This is the text of a broadcast given recently from YA and YZ stations of the NZBS by W. L. HARRISON, Chief Engineer of the NZBS

passed through them, and the crystal detector, which was a small piece of mineral—often galena or iron pyrites—which a fine wire touched lightly. This wire rather strangely was called the "cat-whisker," probably facetiously, but the name stuck permanently even though the wire didn't, as some early listeners who struggled with these things will well remember.

It was in those early days that Professor J. A. Fleming, who was closely interested in the new science of wireless telegraphy, was searching for a better means of detecting electro-magnetic or wireless waves. Professor Fleming was Professor of Electrical Engineering in the University of London, and was scientific adviser to the Marconi Wireless Telegraph Company.

Some years earlier in association with Thomas Edison and the Edison Electric Light Company of London he had carried out some experiments on the passage of electric currents through rarefied gases in evacuated glass bulbs. He had noticed that if two electrodes were separated in a partial vacuum and one of them, such as a carbon filament, was heated, a current could be made to flow across the space between the electrodes in one direction but not in the other. Fleming remembered this interesting phenomenon and decided to give it a trial for the detection of radio waves. He took one of his old experimental bulbs from his junk box and connected it up to receiver circuit using a galvanometer as an indicator. At the other side of the room he pressed the key of his small spark transmitter and the galvanometer needle immediately deflected—the experiment worked magnificently.

And so the first thermionic valve in its application to wireless communication was born. Fleming took out a patent on this form of detector on November 16, 1904—just 50 years ago. What a vast field of scientific application this has opened up—long distance radio communication, radio broadcasting, television, carrier telephony, radio navigational aids, radar and many other highly complicated electronic techniques. In those early days nothing was known of electrons, but Fleming assumed that the current was conveyed by particles of negatively charged carbon thrown off from the incandescent filament, and subsequent events show that he wasn't far wrong.

The Marconi Company adopted the invention at once and the "Fleming Oscillation Valve," as it was called, was very soon in production. In January, 1907, an American inventor, Dr. Lee de Forest, who had been following Fleming's work closely, fitted a third electrode in the form of a screen or grid between the filament and the plate. He then found that by varying the potential on this grid in relation to the potential of the filament he could control the current flowing between the plate and filament. And what was more, quite small variations of grid potential produced quite large changes in plate current. He thus discovered that the thermionic valve could be used in this way as an amplifier as well as a detector. It is this amplifying action of the thermionic valve that is its greatest use today.

Marconi challenged the de Forest patent application and after several important legal actions it was ruled that the Fleming valve was fundamental, and that de Forest's addition of the grid was merely an improvement on the basic idea. However, there was still more to come in the development of the thermionic valve. In 1913 almost simultaneously, it was found independently by Meissner in Germany, Franklin and Round in England, and Armstrong in the United States, that by coupling the grid and plate circuits of the three-electrode valve — now called a triode — it could itself be made a generator of continuous oscillations of a high frequency. It was thus able to replace other cumbersome, expensive and inefficient devices then being used for radio telegraph transmission. What is more, its oscillations were found to be steady, pure in form and easily modulated, and the door was then suddenly opened to the development of wireless telephony, broacasting and television as we know it today.

All this has happened in the brief space of 50 years. It was only as recently as 1927 that the first "Australian Beam" circuit, as it was called, was put into operation between England and Australia, and this was the first really successful long-distance radio communication system. It used valve receivers and high power valve transmitters. As far as radio broadcasting was concerned, experiments at Station KDKA, Pittsburgh, U.S.A., in 1921 showed the great possibilities of this new medium and led to regular broadcasting in the United States of America and England in 1922. This was followed ten years later by the opening of the Empire Shortwave Service, and in 1936 by a regular television service in London from Alexandra Palace.

In the early investigations in the use of radio valves more than a little credit is due to radio amateurs. Since the earliest days of radio—or wireless as it was then known—there has been a band of amateur workers who have made radio communication their enthusiastic hobby, and in many cases they have equalled professional workers in their standard of knowledge. Their main goal was to communicate over long distances with simple, inexpensive equipment, and by the end of 1924 the longest distance on the earth's surface had been covered by amateur transmissions. On October 18 in that year Mr. Goyder, of Mill Hill School, London, exchanged messages with Mr. Frank Bell, of Waihemo, near Dunedin, New Zealand, using thermionic valve equipment costing just a few pounds. This was in sharp contrast to the results being obtained by the very costly spark and arc installations then being used by commercial companies.

Today there are many other applications of the thermionic valve besides radio communication; but radio and television receivers together use more thermionic valves than any other equipment. Last year in the United States of America alone thirteen million radio and television receiving sets were manufactured; they required something like one hundred million thermionic valves to fit them out.

When Fleming first reported the result of his original experiments to the Marconi Company in 1904, he said, "I have not mentioned this to anyone yet as it may become very useful." Just how useful his invention has become should now be clear to us all. Luckily, Fleming lived to see much of it himself, for he died in England as recently as 1945 at the age of 96.