

Colour and the Printer

By Way of Explanation by *John B. Easson*

One of the tools at the printer's command is colour. Like many aspects of printing it is a complex subject if studied properly, but is capable of simplification, and an understanding of even the simpler aspects of it can help the printer achieve a nearer approach to putting his ideas into practice, as well as on occasions suggesting further ideas for a job in hand.

I am not going to try to suggest to printers how to use colours; how each printer uses colour is part of his own style, and that subject is a large one in itself. I am going to attempt to describe briefly, in three articles, some of the terms and principles of colour which I have found myself are used directly or need to be kept in mind by the small printer. Many small printers seldom make use of colour, yet it is a field where they can easily excel the professional and larger printers, for the simpler uses of colour cost little more than more time on the job, the very thing that the amateur or small printer can afford but the larger professional cannot. Even so, it is recognised in professional circles that colour is very often more than worth the extra effort or cost, and so it is widely used. Personally, I have found that my own practice of always using a second colour (i.e., as well as black) unless impossible has always not only led to a better result from my own point of view, but been much preferred by the recipients.

Terminology

The first difficulty in colour is that of terminology; apart from the problem of describing a colour in words, the fact that different people use different names for the same thing, and the same name for different things causes terrible confusion. And about the worst culprits here are printers! In order to get round this problem, I am going to use only accepted scientific terms, which are unambiguous providing you use only the scientific meaning. This will make it easier for anyone who wants to read more on the subject, but means that I do not always use the printer's terms.

There are many ways of describing colours, but nearly all divide the effect of a colour into three components, the commonest being the 'hue', the 'saturation',* and the 'tone'. † The 'hue' is the par-

ticular shade of colour (red, blue, purple, etc.) which is basic to the sample. The 'saturation', is how pure the colour is — pillar-box red being, for example, a nearly pure colour, while pink and brown are less saturated versions of that same hue, being made from it by diluting it with white and black respectively. The 'tone' is how light or dark a colour is — if you like, how it would come out on a black-and-white photograph.

Thus you will see that when mixing colours to make some special shade, there are three things you can vary — the choice of hue used, the amount of hue relative to the rest (which will be 'hueless', i.e., grey), and the relative amounts of black and white used. However, I will come back to colour-mixing later.

**Or 'chroma' †Or 'value'. The more colloquial versions have been used for simplicity*

How we see colour

When we see a coloured object, what we see depends on what colours are in the light illuminating it, on which of these the object scatters in our direction, and on which of these our eyes can detect. White light contains all the hues our eyes can see, but as most people realise, the light we use normally (sunlight, tungsten lamps, fluorescent lights) is seldom a pure white — there is usually more of certain colours than of others. This of course means that an object appears a different colour at different times: it may be blue in fluorescent light (which tends to have extra blue and less red in it) and green in tungsten light (which is the other way round). The agreed 'white' light is effectively that of a north-facing window.

Which of the colours in the light the object (from now on, I will assume the object is ink on paper) will scatter towards the eye depends on the colouring pigment in the ink, and the paper it is on. Most simple colours of ink simply absorb some of the light and scatter back the rest. Some inks, however, are transparent, and the light then goes through them (some colours being absorbed on the way), bounces off the paper, and back through the ink. This means that the

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paper can affect the colour, for it can also absorb some of the colour. Hence, in four-colour process printing, which uses transparent inks, the whiteness of the paper matters. Hence, too, unless opaque inks are used it is impossible to get certain colours on coloured papers — and as few inks are completely opaque, strong colours of paper make the number of colours possible limited. Certain pigments have the ability to absorb one colour of the light and transform it into another, usually absorbing the ultra-violet (which the eye cannot detect, so does not normally matter) and transforming it into a red. This makes the colour appear much more saturated than any ordinary one, and they are termed ‘fluorescent’.

The colours from the object are then detected by the eye, and this can only detect certain of them, the visible spectrum being only a tiny part of the full one. Here we find that the final effect not only differs from person to person (usually only slightly, except for the ‘colour-blind’) but differs greatly according to circumstances. The eye is only sensitive to colour in bright light, not in dim. Moreover, the eye, or perhaps the brain, often alters the effect, usually trying to adjust the strongest colour it can see to be neutral.

The three-colour theory

In fact, it appears that the eye can really only detect three basic colours in light : red, as in traffic lights; green, slightly more saturated than in traffic lights; and blue, as in police lights. All other colours which are ‘seen’ are detected as mixtures of these three. The best proof of this is, of course, the colour television set, for its picture is composed from spots emitting these three colours, and yet the brain sees the picture in full colour. This idea is a rather surprising one, but it is easy enough to test, and when this is tried, one finds that if red and green lights are used, the eye sees yellow, with red and blue, the eye sees a purplish-pink called magenta (see cover of *Small Printer 46* or, better, *40*), and with green and blue, a blue-green called cyan. By using all three, the eye sees white. Other colours can be formed by altering the relative strengths of red, green and blue.

Now the important point about inks is that they

absorb colours, and so we see that if we take an ink that absorbs red, one that absorbs green, and one that absorbs blue, we could use these to absorb any or all of white light, i.e., to form any colour. Now an ink that absorbs red must leave green and blue, hence will appear cyan, and the one that absorbs green must be magenta, the one that absorbs blue being yellow. Thus if we use perfectly cyan, magenta and yellow inks we can mix them to form any hue we want, and by adding black and white, any colour at all. Unfortunately, it isn’t possible to make such perfect inks, but the present ones are quite good, and can form quite a wide range of colours.

This idea is used directly by ink-makers who provide a set of inks which can be mixed to form a vast number of colours (they provide extra colours such as purple to fill the gaps that the present imperfect three primary inks cannot manage to mix). It is also the basis of three- and four-colour process printing. The full-colour picture is first split into its three colours of light, and printing plates made corresponding to these and printed in the three ink primaries. Any colour in the original picture is thus represented on the print by corresponding amounts of magenta, cyan and yellow on top of each other. A fourth plate in black is usually printed to improve the contrast and detail.

Here let me emphasise again what I have been saying: the three basic colours in printing (and painting, etc.) are the ones I have called magenta, yellow and cyan. Using these, in theory, any hue can be mixed. The confusion over names that I mentioned earlier centres on these three colours, for they are often called ‘red’, ‘yellow’ and ‘blue’ — and, as you will see, this leads to confusion with the colours our eye can detect, and if any of you have tried mixing colours using the obvious ‘red’, i.e., pillar-box red, ‘yellow’, and ‘blue’, i.e., sky-blue, you probably gave up in disgust.