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Dawn of television

Using computer enhancement techniques, Donald McLean* has managed to look at television recorded on disc seventy years ago – thirty years before video tape recording became possible. What is more, this is the first time it has been seen since it was recorded.

Thirty years before videotape recording, between 1927 and 1928, John Logie Baird experimented with recording his television signal onto discs. Five years later, enthusiasts made a few off-air disc recordings of the BBC's 30-line tv broadcasts. The discs have remained as curiosities since then, defying attempts to retrieve recognisable pictures.

For many years I have been seeking out and restoring these discs using software signal and image processing. The images recovered from the discs give a remarkable insight into those pioneering days of tv. As a bonus, analysing the recorded signal and its distortions unfolds a wealth of new information on the mechanical tv era.

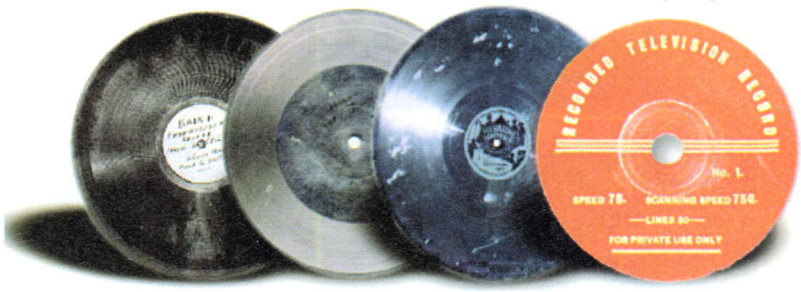

Fig. 1. Resembling contemporary audio discs, these are the different types of discs that contain the world's earliest-known recordings of television.

Recorded *live...*

In television's short history, the development of video recording technology has lagged behind broadcast television by decades. In 1956, Ampex in the USA demonstrated and marketed the world's first practical broadcast video recorder.[1] It was one of the great technological achievements of the television age and transformed broadcast television services, rapidly becoming essential to programme production.

Before videotape, 'tele-recording' – filming a television display – was the only method of capturing the fleeting images. Broadcast companies used the technique widely and for many years after the introduction of videotape. The quality, however, was always poorer than the original material largely because it had the extra distortion incurred by being displayed and filmed.

The first recordings?

The earliest direct video recordings appear to come from Ampex's video recorder between 1951-56, or the

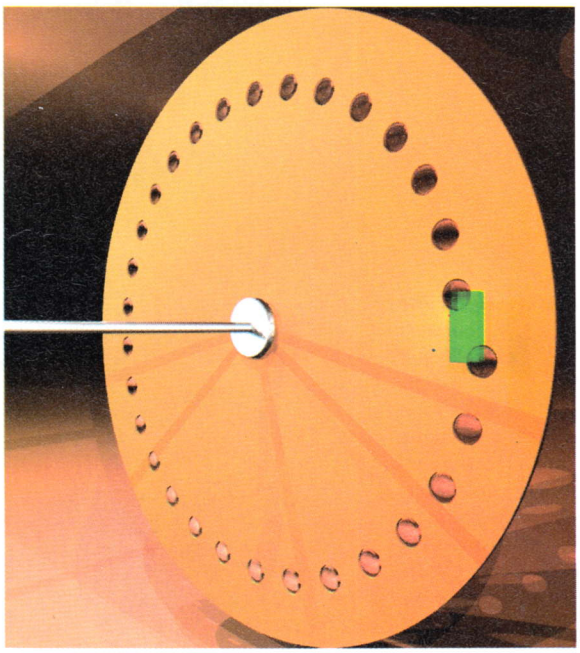

Fig. 2. A single spiral 30-line Nipkow lens disc set up for the Baird standard. The area for imaging or display is shown in green. For a 1.5m diameter disc, this area is only about 6cm horizontal by 14cm vertical.

*Donald F McLean BSc (Hons) CEng FIEE

BBC's VERA and RCA's 1953[2] experimental linear video recorders.

In the UK, the earliest tele-recordings come from just after the Second World War. In the USA, the earliest recording appears to be of 48-line mechanical television made in 1930 by GE of Schenectady, New York. Of the BBC's historic pre-war 405-line service that started in 1936, there is no recorded material other than newsreel and film inserts used to support live television.

Recently, I restored several direct video recordings, **Fig. 1**, that pre-date that period. They span the pioneering days from soon after the world's first demonstration of television by John Logie Baird in 1926 to the BBC 30-line Television Service that ended in 1935. They are now recognised as being the earliest video recordings in the world.

