving wire by electric waves, the fronts of which impinge upon it, are now fairly well understood.

The junction of the earthed terminal of the radiating and receiving aerial wires are not, however, as amenable to mathematical formulæ, but actual practice has shown that assuming any one of the several theories to be correct, a good ground is very essential in the elimination of obstacles that produce interference.

Some exceedingly vital experiments have recently been conducted along these lines by George O. Squire, Ph.D., Major Signal Corps, U. S. A., who has carefully observed and noted the absorption of electromagnetic waves by living vegetable organisms; and in these tests some valuable data is adduced, which shows that trees may be made to serve the useful purpose of an impromptu but good ground in field operations.

In the preliminary statement made by Dr. Squire, it is pointed out that the value of a good earth in wireless telegraphy cannot be overestimated; and he cites the fact that Fessenden and Stone have patented devices enabling ideal conditions to be more nearly satisfied. In the specifications of the former's patent there is embodied the following observations, namely, that he (Fessenden) has found it essential for the proper sending and reception of these waves that the surface over which they travel should be highly conducting, more especially in the neighborhood of the point where the waves are generated.

Fessenden ascertained, moreover, that this highly-conducting portion of the surface of the earth should extend to at least a distance from the origin of the waves to one-fourth of the length of the waves in air, and in the direction toward the station to which it is desired to send the waves. In order to accomplish this, a wire is connected to one side of the spark gap, and this is led over buildings, trees, and other intervening objects beyond the limits of obstruction when the wire is earthed. The inventor terms this arrangement a "wave chute."

John Stone Stone advocates a little different method to increase the effective radiation of the electromagnetic waves, and this, he explains, consists in artificially increasing the natural conductivity of the earth or other media in the immediate vicinity of the base of the transmitting aerial wire, and maintaining said surface in a constantly-connecting state. To bring about this result, it is only necessary to lay a wire netting having a large mesh on the surface of the ground, so that it completely surrounds the aerial wire with which it is connected; and the designer states that the netting should have a radius at least equal to one-quarter of a wave length.

In neither the patents of Fessenden nor Stone is there any mention of the application of the above schemes to the receiving aerial or antenna, or that these arrangements would facilitate the reception of electric waves; but the point that both these specialists make is the desirability of providing artificial earths for the radiating aerials. From Major Squire's researches it at once becomes evident that a good ground is just as important at the receiving end as at the transmitting station; again, it is pointed out that the necessity to insulate thoroughly the earthed terminal of the spark gap or wave detector, as the case may be, from the vertical aerial wire, so that there may be no leakage of the high-frequency oscillations set up, must not be ignored.

Under the conditions imposed in temporary field operations, as in military maneuvers, it is not always feasible, especially in dry countries, to obtain a good ground, i. e., a constantly moist earth; and these facts as observed above, together with the difficulties just cited, led Major Squire to consider the possibility of resorting to the use of growing trees or other vegetation as a quick and ready solution for the problem.

The data upon which these deductions were based, and which afterward resulted so successfully when the experiments were made, began with an early observation of Alexander Graham Bell, who in 1877 carried on with Frederick A. Gower, in London, a remarkable series of tests with the former's newly-discovered telephone. The inventor and his friend took a couple of telephones and an insulated wire about 100 feet in length into a garden, and were enabled to carry on conversation with the greatest ease when they held in their hands what should have been the earth wire, so that the connection with the ground was formed at either end through their bodies, their feet being clothed with cotton socks and leather boots.

The day was fine, and the grass upon which they stood was seemingly perfectly dry. Mr. Gower made earth connection at his end of the line by standing upon a grass plot, while at the other end of the line Mr. Bell stood upon a board; and when the former sang into the telephone, to the latter it was distinctly audible. Upon examining his feet, Mr. Bell found that a single blade of grass was bent over the edge of the board, and that his foot touched it.

