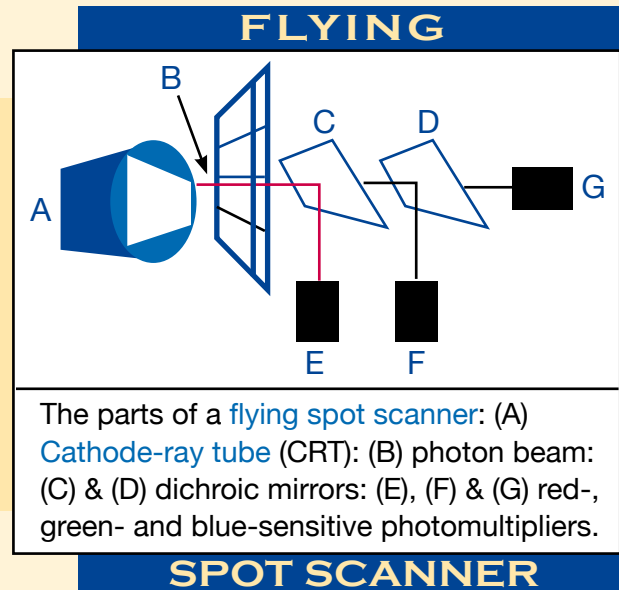


Flying Spot Scanner

The flying-spot scanner was invented by Manfred von Ardenne in 1930. It was used for electronic television. The scanner of a cathode-ray tube is a fast flying spot generated by an electron beam. The light spot illuminates a picture and the passed or reflected light is converted into picture signals by a photodiode.

Telecines that use a monochrome CRT as the light source can be referred to as flying-spot scanners. The advantage of the FSS technique is that as colour analysis is done after scanning, simple dichroics may be used to split the light to each photomultiplier — and there are no registration errors, as would have been introduced by early electronic cameras.



In 1964, H. Philip Peterson used a CDC (Control Data Corporation) 3200 computer and a “flying-spot” scanner to create a **digital representation of the Mona Lisa**. The image contained 100,000 pixels plotted using numerals, sometimes overprinted, to approximate the required density and took 14 hours to complete.

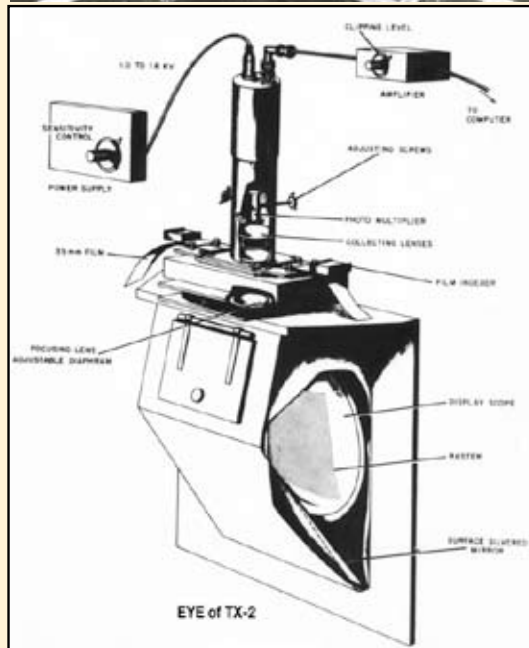
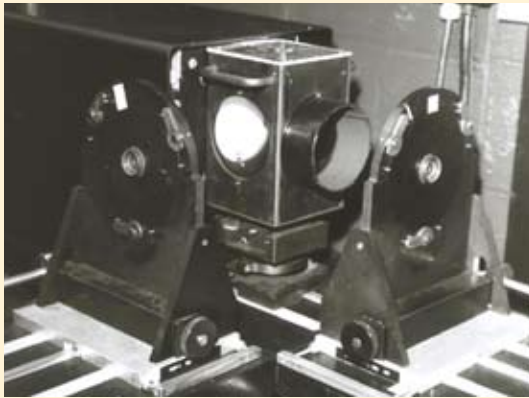
[source: Computer History Museum, Boston, MA]

Early Scanner Use:

Historically, flying-spot scanners were also used as primitive live-action studio cameras at the dawn of electronic television, in the 1920s. A projector equipped with a spinning perforated disc created the spot that scanned the stage. Scanning a subject this way required a completely dark stage, and was impractical for production use, but gave early researchers a way to generate live images before practical imaging pickup tubes were perfected.