How could such recordings have

Fig. 3. The Baird standard called for a vertical letter-box format designed for viewing people from head-and shoulders to long-shot. The subjects that came across best were those that showed plenty of movement. The characteristic curved picture comes from using a Nipkow disc.

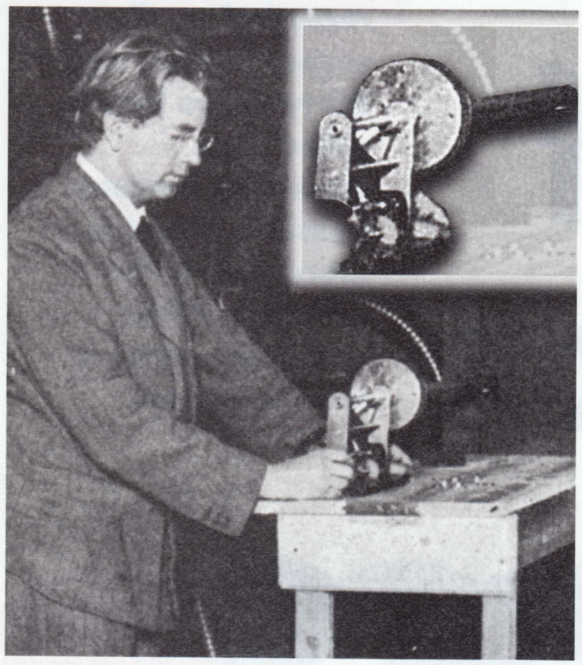

Fig. 4. John Logie Baird in 1927 at the Leeds demonstration to the BA. He is posing with a wax cylinder video record/playback system – the precursor to 'Phonovision'. The drive shaft probably connected the Nipkow camera disc with the cylinder drive. No cylinder recordings have survived.

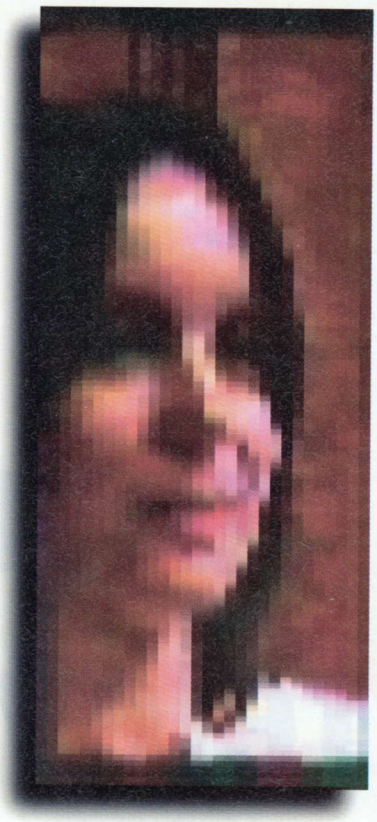

Fig. 5. This frame-sequential colour 15-line dithered image from normal audio cassette tape was generated by the author to simulate what Baird may have seen in his studio in 1928.

