The Romance of Radio

FOR those who have watched the progress of radio communication from its beginnings, he said, it was possible to pick out with some exactitude the inventions and discoveries which have helped towards the success already attained.

The Beginning of Wireless.

IN attempting to do this for long-distance radio-telegraphy as it is applied in the Empire scheme and, possibly, a few other similar systems, it is desirable to limit oneself strictly to the inventions and discoveries that are essential to the work of the most modern stations, and to ignore inventions that are not now being employed at all, however important they seemed in their day.

All wireless telegraphy is based upon the discovery made by Hertz, in 1888, of how to generate electric waves and detect their arrival at a distance. Crookes, in a famous article in "The Fortnightly Review," of 1892, dreamt eloquently of their possibilities. Oliver Lodge, in 1894, demonstrated at the British Association meeting at Oxford the first wireless telegraphic apparatus—a Hertzian oscillator for making electric waves, a coherer for receiving them at a distance of 100 yards, together with a Morse key and a relay for handling the dots and dashes. None of this apparatus was patented.

But in 1896 Marconi filed patents for wireless transmission, and for reception in 1897. Before Marconi's patents were published, Lodge filed another patent embodying certain fundamental elements that survive in all the wireless stations of to-day.

Early Patents.

Marconi's patents, among other things, showed that only one half of the Hertz aerial, if arranged vertically, need be employed, the other half being supplied by an electrical reflection in the surface of the earth.

Lodge's patent included, among other things, the introduction of tuning coils into transmitting and receiving antennae, and the use of high-frequency transformers—thus bringing the idea of "tuned" wireless telegraphy into the world.

Before the publication of Lodge's patent, no one talked of adjusting the wave-length of his transmitter by means of inductance coils, or of tuning his receiver to a distant transmitter—though nowadays every listener turns his knobs almost automatically.

This great work of Lodge's, written down in excellent scientific form, at a time when every other mind was dark upon the matter, led up to the next important patent, three yeares later, namely, Marconi's famous "four sevens" patent, dated 1900, in which the secondary circuits of both transmitter and receiver were all tuned to the working wave-length.

History holds few more interesting stories than that of the growth of wireless communication. Within fifty years the singular discovery of Hertz has been developed into a mighty force which is moulding a new era in communication. Where it will lead we can only surmise.

In the course of a lecture recently given to the H.M. Patent Office, Dr. W. H. Eccles, F.R.S., dealt with the development of wireless from the point of view of its dependence upon discovery and invention. The accompanying is his almost romantic story.

The Famous Atlantic Test.

ALL these patents, though probably limited in the strict sense to spark telegraphy,, passed some of their usefulness on to the continuous-wave era in which we live, and may, therefore, be included in our list of those contributing to the success of present-day long-distance radio-telegraphy.

The next step was unpatentable. Marconi proved in 1901 that wireless signals from Cornwall could travel one-sixth of the earth's circle in strength sufficient to be received in Newfoundland. This discovery made the possibility of spanning the Empire seem practicable. But many major and minor inventions were to be made before long-distance radio-telegraphy could be called commercially successful.

First came Poulsen's invention of the high-frequency arc, which made continuous-wave telegraphy, the ideal method, possible—at any rate, in moderate power. It was followed by the invention of a number of types of high-frequency alternators, some of which, even to-day, work side by side in great wireless stations with the Poulsen arc they were born to rival.

The Three-Electrode Valve.

THE next step to be considered relates to the wonderful method of reception known as the heterodyne, which was due originally to Fessenden in 1907 but was subsequently improved by Lee and Hogan in 1913. Heterodyne reception is employed in one form or another in every modern long-distance station in the world, being literally indispensable in telegraphy.

Fassenden's conception of the heterodyne method of reception came to fruition very slowly, as time is reckoned in wireless circles, and, curiously enough, another great invention, one of vast importance, was at the same time lying similarly unhatched in the Patent Office. This was de Forest's invention of the triode—the three-electrode valve—filed in 1908.

It is hardly necessary to point out that the bulk of ordinary commercial radio-telegraphy, all broadcasting transmissions, and most broadcasting reception, is accomplished by means of the triode. The sales in this country alone must have run into millions since 1913, the date when its merits came to be recognised. And after 22 years, though improved and elaborated forms of electron control have been devised, and tried, the three-electrode valve remains paramount.

A Valuable "Gift."

IN 1912, the inventor endeavoured to find business men in London willing to help him in exploiting the invention. A number of large and small firms were approached, but none of them seemed to realise the value of the new valve. In fact, de Forest himself in 1912 failed to pay the first renewal fee, and the patent lapsed. It thus became the property of the British public—surely one of the most valuable gifts in the annals of the Patent Office.

Further Developments.

DE FOREST'S triode valve as used for transmission operates as a generator and amplifier of high-frequency currents of great power. In the receiving sets it appears as an amplifier and detector of the exceedingly feeble electrical oscillations picked up by the receiving antenna. But it is employed in these various manners by aid of circuits not foreshadowed in De Forest's original patent specification—circuits that were devised, at any rate in Europe, by other experimenters. Let us consider, first, certain transmitting circuits, and, later, some receiving circuits, based upon the use of the triode valve.

The earliest European patent for a valve transmitter is that of Arco and Meissner, two Telefunken engineers, who filed their application in Germany in April, 1913, and in this country in January, 1914. The British patent describes, among other things, the adaptation of the principle of "back-coupling."

The principle of back coupling consists merely in taking from the high-power side of the amplifier a small fraction of its power and passing it back to the low-power side to be magnified again, with the result that once the apparatus starts oscillating it goes on doing so automatically and can deliver power to a radiating aerial.

In modern receiving stations the triode valve may appear in several capacities. First, it may be used, as originally described by De Forest, as a simultaneous detector and amplifier of faint signals; or it may be used as a mere amplifier for either low-frequency or high-frequency, as was shown by various experimenters in 1912 and 1913. Or,, again, it may be used for heterodyne reception, in which case it is arranged to produce local oscillations of feeble power for mixing with the received signals in the manner already described.

Crystal Control.

ANOTHER invention of wide application is that which utilises the triode for the mutual sustaining and linking together of electrical and mechanical oscillations. It is usually carried out at lower frequencies by aid of a tuning-fork, and at higher frequencies with the help of a slice of quartz crystal. In either case, the natural