



George Wells, *The pink dress*, 1945  
Three-colour carbon print



D.A.Spencer, *Imperial state crown*, 1937  
Vivex print



A.C.Banfield, *Lena Ashwell*, 1907  
Three-colour carbon print

# Colour Photography: The First Hundred Years

## Part Three - Subtractive Colour

Most early colour processes worked on the principle of mixing, or adding together, appropriate combinations of red, green and blue light. These are usually grouped together under the general description of 'additive' colour processes. All additive processes share one great disadvantage – they rely on the use of filters which, by their nature, block out a great deal of light, resulting in long exposure times and very dense transparencies. Moreover, the colour photographs made by using these processes can only be viewed by transmitted light – by projection or by using special viewing devices. However, there is an alternative method of reproducing colour photographically – 'subtractive' colour synthesis.

The original theory for subtractive colour reproduction can be traced back to the fertile mind of Louis Ducos du Hauron who, as early as the 1860s, explained the method in his book *Les Couleurs en Photographie*. Du Hauron proposed that colour separation negatives be used to produce three positive images which were then dyed the complementary colours of cyan (blue-green), magenta (blue-red) and yellow. Each of these complementary colours absorbs, or subtracts (hence the name), one of the primary colours. Cyan absorbs red light, reflecting a mixture of blue and green light. A cyan image, therefore, performs the same function as the red filter used in an additive process. Similarly, magenta absorbs green light and yellow absorbs blue light. By accurately superimposing these three complementary colours,

all other colours can be reproduced. The colour in subtractive processes comes from dyes or pigments rather than coloured filters.

With subtractive colour, white, for example, is represented by clear glass or by white paper rather than by light passing through three filters – red, green and blue. This means that subtractive processes are much less wasteful of light. More importantly, they work with reflected rather than transmitted light which means that they can be used to produce colour photographs on paper.

The development of subtractive colour processes followed two distinct paths. First, the design of specialised cameras, for taking sets of colour separation negatives and, secondly, the search for practical methods of making and superimposing three positive images in the complementary colours.

When taking colour separation negatives of subjects that did not move – for example, a vase of flowers – a conventional camera could be used. All that was needed was to change the colour filter after each exposure. If a great deal of colour work was being done this procedure could be made simpler through the use of repeating backs. A number of different devices of this sort were marketed. The simplest type were long plateholders, fitted with three filters, which could be slid along the camera back in three steps. The most complex were fitted with clockwork motors, enabling three negatives to be exposed in rapid



Gordon Crocker  
*Margaret Sullavan, 1938*  
Vivex print

succession in as little as two or three seconds. When photographing subjects where movement was likely to occur – such as portraits – even automatic repeating backs were not fast enough. For these, a camera that could expose all three negatives simultaneously was needed. Over the years, many designs for such ‘one-shot’ cameras were patented and a number were produced commercially. These used various arrangements of mirrors and prisms to split the light entering the camera into three separate beams, each of which went to a plateholder fitted with a different coloured filter. Among the most successful designs were the Jos-Pe, Bempohl, Klein and Mirkut cameras.

Obtaining satisfactory negatives was only the first stage. These negatives then had to be converted into positive images in the complementary colours of cyan, magenta and yellow. Several different methods were used to obtain these images, the most popular being variations of the carbon process. These used sheets of carbon tissue, consisting of a gelatine coating, containing pigment, on a paper base. This tissue was sensitised before use by soaking it in potassium bichromate. Potassium bichromate hardens when exposed to light and, after exposure in contact with a negative, the areas of unhardened gelatine could be washed away, to reveal an image. Tissues could be produced using pigments of any colour – images on cyan, magenta and yellow tissues being superimposed to produce subtractive colour prints. A variant of the carbon process was the Trichrome Carbro process, first developed during the 1890s but made popular by the Autotype Company of Ealing, during the 1920s and 1930s. The Carbro process used a set of bromide prints made from separation negatives

to make the necessary yellow, magenta and cyan pigment images on tissue for transfer in sequence on to a paper base.

Whilst processes such as Carbro were available for amateur photographers to use, tissue assembly techniques were difficult and complex. Apart from the really dedicated, most amateurs preferred to use additive processes such as Autochrome and Dufaycolor. Commercial colour photography was to become increasingly important during the 1930s and for professional colour printing at this time, one process was to reign supreme – Vivex. Invented in 1928 by Dr D A Spencer, who later went on to become Managing Director of Kodak Ltd, Vivex was a modification of the Trichrome Carbro process in which sheets of cellophane were used as temporary supports for the pigment images. Any minor problems with registering the images could be corrected manually by stretching or squeezing the cellophane to ensure perfect superimposition. To exploit the Vivex process, a company called Colour Photographs (British & Foreign) Ltd was formed with a factory in Willesden, north London. This was the first laboratory to offer a colour print making service to professional photographers. It has been estimated that over 90% of all the colour prints made in Britain during the 1930s were produced using the Vivex process.

Subtractive processes such as Vivex used separation negatives produced on three separate photographic plates. It is possible, however, to combine all three films or plates into a single unit. Such combinations are known as tripacks. It was the use of integral tripacks that paved the way to the development of ‘modern’ colour processes such as Kodachrome.