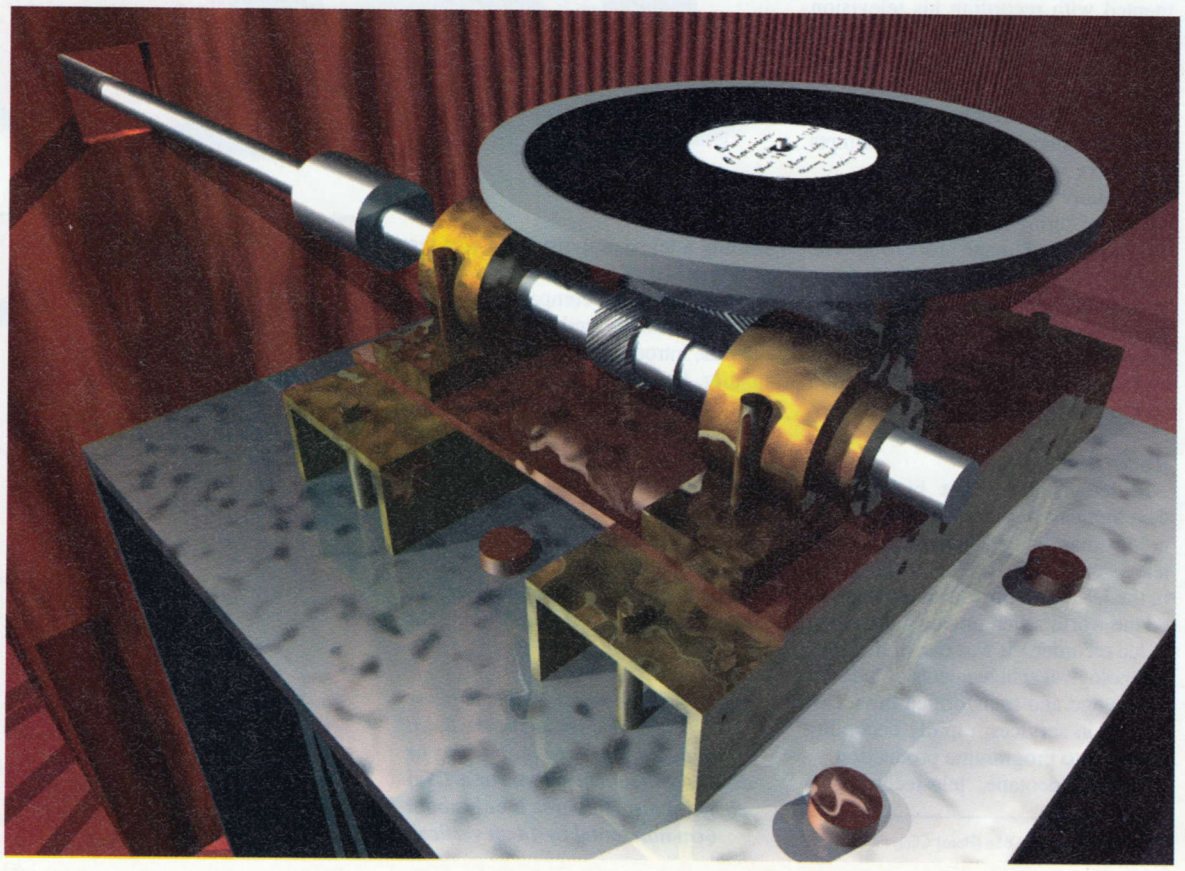

Fig. 6. The author's modelling of Baird's Phonovision recording studio of 1927/28 shows the drive-shaft from the scanning disc connected through a 3:1 worm gear to the record platter.

been made decades before Ampex's achievement? To answer this, we need to review television's roots.

The dawn of television

Spurred on by the discovery of the light sensitivity of selenium in 1873, the transmission and reception of still pictures over cable was demonstrated in the late 19th century without the advantage of electronics. Fleming's thermionic diode valve in 1904 and de Forest's triode valve and amplifier of 1912 kicked off the electronic revolution that was essential for television. By the early twenties, news-picture 'facsimiles', some even using digital coding,[3] spanned thousands of miles.

In contrast to these slow, yet high quality transmissions, television required several pictures per second to give the perception of motion. The advantages offered by electron tubes for television camera and display were recognised (1908[4], 1911[5]) well before their practicality. The practical electron tube display first appeared in the twenties and the camera – a major technological challenge in itself – in the thirties.

Several mostly independent pioneers around the world, including Baird in the UK and Jenkins in the USA, focused on the achievement of a practical television system by adapting what already existed to their purpose. They used the only method of scanning the scene available – mechanical scanning. Of the many methods developed for scanning, the Nipkow disc[6] became the most popular. It supported the development of several of the first practical television systems for almost half a century after its patent.

The Nipkow disc was normally one spiral of holes or apertures spread equally around the outer part of a flat disc, **Fig. 2**. The path each aperture swept out, through the angle between apertures, corresponded to a line in the image. The radial distance of each successive aperture changed in equal steps so that, in one revolution, all the apertures swept out the area of one tv frame.

By masking off the area and placing a photocell behind it, we have a television camera. By placing a variable light source – usually a neon – behind a similar disc, we have a television display. With synchronisation of camera with display, we have the vision channel for television.

The first demonstration of television

First with a demonstration of scanning and display of moving pictures in reflected light was John Logie Baird on 26th January 1926. Baird's transmitted standard of 1929-1935 was 30 lines per frame refreshing 12.5 times per second **Fig. 3**.

Line scanning was vertical, from bottom to top with frame scanning from right to left. Baird chose an aspect ratio of 3:7 – a vertical letterbox, optimised for televising individuals from close-up portrait to long-shots.

The mechanical nature of his Nipkow-disc-based system, and the sensitivity and bandwidth of photocell-amplifiers, constrained his television picture to mere tens of lines rather than the hundreds of lines of the electronic systems emerging in the thirties.

