John Logie Baird & the early days of TV

How many people sitting in comfort and watching a program on their modern high definition, brightly coloured television screen, ever think about the pioneers like John Logie Baird who made it possible?

by DOUG THWAITES

Working with little money and primitive equipment, the early television pioneers all had the same dream: that one day they would be able to send a picture from one place to another, even if it was only the next room.

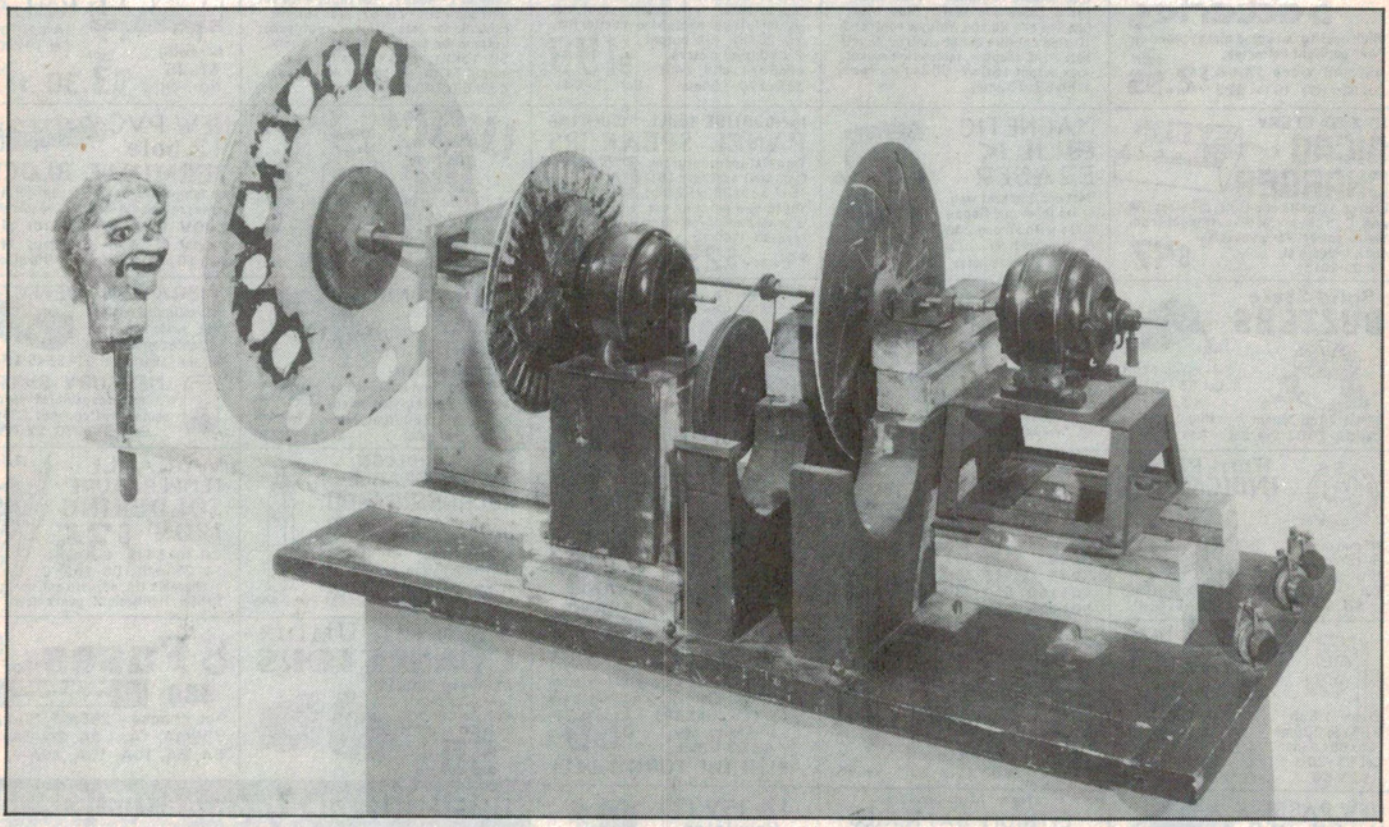
In 1876, Alexander Graham Bell perfected the Telephone and the human voice could travel from one place to another, so the search was on to send the picture as well.

