HOW DOES 3D WORK?

Three-dimensional (stereoscopic) images have been with us for a long time. Soon after the invention of photography, photographers sold stereoscopic pairs of photographs, to be viewed through a 'stereoscope'. Fig 1 is an example—it can be seen in 3D either with a viewer, or by focusing your eyes on the background behind the image. For many years past,

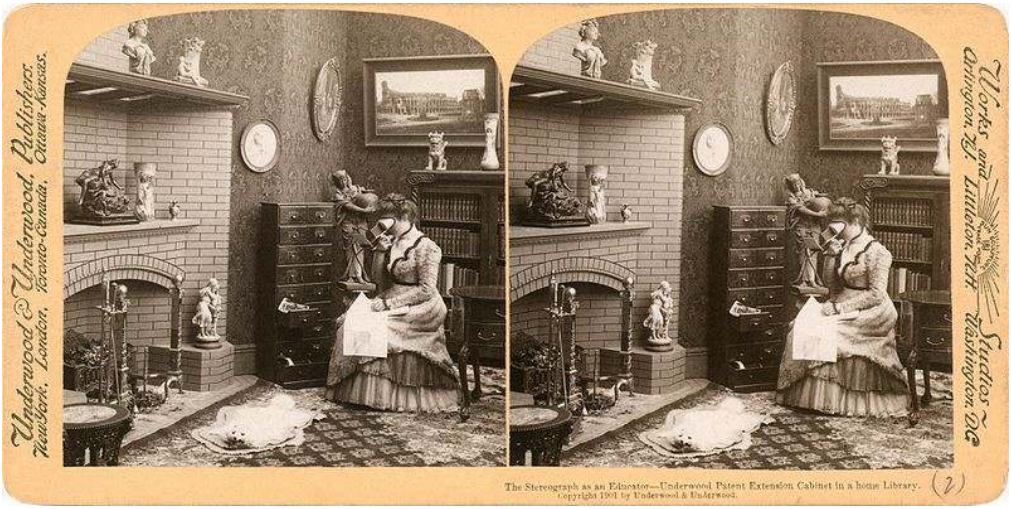

Fig 1: A Victorian stereopair—commons.wikimedia.org

you have been able to buy booklets of pictures, to be viewed through red and green glasses, resulting in a realistic 3D image, in a horrible mixture of red, green and brown! In 1939, an updated version of the stereoscope appeared as the 'View-Master', which used a disc with seven pairs of coloured stereoscopic photographs (Fig 2). Depressing the lever advanced to the next image. Movies in 3D were produced from the 1940's onwards, initially using the red/green (anaglyph) system, but much more successfully in full colour, using Polaroid (see below). Such movies never really 'caught on', partly because of the need to wear special glasses, and partly because 3D is really a slightly pointless 'gimmick'! There has recently been an explosion of 3D movies, of which 'Avatar' is the best known, but I suspect this craze will die out, and for the same reasons. Extremely expensive 3D televisions are now on sale, but it would be surprising if they ever become popular.

Fig 2: A View-Master—rickgibson.net

But how does it all work? The principle behind 3D images is simple—since the two eyes are not in exactly the same place, but are side-by-side and about 6cm apart, they do not see exactly the same image. If the two eyes view two pictures which

mimic these slightly different viewpoints, the brain interprets the images as being in 3D. The stereoscope and the View-Master simply show a different image to each eye, and the job is done. The anaglyph system uses red and green printing ink for the pictures, and red and green filters in front of the eyes. In theory, you can't see the red image through the red filter, so you only see the green image. Conversely, through the green filter, the green image is invisible and you only see the red image. In practice, the inks and filters are never perfect, and there is always a slight double-image. A recent TV programme, about filming the Queen's Coronation in 3D, used the 'ColorCode 3D' system, in which one eye sees a coloured image, through a a brown filter, and the other sees an image through a dark blue filter, which provides a 3D effect. It doesn't work particularly well!

The Polaroid system is now used in almost all 3D movies, but it is difficult to explain exactly how it works. Roughly speaking, it relies on the fact that light waves normally vibrate in every possible direction, but a material called Polaroid only passes light waves which are vibrating in a single direction. The projector puts out two oppositely polarised images, and the viewer wears glasses with oppositely polarised lenses, so that each eye only sees one of the two images. Incidentally, the Polaroid camera was produced by the same firm, but did not use the polarising material. Polaroid sunglasses do use this material, however. Light reflected off smooth surfaces is polarised, and the sunglasses are able to block that reflected light.

Another method of producing 3D images, used in 3D televisions, involves showing the images for the two eyes alternately, at high speed. The viewer wears special glasses which go back and forth between dark and clear. The glasses are synchronised so that one eye only sees the first image and the other eye only sees the second.

Making 3D pictures of live subjects—either still or moving—involves the use of a camera with two lenses, spaced as far apart as normal eyes. Increasing the distance between the lenses increases the 3D effect, but also makes objects in the scene appear smaller—a mistake which was made in some of the View-Master reels!

3D cameras have been around for a long time, but have always been a very specialised interest. What has changed recently is the ability to make 3D movies using CGI (computer-generated imagery). Such movies are actually cartoons, since the images are drawn, rather than photographed, but they can be remarkably life-like, as in 'Avatar'. The computer 'knows' the shape of the object in three dimensions, and produces the two views needed for a stereoscopic effect. Cine projectors used to show 3D movies in the past had two lenses, each with appropriately orientated Polaroid. Nowadays the projectors are digital—they don't use film, but work like a computer display. They only have one lens, through which two images are projected alternately, through a filter which rapidly switches its polarisation back and forth. 3D films and television are a bit of fun, but we can probably live without them!