In the case of the CRT-based scanner, as the electron beam is drawn across the face of the CRT, it creates a scan that has the correct number of lines and aspect ratio for the format of the signal. The image of this scan is focused with a lens onto the film frame. Its light passes through the image being scanned and is converted to a proportional electrical signal by Photomultiplier tube(s), one for each color (Red, Green, Blue) that detect the variations in intensity of the beam spot as it scans across the film, and are converted to proportional electrical signals, on for each of the color channels.

The TX-2 EYEBALL Beam Splitter



As a tribute to simultaneity, these two pictures show a device and controls for the TX2 EYE, invented around 1958 or 59 by H.Philip Peterson at the MIT Lincoln Laboratories, and functionally identical to the EYEBALL. The TX2 version is elegant and obviously much less complicated although one could claim that the TX2 was bigger than the PDP-1. For those old enough to recall it, Peterson used his EYE to scan a 35mm slide of the Mona Lisa, and then, using a specially designed character set, played the scan back onto a 30 inch Cal Comp plotter. The 30 inch monochrome playback sparked a mini collecting frenzy all over the country

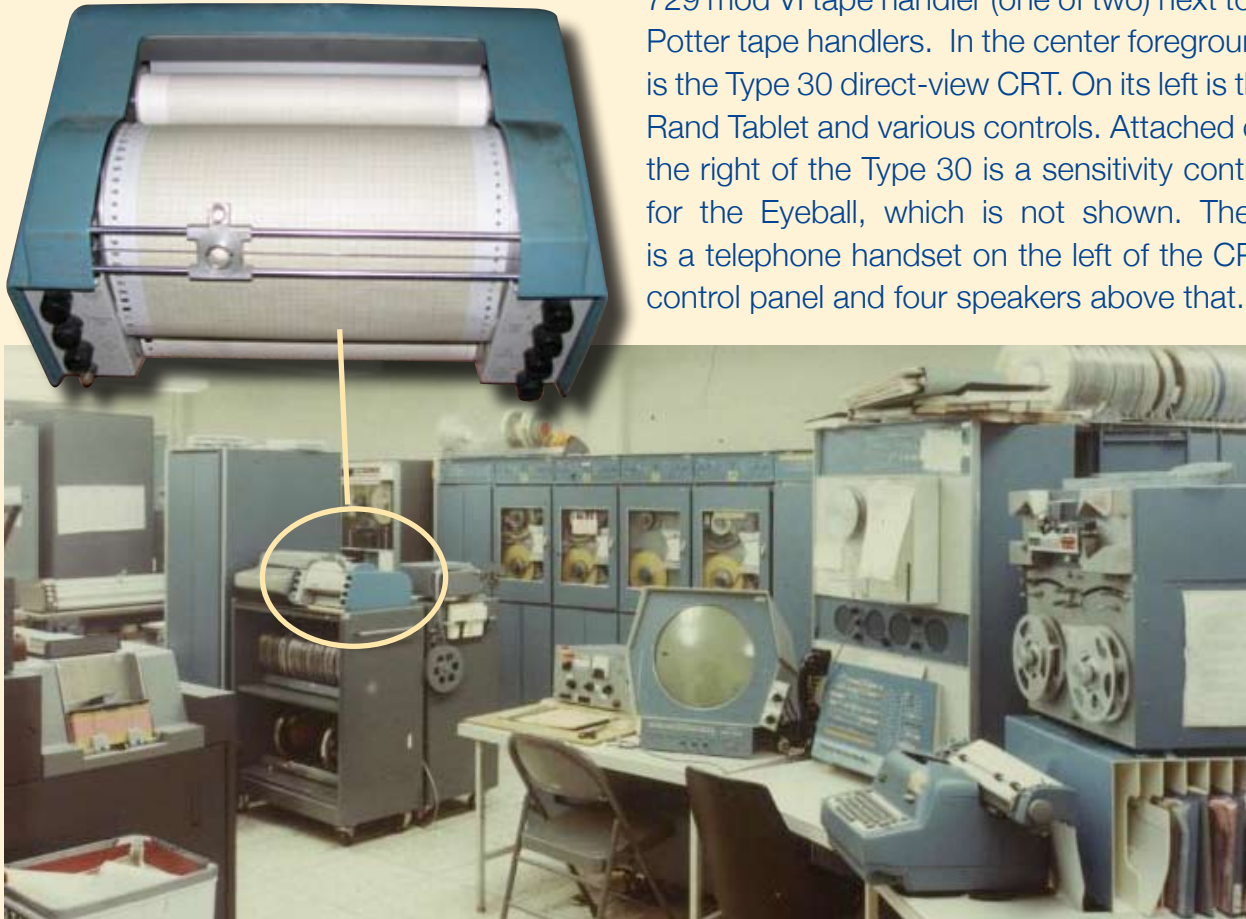
The first EYEBALL device was developed for use with the Model 740 CRT on the IBM 704. This was in 1959, and our test uses of it showed that a more accurate version would be very useful. We replaced the camera that ordinarily imaged the CRT with a platen to hold exposed film, backed with a Photo Multiplier Tube (PMT). If the PMT didn't see any light when the CRT point (x,y) was plotted, it meant that the corresponding point on the film sample was preventing the light from getting to the PMT; by implication, a piece of the image was blocking the light. Similarly, if