Research to do this commenced in many countries, including Britain, Germany, France and the USA. What was needed was a method of converting light variations into electric current.

By chance towards the end of the last century, it was found that the element selenium changed its resistance when light fell on it. Selenium is a non-metallic element discovered in 1817, by Berzelius; it became widely used in resistors, and also in rectifiers. However it was not until 1873 that English telegraph engineer Willoughby Smith discovered that its resistance varied with light.

Once its light sensitive properties became known, methods were tried to use it to reproduce the different values of light and dark of a picture. To do this, the picture must be broken up into many separate areas each with its own value of light.

One method tried was to focus an image on to a mosaic of small selenium cells, each one of which was connected by wires to a tiny bulb, arranged in a



Baird's original television apparatus of 1925. It used a single drive shaft for "transmitter" and "receiver", to simplify synchronising. Note the makeshift construction, and the test subject: a head from a ventriloquist's dummy. (Photo courtesy Science Museum, London)

similar mosaic. However the difference in the current drawn by the selenium cells for light and dark of the image, was not sufficient to produce a recognisable picture.

In 1887-8 Heinrich Hertz discovered the principle of photo-electric emission: that electrons tend to be emitted from the surface of metals when light falls on them. Shortly afterwards, Elster and Geitel developed the photo-electric cell. This gave better variations in current, but the output was too weak to use. The thermionic valve had not yet been invented, and even when it was in 1904 by Fleming, the early ones were not capable of producing the enormous gain required.

It was not until 1923 that experiments had reached the stage that very blurred images could be sent by wire from one room to another.

John Logie Baird, born in Scotland in 1888 and the son of a minister, was the man who was going to lead the world with his work on television. In 1925 he demonstrated the first working model. It was very crude, made of mostly secondhand materials, but it did produce flickering images.

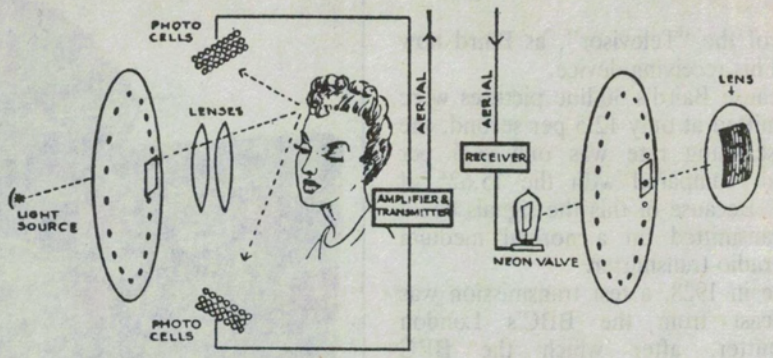
He was dogged all his life by ill health, and it was due to this that he developed television when he did. He worked mainly for himself, selling some of the things that he invented, and had money trouble most of the time.

In 1922 his health broke down, and he went to a seaside town to recover. Having nothing to do, he set up a bench in his room, and tried to solve the problem that had occupied his thoughts for some time, how to convert a picture into a varying electric current.

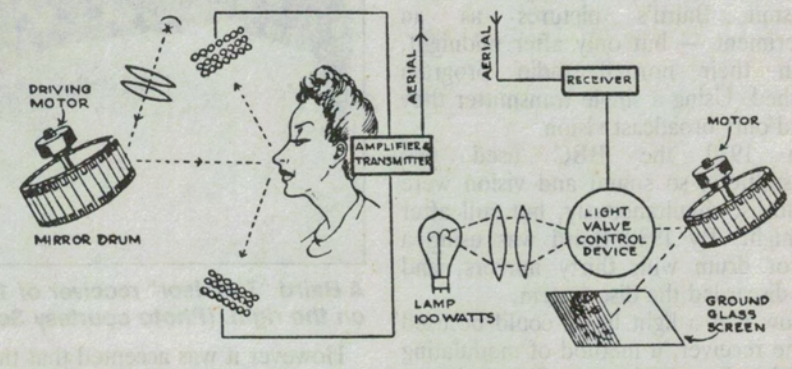
In order to transmit the details of a picture through a single pair of wires, it would have to be broken up into small pieces, and the light value of each piece sent in sequence, and presented at the receiving end in the same way.