However, this low definition turned out to offer a distinct advantage. The highest vision frequency was so low that it was in the audio spectrum. Both this narrow bandwidth and the ease of creating different scanning arrangements were the main reasons why Baird was able to achieve so many 'firsts' – years before they were repeated in electronic television.

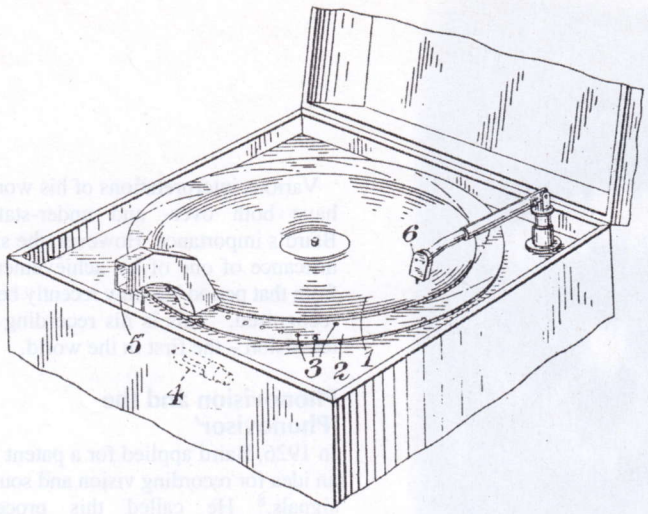

Fig. 7. Baird's patent for the 'Phonovisor'. A Nipkow disc under the record platter provides what must be the cheapest and simplest video replay device ever designed. The Phonovisor required the specially prepared Phonovision discs to be recorded synchronously with the camera disc. Looking into the viewport, the picture would be seen perfectly stable, independent of playback speed.

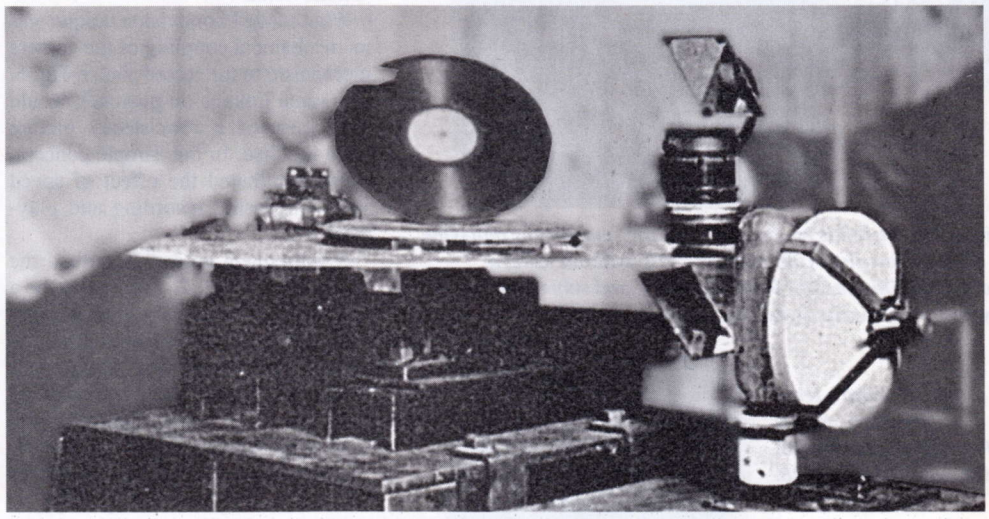

Fig. 8. The experimental 'Phonovisor' replay device used a large diameter Nipkow disc underneath the record platter. A light source at the right shines up through the disc via a mirror. This arrangement could also have been used for recording.

Inventions

Spurred on financially and technically by his early demonstrations, from 1926 to 1928 Baird patented and developed a series of innovations that covered almost every engineering aspect of television, **Fig. 4**.

He demonstrated colour television, **Fig. 5**, stereoscopic television, (near) infrared, and long-distance transmission. In early 1928, he demonstrated reception of pictures across the Atlantic in East Coast USA from transmissions in Surrey, England.

In the months leading up to that event, he not only transmitted live images, but also used his latest experiment, videodisc recordings.[7] These and other demonstrations served to establish Baird in the public's eye and to raise general awareness of a television revolution.

Today, little evidence remains of these early achievements. This makes it difficult to be factual about Baird's contribution to television – especially in his most publicised creative era of the late 1920s.