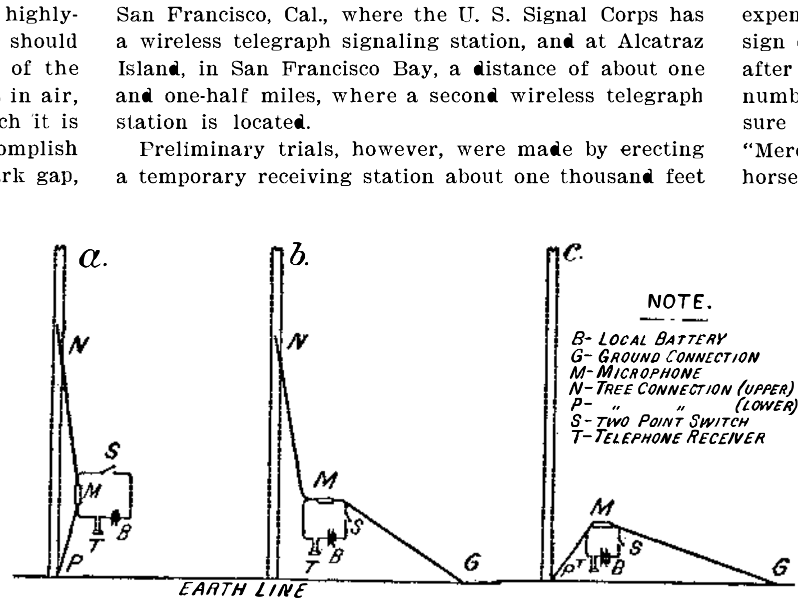
The practical application of this pretty little experiment was made by Lieut. William M. Goodall, of the United States Signal Corps, who found that he could obtain a much better ground, when laying rapid telephone lines in a wooded country, by merely driving an iron nail into the trunk of a tree or shrub than by the ordinary and more laborious method of burying a conducting plate of metal in the earth itself.

This singular fact was afterward communicated to Major Squire by General Arthur McArthur; and later, when the military maneuvers of the Department of California at Camp Atascadero, Cal., were held last August, the doctor was enabled to try out the efficiency of this simple method of grounding wireless telegraph aerials in places where it would have been impossible to have grounded the circuit in the ordinary way.

In these tests it was found that the conductivity of a growing tree in a healthy condition for circuits used in telephony with wires was sufficiently good, so that a nail driven in the tree at a height of thirty feet served the purpose nearly as well as though driven in at the root. Not only this; but it was also demonstrated that articulate speech could be transmitted and received from one tree top to another when the trunks of both trees were employed to complete the circuit.

The utilization of growing trees as antennæ for the reception of wireless telegraph messages logically followed the experiments taking place at Fort Mason, San Francisco, Cal., where the U. S. Signal Corps has a wireless telegraph signaling station, and at Alcatraz Island, in San Francisco Bay, a distance of about one and one-half miles, where a second wireless telegraph station is located.

Preliminary trials, however, were made by erecting a temporary receiving station about one thousand feet from the regulation transmitting station at Fort Mason. It was thought best to ascertain what effects, if any, the impinging waves would have at short range before longer ones were attempted. The transmitting apparatus at the regular station consisted of a small induction coil having a maximum spark length of four inches and a radiator system having its aerial wire suspended from a 75-foot mast, which was located on a bluff about 80 feet above the sea level. The receiver included an auto-coherer, made by filling a pocket, formed between two conductor plugs sliding in a small ebonite tube, with carbon granules such as are used in telephone transmitters.



PRINCIPLE OF MAJOR SQUIRE'S SYSTEM.

To this microphone detector there were connected in series three dry cells and a pair of head telephone receivers. The method of connecting the local battery circuit with the external or oscillator circuit is shown in the diagram, as well as the different connections used in elevating and earthing the receiving wires. The first test made by Major Squire is indicated graphically at *a*. Now, instead of grounding the earth wire, as is usual in wireless telegraph practice, a nail was driven in the tree a couple of inches above the earth line, at the point marked *P*, the electrical contact being only made with the tree itself.