Baird's apparatus consisted of a rotating disc pierced by 30 holes, oblong in shape. As this rotated the object being viewed was scanned vertically by a bright spot of light, which because of the holes in the disc, moved right until 30 parallel scans had occurred. The studio was in semi-darkness, and the reflected light from the object being scanned was picked up by two or more banks of photo-electric cells. This was the birth of "video".

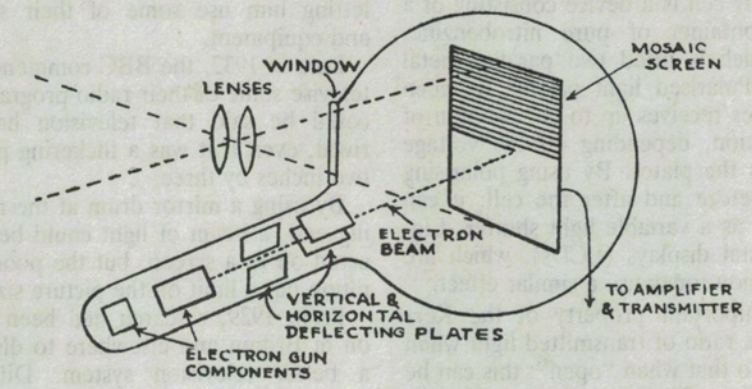
At this time no method had been found to modulate a beam of light, so the receiver display consisted of a neon lamp with an oblong electrode. When



The basic operation of Baird's first television system, using spinning discs for picture scanning.



Later the mechanical television system used rotating drums with sequentially tilted strips of mirror for the scanning.



The Emitron tube had no moving parts, but used an electron beam to scan the image focussed on a photosensitive mosaic of tiny cells.

the video signals were fed to it, the intensity of the red glow varied in sympathy, and by viewing the lamp through a revolving disc with 30 holes synchronised with the transmitter disc, an image of the original object could be seen.

Because the human eye can detect changes that take place slower than 24 times a second, and Baird was scanning at 12.5 per second, there was bad flicker.

Once a working model had been produced, continuous improvements took place.

By 1928 Baird had formed a company, which operated a studio and transmitter. It was a remarkable year for Baird — in February pictures were received in New York from London, using a frequency of about seven megahertz. The next week pictures were received aboard a liner in mid-ocean.

In June, a picture was produced using daylight instead of the bright artificial lights. In July, he demonstrated colour television using three colour filters — red, blue and green — set into a disc. Two discs were used, and synchronised, one in front of the camera, and one in

John L. Baird

front of the "Televisor", as Baird now called his receiving device.

Because Baird's 30-line pictures were transmitted at only 12.5 per second, the line scanning rate was only 375 per second, compared with the 15,625 of today. Because of this the signals could be transmitted on a normal medium wave radio transmitter.

Late in 1928, a test transmission was broadcast from the BBC's London transmitter, after which the BBC decided that the quality was not good enough for a regular transmission. However in early 1929, they decided to transmit Baird's pictures as an experiment — but only after midnight, when their normal radio program finished. Using a single transmitter they could only broadcast vision.

In 1930 the BBC used two transmitters, so sound and vision were broadcast simultaneously, but still after midnight. By 1930 Baird was using a mirror drum with thirty mirrors, and had discarded the disc system.

