Early Colour Cameras and their problems

This short article is developed from the lecture I gave at CAT13 about the early difficulties making colour cameras. As with most TV firsts, John Logie Baird was there with a colour demo in 1928, mechanical television, true but it was colour. It was not long after the birth of electronic television before the first attempts at colour happened. These harked back to the mechanical systems as they used a rotating coloured filter in front of the camera and TV monitor. CBS (Columbia Broadcasting system) was first of the blocks with their 1940 camera, Fig 1., it used a rotating filter drum at the camera and a rotating disc at the receiver. The camera operated at 202½lines with 3 times interlace at 72 frames per sec.

Fig. 1 The CBS colour camera

After WW2 was over thoughts returned to TV and colour. In the UK EMI and Pye both had a go at colour cameras with rotating filters. These cameras were known as sequential colour, i.e. you got a green picture, then red followed by blue, hence the need for the high frame rate to reduce colour flicker. This was the Achilles heel of the sequential colour cameras, they did not offer a picture that was compatible with black and white TV sets. The advantage of this type of camera was it was not much more complex than a monochrome camera and it was relatively inexpensive, the problem was how could this type of camera be made compatible. The answer was a kind on optical standards converter, Fig.2. It had 3 CRTs one for each colour with 3 monochrome cameras looking at them. This fixed the frame rate and converted the signal from sequential to simultaneous. It was not with out its problems, this was like a 3 tube camera, registration and all. What was a simple system was now complex. Marconi watched all this with interest and they had a go at what must be the first example of a camera with a colour striped tube. This was a 2 tube camera with a luminance tube and a striped tube for the colour. The colour tube was of lower resolution than the luminance tube easing the difficulties of registration. (1) It was demonstrated at Marconi House, the Strand, London on the 11 May 1954, Fig 3.

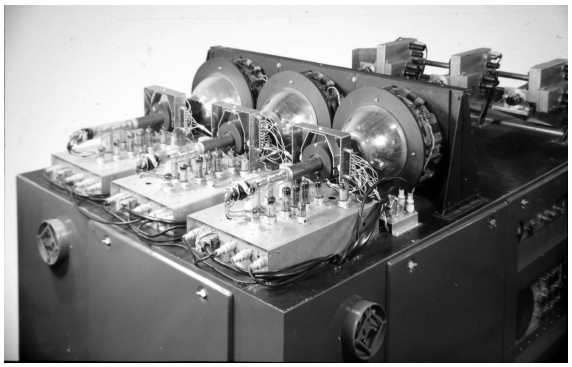
Fig. 2 The Pye optical sequential to simultaneous converter

Back in the USA RCA had taken the view that using 3 tubes was the best way. They chose the 3 inch Image Orthicon tube, this had advantages and disadvantages. It was a BIG camera, expensive, hard to set up and operate, but on the other hand once the RGB output was coded (NTSC) it was compatible with monochrome sets, and the signals could pass though most studio systems. The pictures were considered to be the best available in the middle 1950s. Fig 4

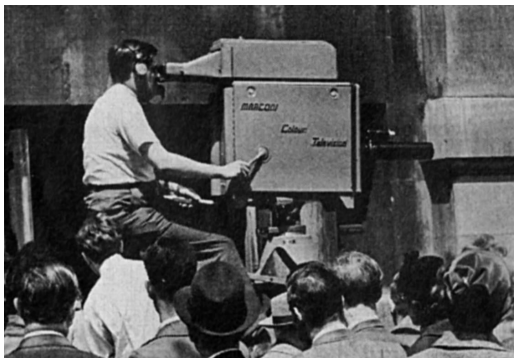

Fig 3 The Marconi 2 tube colour camera

Fig 4 RCA TK-40 3 tube I.O. Camera

In the UK Marconi had an exchange deal with RCA and they took the RCA design and made one for the BBC to test out. This camera, like the RCA one was basically 3 monochrome cameras in the one box, even to the extent of having 3 camera cables (2). This camera was developed and became the production version, the Marconi BD848, now tided up with just the one cable with 88 wires in it. (3)

RCA had invented the shadow mask tube, so the receivers were sorted out, but the cameras were still Very Big and Very Expensive. In the USA colour broadcasting was slowly being introduced and in the UK there was much talk about the BBC starting a colour service. The BBC had been running test transmissions using the Marconi 3 IO colour cameras for some time and it was apparent to Broadcasters and manufacturers alike that colour was on the way. What could be done?

EMI had a perfectly sound 3 vidicon camera in production, but it liked a lot of light and it's pictures were not really good enough for a broadcast live camera. EMI then made an experimental camera with a 4½ inch IO tube and 3 vidicons, to see how well it worked (5). It is thought that the experience gained led to the 4 tube EMI 2001 a few years later. Over in the USA, RCA made a similar decision and took that camera, the TK-42 fig 5 into production, this replaced the ageing 3 tube I.O. cameras they were selling. The BBC sent a team over to RCA to evaluate the camera and their report was quite favourable (4) but the cost was huge, $70,000 in 1965 money, about £350,000 today. So there was a lot evaluation of different cameras to see what could be used and afforded!

Fig 5 The RCA TK-42 4 tube camera

Fig 6 Philips PC60 in use at Wimbledon

At this point Philips came to the rescue with their new tube, the 30mm diameter Plumbicon. The Plumbicon was a vidicon type tube with a lead oxide target, but it performed much better than an ordinary vidicon and its small size made it very suitable for colour cameras. Philips made a demonstration camera which was evaluated by the BBC (5) and this led to the BBC buying the production version, the PC60, Fig 6. for the first of their colour mobile control rooms (CMCRs). At this point it was obvious to everyone that the Plumbicon tube was the way to go. In the UK Marconi was the first (1965) with the 4 tube MkVII closely followed by EMI and their 2001 (1966) camera also a 4 tube design. It was the perceived wisdom that a 4 tube camera with a separate luminance tube was the best solution, but Philips stuck to a 3 tube design with “contours of of green” processing. The next generation of cameras proved Philips to be correct with the 3 tube design. All of these cameras

produced satisfactory pictures (for the late 1960s). Meanwhile RCA having invested heavily in their IO + 3 tube TK-42 camera stuck with it till about 1970. Tube cameras continued their development through the 1970 and 1980s, but the writing was on the wall for them by the early 1980s.

Finis.

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Notes:-

(1) A technical description was published in the Journal of the Television Society, 1954 page 241.
(2) A report in Practical Television, Dec 1955 describes the BBC receiving the experimental colour equipment to operate on 405 lines with modified NTSC coding.
(3) A report in Practical Television Sept. 1958 describes the BD848 camera and associated OB unit.
(4) BBC report No. T-134 An appraisal of the RCA 4 tube colour camera TK-42.
(5) BBC research department report No. T-132 Comparisons between different colour cameras.

The original lecture can be viewed at the BATC Streamer "Film Archive" CAT13/04

More information early colour cameras can be found at the Museum of the Broadcast TV Camera