The Prehistory of Radio

Radio

E. E. BUCHER, in *The Radio Industry* (Shaw):

Numerous experiments were made in the United States and abroad in the period of 1837 to 1882 in transmitting telegraph signals between two points without intervening wires, and with some degree of success. In all these tests, however, Faraday's principle of electromagnetic induction was utilized, not the electromagnetic waves, predicted by Maxwell, experimentally confirmed by Hertz, and now employed in radio telegraphy and telephony. It has been found impossible to transmit signals over any but very short distances by induction.

In connection with these induction experiments. Professor Morse (the inventor of the wire telegraph) in 1842 and Dr. O'Shaughnessey in 1849 succeeded in passing intelligible signals without metallic conductors across rivers. In 1872 Professor Highton made various experiments across the Thames River using the method employed by Morse in 1842. Professor Trowbridge did similar work in the year 1880. In 1882 Professor Dolbear of Harvard University was awarded a patent for communicating between two points without wires, utilizing the principle of induction.

One of the odd sidelights in the series of scientific disclosure leading to radio was that made by Professor Hughes in 1879, who determined that the discharge of a Leyden jar or condenser would cause loosely associated metal filings in the vicinity of the discharge to cling together, or "cohere." It is reported that Hughes set up equipment whereby the "cohering" phenomenon could be detected at a distance of 500 yards. In 1866 S. A. Varley made similar observations. This disclosure was of considerable importance to the success of Marconi's early experiments.

An outstanding series of experiments in connection with electromagnetic waves were conducted by Professor Heinrich Hertz of Karlsrühe and Bonn universities (Germany) in 1886, when he confirmed Maxwell's mathematical predictions concerning such waves. Hertz produced and detected electromagnetic waves; he showed that they were capable of reflection from metallic surfaces; that they were transmitted freely through insulators; that they could be refracted by prisms; and he measured their actual length. He pointed out that the shorter the electric waves the more analogous were its properties to those of light. Sir Oliver Lodge performed somewhat similar experiments prior to the work of Hertz, but it remained for Hertz to complete the experimental proof of electromagnetic wave phenomena.

Hertz's apparatus for producing and detecting electro-magnetic waves was, in the light of modern practice, rather crude and not adapted to the transmission of signals over great distances. However, he proved that the phenomena which he was able to make manifest at a distance were not those of magnetic induction, but actually an effect of electric wave propagation. Hertz took the induction coil of Faraday and Ruhmkorff and used it to charge two metallic plates which were separated by two small metallic spheres called a spark gap. When the induction coil was energized, a discharge manifested itself at the spark gap, and the radiating system composed of the metallic plates was traversed by alternating currents of very high frequency. This caused the system to become a radiator of electromagnetic waves. Hertz then detected the existence of the waves so radiated by a circular loop of wire which contained a small spark gap and which was held at a distance. If the loop was placed in the plane of the radiated waves, a feeble spark manifested itself in the little gap in the loop of wire. If placed at right angles to the plane of the advancing wave, no spark would result. Then by the use of metallic reflectors, prisms, and the like, he verified all the electric wave phenomena recited above.

The observations of Hughes and Varley, namely, that metallic filings in loose condition would cohere when placed under the influence of an electric discharge, were rediscovered by Professor E. Branly, of the Catholic University of Paris, in 1890. He placed these metallic filings in a glass tube between two metallic plugs and then made this tube a part of an electrical circuit which contained a battery. He observed that electric discharges in the neighborhood of the tube would cause the filings to cohere, decrease their resistance, and start a flow of current from a local battery.

Thus, from 1888 to 1892 we find that scientific investigators in the laboratories of Europe and in America, stimulated by the work of Hertz and his predecessors, were conducting experiments with devices for producing and detecting electromagnetic waves. Several of these investigators had witnessed enough to enable them to predict that the dawn of a successful system for communicating through space by electric waves was just over the horizon.

One of the most remarkable predictions in that respect was made by Sir William Crookes in the London *Fortnightly Review* in 1892, from which we quote in part as follows:

"Here is unfolded to us a new and astonishing world, one which it is hard to conceive should contain no possibilities of transmitting and receiving intelligence.

"Rays of lights will not pierce through a wall, nor, as we know only too well, through a London fog. But the electrical vibrations of a yard or more in wave length . . . will easily pierce such mediums, which to them will be transparent. Here, then, is revealed the bewildering possibility of telegraphy without wires, posts, cables or any of our present costly appliances. Granted a few reasonable postulates, the whole thing comes well within the realms of possible fulfillment. At the present time, experimentalists are able to generate electrical waves of any desired wave length from a few feet upwards, and to keep up a succession of such waves radiating into space in all directions.

"This is no mere dream of a visionary philosopher. All the requisites needed to bring it within the grasp of daily life are well within the possibilities of discovery, and are so seasonable and so clearly in the path of researches which are now being actively prosecuted in every capital of Europe that we may any day expect to hear that they have emerged from the realms of speculation into those of sober fact."

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To provide landing facilities for the dirigibles which are being built in England, mooring-masts are being erected in Egypt, Australia, India and South America.

Wool growers of Ohio, Pennsylvania, and West Virginia are attempting to determine how much it actually costs to produce a pound of wool.