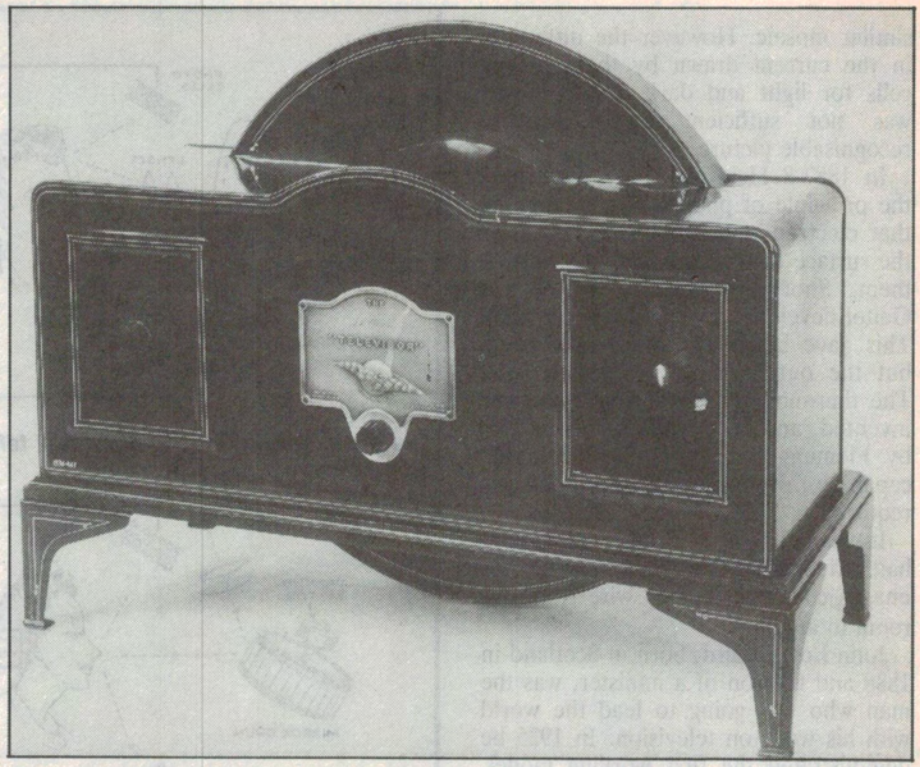
Now that a light beam could be used in the receiver, a method of modulating it had to be found, and a Kerr cell was used.

A Kerr cell is a device consisting of a glass container of pure nitrobenzine, into which is fitted two parallel metal plates. Polarised light passing between the plates receives up to 90° rotation of polarisation, depending on the voltage between the plates. By using polarising filters before and after the cell, it can be used as a variable light shutter. Liquid crystal displays (LCDs), which are so common today use a similar effect.

An important property of the Kerr cell is its ratio of transmitted light when "shut" to that when "open": this can be as large as .000001 to 1 (a million to one). The frequencies at which it can operate are as high as 10MHz, making it quite suitable for television.

Pictures from a mirror drum camera were still viewable on a disc receiver. Baird fitted a mirror drum camera into a van, and transmitted the first pictures from outside a studio, but only from the street in front of his building.

In 1932 the van was taken to Epsom for the famous 'Derby' horse race, and the pictures from it were sent by normal telephone line to a theatre in London. Five thousand people watched the event on a screen measuring nine feet by seven. Newspaper reports were varied, from "A marvel" to "Needs some imagination to visualise the scene".



A Baird "Televisor" receiver of 1930. The picture was viewed through the lens on the right. (Photo courtesy Science Museum, London)

However it was accepted that this had been a clever achievement, and the BBC decided to assist Baird more, by letting him use some of their studios and equipment.

Late in 1932, the BBC commenced to televise some of their radio programs. It could be said that television had arrived, even if it was a flickering picture two inches by three.

By using a mirror drum at the receiving end, a beam of light could be projected on to a screen, but the poor definition put a limit on the picture size.

From 1929, research had been going on in Britain and elsewhere to discover a better television system. Different scanning rates were tried, but it was found that there was a limit of about 200 lines for a mirror drum.