The terminal, *P*, remained stationary, but the wire *N*, serving as the opposite terminal, was moved up and down the tree; while these tests were in progress, the transmitter was sending out waves approximately 300 feet in length; when the terminals, *P* and *N*, were separated three or four feet, the signal letter could be feebly heard, the volume of sound increasing as the distance between *P* and *N* increased, until *N* reached a point where the first branches of the tree began to diverge. That electrical oscillations were set up in the tree itself, and not in the wire, was proven conclusively by using a lead-covered insulated wire leading from the detector to *N* and *P* (see *a* and *b*), this providing an effective barrier to the electric waves, since they could not by any possible means set up oscillations in the inner wire. To further demonstrate the efficacy of the tree as an antenna, screens of wire netting having a fine mesh were used; and not only was the receiver entirely covered, but the wire *N* as well; this protection, however, did not in any way alter the nature of the indicators.

Dr. Slaby has shown that a vertical wire earthed at its lower extremity, if it is one-fourth the length of the received wave, has its potential node and current wave crest at a point where the wire makes contact with the earth; and hence Major Squire regarded a growing tree as a cylindrical antenna, and so earthed one terminal of his detector at the root of the tree, which would, in accordance with the above theory, have its potential node at or near the intersection of the earth line.

The arrangement adopted then took on the form shown at *c*, the opposite terminal being connected to the ground at *G*, at a distance from *P* approximating one-fourth the length of the wave to be received. This method of connecting in the receiving device is at once the simplest in the art, and must prove of great value in the operation of portable wireless telegraph systems.

The Mediterranean Cup for Motor Launches.

The motor boat race from Algiers to Toulon across the Mediterranean will be one of the leading events of the year. The race is organized by the Matin, one of the principal journals of Paris, and is known as the Mediterranean Cup. It is a challenge cup, like the Gordon Bennett for motor cars, and will remain in the hands of the winner until he is beaten. M. Charley, one of the leading spirits in automobile and sporting affairs and representative of the Mercedes Company at Paris, endowed the Cup with the sum of $2,000, so as to engage the competitors to undergo the expense which is necessary for the event. The design of the Cup is to be given to the successful artist after a concourse which is to be held shortly. The number of entries for the race is now sufficient to assure its success. Among these may be mentioned the "Mercedes" racer 60 feet long, equipped with a 200-horse-power motor, belonging to M. Mercedes-Jellineck, and a second "Mercedes C. P." of 100-horse-power and 50 feet length, owned by M. Charley. These two boats are now in construction at Paris. M. Perignon is building a new racer of high power, which will have a De Dietrich motor. The latter is constructed by the well-known automobile firm. Mr. S. F. Edge will enter the race with the boat which he is now having built at Yarrow. Messrs. Dutheil, Chalmers & Co. have two cruisers under way for the Algiers-Toulon race. They are now trying three motors which will use heavy kerosene oil. Two of the motors will be placed on the same boat, and each motor will drive a separate screw. The Duke of Decazes is having a new launch built at Cannes. It will be known as the "Quand-Méme," and is a rapid cruiser of 75-foot length, carrying a Baudoin motor. Doranlo & Co., of Geneva, will enter the "Albatros," which measures 50 feet long with a 16-inch draft. Among others may be mentioned M. P. Courtot, the Ostend (Belgium) constructor with the "Cosmos," carrying a 200-horse-power motor, and Marcel Hamand with the torpedo launch "Patrie," measuring 78 feet. It is now building at Nantes.

The Largest Diamond in the World.

News comes from Johannesburg that the largest diamond ever found has been taken out of the Premier mine. It weighs 3,032 carats in the rough. A few years ago a large black diamond was found in Brazil, which was somewhat larger. This gem was of no ornamental use, however, and was eventually cut up and used in making diamond drills. Except for this, the gem just found is three times larger than any hitherto discovered. The stone weighs about a pound and a half. In cutting it from forty per cent to sixty per cent will be lost. The stone's value will depend, of course, upon its quality and shape.

Approximately, the new stone weighs about 621.56 grammes, or about a pound and a half avoirdupois. The last diamond of any note found in recent years was the "Syndicate," dug up in the De Beers mines. It weighed, uncut, 960 carats.