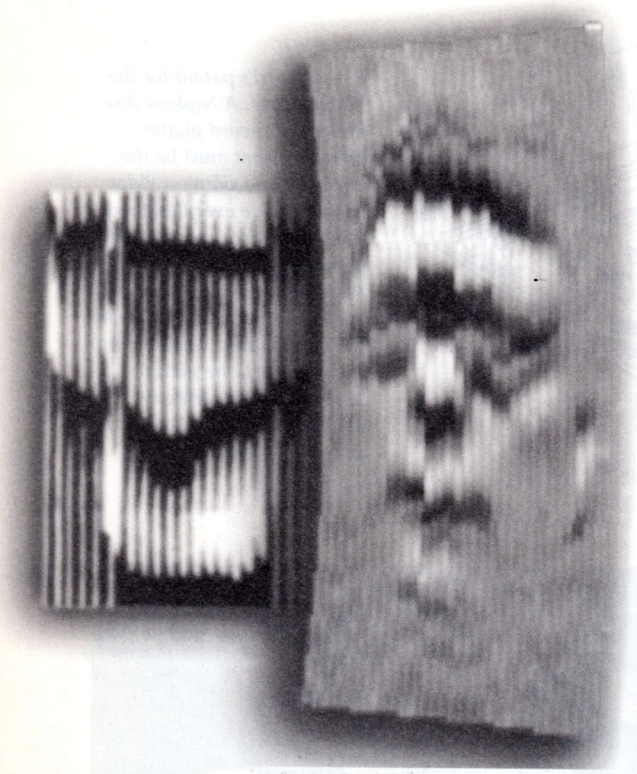

Fig. 9. On the left is an attempt from the seventies at replaying a Phonovision disc (10th January 1928) without using a computer. On the right is the same disc and subject enhanced by custom software signal and image processing.

Fig. 10. Baird's temp secretary, Mabel Pounsford, captured on disc on 28 March 1928. Her identity was discovered after the restored pictures were broadcast in 1993 on Channel 4 and recognised by a relative.

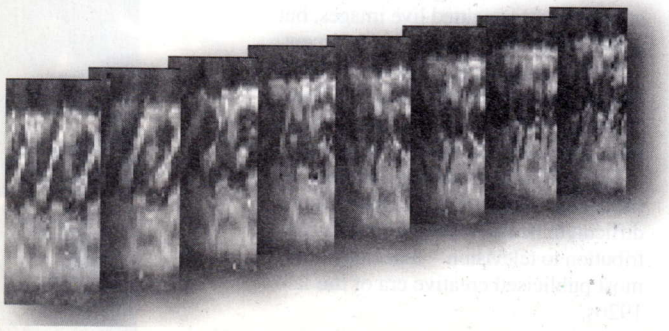

Fig. 11. The earliest-known video recording of broadcast television from the BBC, 21 April 1933. The main feature, captured on disc, was the Paramount Astoria Girls with their high-kicking routine.

Various interpretations of his works have both over- and under-stated Baird's importance. However, the significance of one of his achievements from that period has only recently been recognised. This is his recording of television – the first in the world.

Phonovision and the 'Phonovisor'

In 1926, Baird applied for a patent on an idea for recording vision and sound signals.[8] He called this process 'Phonovision'.

What made Phonovision unique was its mechanical coupling of the camera mechanism to the record platter, **Fig. 6**. The same linkage on playback would have ensured a rock-steady picture from the disc. In one simple concept, Baird eliminated the effect of speed variation during recording and playback.

A subsequent patent[9] described the 'Phonovisor', **Fig. 7**. This was to be a simple machine used for both playing back and displaying pictures from the Phonovision discs. The Phonovisor would have looked like a conventional gramophone. However, mounted coaxially with the disc platter was a horizontal Nipkow disc with the apertures on the rim outside the disc platter.

Although highly innovative in its simplicity and inherently cheap, neither Phonovision discs nor the Phonovisor ever appeared commercially. Unlike Baird's other experiments, the reproduction of pictures from the Phonovision discs – though undoubtedly attempted in the laboratory, **Fig. 8** – was never publicly demonstrated. From his own comments, it would seem that Baird was never sufficiently satisfied with the picture quality to give such a demonstration.

Baird moved on to other ideas and abandoned Phonovision. He passed a few of the discs to museums[10] and to his friends and employees. Over subsequent years, many people attempted reproduction of images from the Phonovision discs.[11] Their efforts yielded only crude distorted images, **Fig. 9**.