There were rumours of new non-mechanical methods being developed in Germany and the USA, while in Britain, EMI were working on an electronic camera using their patented 'Emitron' tube. In 1934 the British Government set up a committee to investigate what systems were available, and whether a public television service should be started.

In 1935 they produced their report. They had decided that the low definition system in use was not suitable for a public service, and that any future service should have a minimum of 240 lines and not less than 25 pictures a second.

In September 1935 the first stage of television came to an end, and transmissions ceased.

An old Victorian eyesore, Alexandria Palace was chosen as the home for Britain's first official television service. A 300"tower was erected, and both Baird and EMI were asked to supply their equipment, so that a test could be done to find the best system. Programs from both systems were shown on alternative weeks. Transmissions were for two hours a day, one in the afternoon and one at night, six days a week.

BBC Television started in 1936, and used VHF because of the broader bandwidth required for the higher definition.

Baird had two systems. One used a movie camera, from which the film went through a developing process, and then was scanned by a disc while still wet. The trouble with this was that it took 65 seconds to develop the film, and so the sound had to be delayed for this length of time. His other method was using a camera with an electronic device patented in the USA, with a scanning rate of 240 lines.

EMI however used all electronic equipment. Their cameras were fitted with the 'Emitron' tube, using a scanning rate of 405 lines and 25 pictures a second.

They also introduced the technique of *interlacing*, in which the 202.5 "odd"

lines of the picture were scanned first, followed by the 202.5 "even" ones. This meant that although there were only 25 complete pictures a second, any changes in the picture took place 50 times a second, reducing flicker even more.

The new electronic cameras used a cathode-ray camera tube, in which there was fitted a target screen comprising a mosaic of tiny light cells. The picture was focused on to this screen through a window of optical glass in the side of the tube.

Each light cell acquired an electrical charge proportional to the amount of light falling upon it. An electron beam was used to scan the screen and 'read' the variations in charge.

The current from the final anode contained these variations and therefore provided the 'video' signal.

Using higher line frequencies meant that the existing mechanical receiving devices could no longer be used to display the picture. The cathode ray tube now entered the television industry as the replacement.

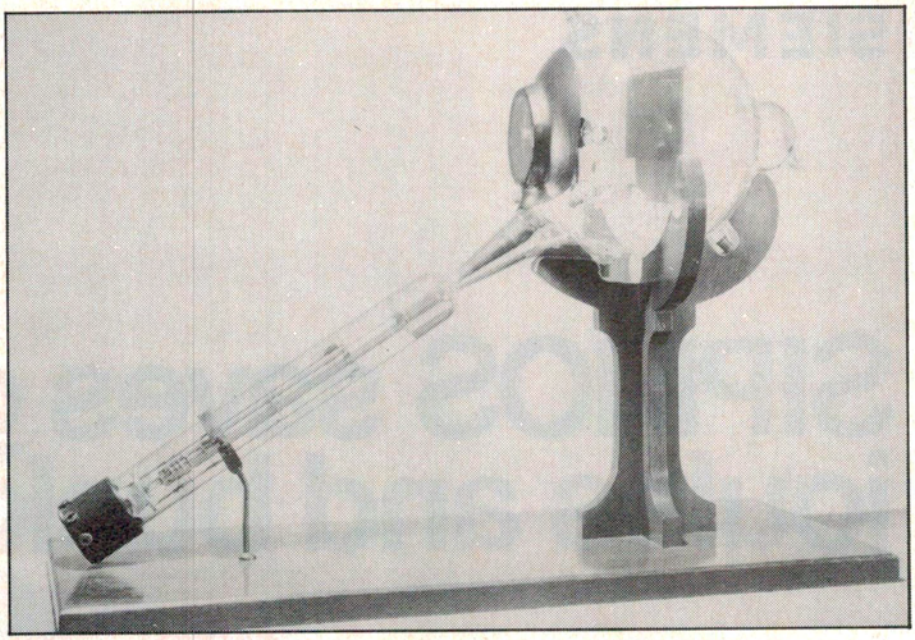
Not however the 'picture tube' as we know it today, with its flat face and short neck with 110° magnetic deflection, but a round faced tube with a long neck, used to obtain the deflection sensitivity needed for electrostatic deflection.