Here is a list of a few famous diamonds:

	Carats (rough)	Carats (cut)	Diameter	Discovered	Purchaser	Value
New Gem	3,032	....	4 inch	1905	....	$4,000,000
Syndicate	960		....	1900	Tiffany	......
Kohinoor	790	102	....	1804	Queen Victoria	600,000
Sanay	....	53	....	1477	Charles the Bold.	70,000
Hope	112	44	1 inch	1668	Louis XIV	350,000
Brazil	900	130	3 inch	1680	Court of Portugal	2,000,000
Star of the South	254	83	....	1858	Paris	450,000
Nizan of Hyderabad	431	279	....	1760	Paris	1,500,000
Orloff	....	194	...	1776	Catherine II	......
Moon of Mountains	....	....	....	1770	Russia	50,000
Pitt	....	186	....	17—	Louvre	......
Victoria	....	180	....	1740	Nizan	..
Ernestine	221	110	....	1900	America	40,000

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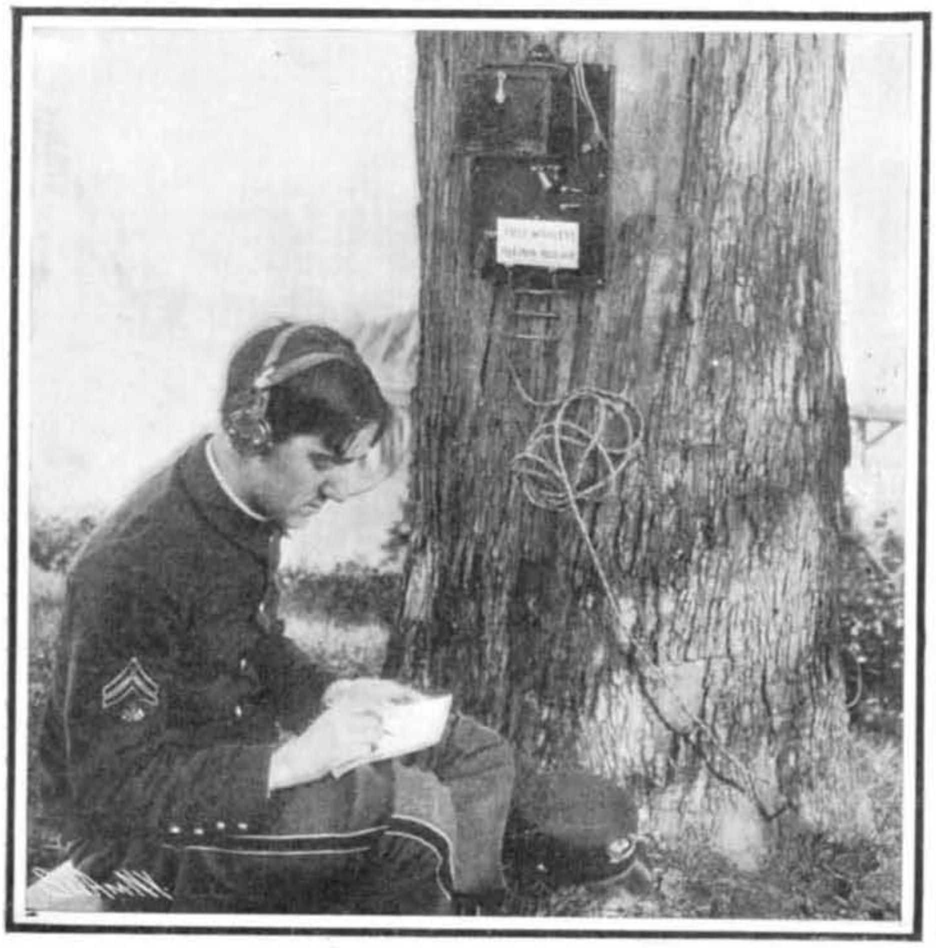

Receiving Wireless Messages at Fort Mason, California, From Yerba Buena Naval Station. Eucalyptus Tree as Antenna.

Temporary Automobile Wireless Transmitting Station Used in Major Squire's Experiments.

Temporary Field Automobile Wireless Telegraph Car Used by the United States Army.

MAJOR SQUIRE'S METHOD OF USING TREES AS ANTENNÆ IN WIRELESS TELEGRAPHY.—[See page 123.]