What Baird could not have realised is that more than sixty years later the faults during recording could be corrected in a personal computer,[12,13] restoring the latent image on his discs to a recognisable form. Those images give a remarkable insight into those pioneering days of television, **Fig. 10**.

But the images are only part of the discoveries made. Studying the details of the video signal tells us the camera type and even how well it was built. In addition, analysing the faults on the recordings gives a unique and in-depth understanding of the difficulties Baird encountered.[14] From previously being mere curiosities, the discs have today become one of Baird's most historical legacies.

The 30-line broadcasts

In September 1929, after much lobbying, the Baird Television Development Company started a series of experimental transmissions through the BBC transmitters.

For nearly three years, for no fewer than five times a week, the Baird Company produced its own programmes from its laboratories in Long Acre. In August 1932, the BBC took over full control and started the BBC Television Service with regular programming from studio 'BB' in the basement of Broadcasting House.

It now seems that a few of the enthusiasts watching the television programmes on their Baird 'Televisors' were moved to use their domestic audio recorders to record the vision signal for subsequent playback. Although the quality of the result would have seriously disappointed them, they very fortunately kept the discs safe rather than destroying them.

Off-air recordings

News of my discoveries from the Phonovision discs triggered some tremendous finds. A single privately recorded aluminium disc found in 1996, with just the cryptic words "Television 1933" written in ink on the label, was the first.

The material on the disc overturns established views on the 30-line BBC programmes. After restoration and analysis, this disc contains the earliest known recording of a television broadcast – in fact, a television special **Fig. 11**. It was broadcast in April 1933, just eight months after the start of the BBC 30-line Television Service.

The camera technique, lighting technique and production features are all unusual and unique. The rapid pace of the performance is stunning and provides us today with a true measure of Britain's heritage of television programme making.

In early 1998, another discovery was made. A set of unmarked privately recorded aluminium discs has turned

out to contain the highest quality original 30-line vision recordings known to exist.

From the video characteristics, they were extracts from BBC transmissions from the latter part of the 30-line service. By that time, the BBC had moved out of Broadcasting House into a new studio in 16 Portland Place.

One of the singers on the discs is Betty Bolton, **Fig. 12**. Betty is a well-known contralto, who performed over a dozen times in front of the 30-line cameras. Her visual performance on disc is exceptional – even on a sixty-year old corroded aluminium disc she still managed to charm her re-discoverer.

In 1935, the first video disc was sold in the UK. A 78 rev/min test disc intended for 'lining up' displays, it contains only static lantern slides of cartoon figures, **Fig. 13**. Although a collector's item today, this, the 'Major Radiovision' disc, contains little of interest for the historian. It is certainly not, as has been claimed, 'Phonovision'.

The parallel developments of television in other countries suggest that there should be similar discs around the world. To date, I have only found discs of British television. It may be simply that, like the British discs before this restoration work, recordings made in other countries were written off as unplayable.

Fig. 12. Far left Believed to be from a BBC broadcast in 1934-35, this is Betty Bolton. Her performance is stunning and easily makes her the 'Madonna' of thirties videos.

Fig. 13. In early 1935, a test disc of still images was sold for 'lining up' 30-line displays. A few months later, the 30-line service was terminated, rendering thousands of receivers, and this test disc, obsolete.

In summary

The discovery and restoration of the discs falls somewhere between being a computer-age detective story and a practical example of technological archaeology.

Applying the latest technological advances of the eighties and nineties has given us a unique view of the latest technological developments of the twenties and thirties. What makes this so fascinating is that the material comes from such a dynamic and important period in Britain's technological history.

After 1500 programmes, the BBC 30-line service closed on 11 September 1935. In November 1936, the BBC re-opened its television service with high-definition television. The massive technology leap that television had made left recording technology far behind. It would be nearly twenty years before direct video recording could catch up.

I plan to produce two follow-up articles covering in more detail the discoveries from Baird's Phonovision and the restoration techniques used, the later BBC tansmissions and how they appear in context with today's television.

Acknowledgements

My thanks go to all those who have supported and encouraged this private research throughout the years. Special thanks go to Ray Herbert, Eliot Levin of Symposium Records, Nicholas Moss of the BBC and the owners of the discs for their freely-given help and support for the recent discoveries. ■

See more...

The author's website at http://www.dfm.dircon.co.uk contains sound and video clips from all the restored discs. Bear in mind that the images shown here have been restored from poor quality, distorted audio recordings, so they do not represent the quality of the original 30-line broadcasts.

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