One radio receiver was fitted with a small 3" tube, and became a television receiver by switching to the TV band. After all with only a few hours transmissions a day, television was still only a novelty, and had yet to become so entertaining that it would change our lifestyles.

After three months of the two system trial, it was decided that EMI had the best standards, and Baird backed out, very disappointed. His company continued to manufacture television receivers, and he went back to research.

The technical standards had been set, and now it was the production side that continued to develop, with many new 'firsts'. Slowly television became accepted as a form of entertainment, with its own individual type of programs, outside broadcasts, panel games, plays etc. — and most important, the 'news'. Now, instead of waiting for tomorrow's newspaper, the pictures and the details could be seen today.

Unfortunately for this rapidly growing field of entertainment, war was declared in September 1939. So just four years after the official television service had started, it had to be stopped for security reasons. The exciting first era of television came to an end.

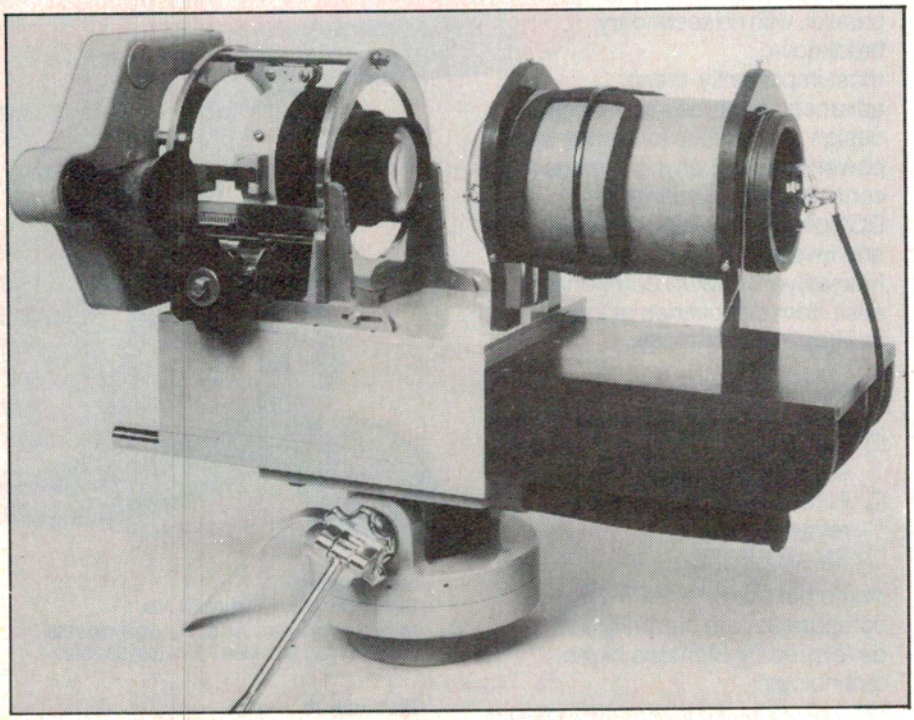


One of the first Emitron electronic camera tubes, of 1935. These soon replaced Baird's system. (Photo courtesy Science Museum, London)

I myself began working in the radio industry in Britain some years before World War 2. I not only met Baird, but also worked on some of his television sets. One used three TSP4 valves in cascade as RF amplifiers, and after detection the video signal was passed back through them for amplification, in "reflex" fashion. The stages needed very high linearity, otherwise cross modulation would occur.

When I arrived in Australia in 1956, it was to set up Myer's TV service department in Melbourne, for the commencement of Victoria's first TV broadcasts.

As Australia's television system was based largely on that of Britain, I believe it's fair to say that if it were not for the efforts of people like John Logie Baird, you might not be watching your nice colour TV set here today.



The 240-line electronic camera developed by Baird for the British Government's 1935 television tests. (Photo courtesy Science Museum, London)