light was seen, the film was clear at that point. In effect, this computer-controlled "flying spot scanner" was used to build a mosaic of points where an image existed.

Again, this application was too time consuming to be run on a worker computer, so it was moved (with some embellishments) to a dark room next to the PDP-1. The addition of the CRT reference leg made it possible to read all sorts of photographically noisy film. Later versions of the EYEBALL were also able to digitize images on opaque material such as paper. In this case, the PMTs sensed reflected rather than transmitted light. The applications included films from experiments, seismic records, and fingerprints. Although it could read sheet music, it didn't do it smoothly and we never implemented an ability by the PDP-1 to play music. Attempts to read text were also not successful enough to stimulate anyone to work on developing that application

PDP-1 Programmed Data Processor

Below is a view of the PDP-1. At the extreme left is the punch end of the IBM1402 card reader/punch. Also on the left, in the background, is the 30-inch Cal Comp plotter. On the top of a tape cart is one of the IBM "golf ball" Selectric typewriters and, next to it, a 12-inch Cal Comp plotter. Behind the plotter is the Mylar tape punch and, further in the background, an IBM 729 mod VI tape handler (one of two) next to 4 Potter tape handlers. In the center foreground is the Type 30 direct-view CRT. On its left is the Rand Tablet and various controls. Attached on the right of the Type 30 is a sensitivity control for the Eyeball, which is not shown. There is a telephone handset on the left of the CPU control panel and four speakers above that.



CAL COMP PLOTTERS - were generally, graphical-output devices. They (a 12-inch width and a 30-inch width) consisted of a roll of graph paper, 120 feet long, that could be moved in the y direction (the paper length) in steps of 0.010 inch, and a pen carriage that could be moved in the x direction (the paper width) in steps of 0.010 inch. Additionally, the pen could be raised above or lowered onto the paper surface. The speed was such that one could move about one inch per second. Using these elemental motions one could produce excellent graphs or sketches of arbitrary complexity. It was possible to include halts, so that various colored pens could be utilized, thus allowing for colored drawings. The decided advantage of these plotters was that, being digital in nature, they were able to return precisely to an initial point, an ability that analog plotters did not generally have. The CAL COMP plotters were used all over the country; there are even reports of successive frames being plotted on this device and photographed to produce movies at the Universities of Ohio, Toronto and Syracuse. It was driven either by the PDP-1 or from a magnetic tape on which the steps had been written at 200 steps (characters) per inch.