
CHAPTER 20

Early history and legacy of optical colour-mixing

Introductory

This chapter deals with a subject that plays a key role in the historical development of colour theory for artists. The name given to it by Seurat and Signac (who introduced it to painting) was “chromo-luminarism”, although it very quickly became better known as “Pointillism”. Both terms relate to a method of using mosaics of closely packed dots of varying colours such that they blend into one colour impression at a certain distance. The idea of using optical colour-mixing was not original to these artists. As well as being included in the practice of a small list of earlier painters, the subject had interested the scientists of visual perception for almost fifty years before the findings of their researches were to play an important role in the birth of chromo-luminarism.

Some of the ideas presented in this chapter are intimately linked with material presented in “Painting with Light”, the first book in this combination of two books and this leads to some repetition. In particular there is overlap with respect to painting light and illusory space.

Also and more important for “Painting with Colour”, the second book in this volume, are the various ways in which discoveries, due to the research of the Pointillists, turned out to act as catalysts to work on:

- *Colour dynamics that occur at the boundary between two adjacent regions of different pigment colour painted on a flat surface.*
- *Effects of viewing conditions on appearances.*

In other words, the two main subjects of this book.

The phenomenon

Optical-mixing occurs when the eye cannot resolve differences between re-

gions of colour on a surface which, as a result, blend into one impression. There are two main kinds of it. These are illustrated in *Figure 1* and can be classified as “temporal” and “spatial”. Thus:

- Temporal optical colour-mixing takes place if the movement of a multicoloured surface in relation to the eye is sufficiently fast that the eye can no longer distinguish the individual colours. The classical way of demonstrating it was pioneered by James Clerk Maxwell, using fast-rotating discs similar to the one illustrated on the left hand side of *Figure 1*.¹
- Spatial optical colour-mixing results when regions of different colour on a surface are sufficiently small and closely-packed that, whereas from a near viewpoint they can be seen separately, from further away, they merge into one impression. The right hand side of *Figure 1* provides an example. Look at it from close and it will be seen as red dots on a green background, while from far it blends into one colour.

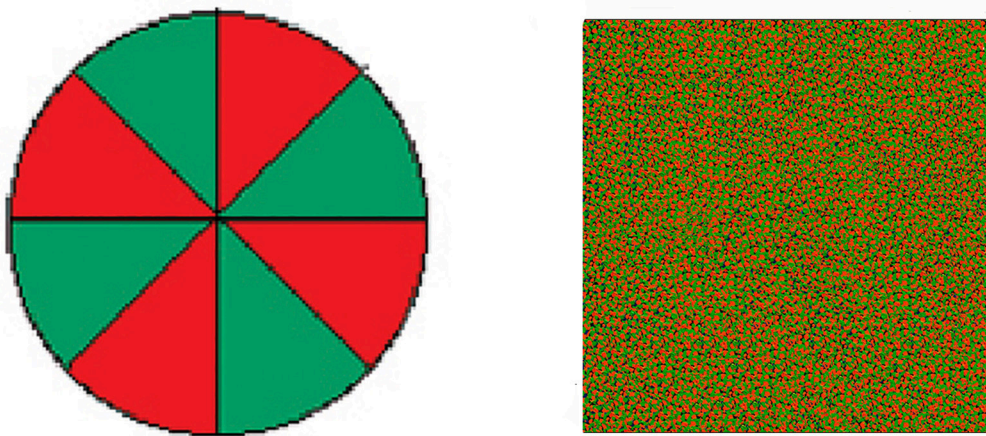


Figure 1: The two different methods of optical colour mixing described above.

The colours produced by both these methods are governed at least in part by the rules that apply to mixtures of coloured lights and can be described as “*additive*” colour mixing. Thus, for example, in both, red and green add together to make a yellow, even if a rather dirty one,² and not a black or grey or brown, as

1 Maxwell, 1856, Transactions of the Royal Scottish Society of Arts 4, 394-400.

2 “Dirty” because the complementaries of each of the component colours absorb light resulting in an accumulative absorption, whereas when coloured lights are mixed there is no analogous absorption.

they would be if the same pigment colours had been stirred up together.

Status

The popularity of optical-mixing as a systematically applied painting technique along the lines used by Seurat and the *Pointillists*, was not long lasting. Certainly, it is not practiced very much these days. Nevertheless, the ideas behind it and the lessons it provided for the community of artists have played such a key role in the development of the ideas of *Modernist Painters* that it deserves special attention in the context of a book which is so importantly inspired by them. They are also valuable for introducing information that will come in the next chapter.

The literature

Though not in fashion, no aspect of colour has been more comprehensively or better treated in the literature than optical colour-mixing. A great deal of what has been written about it was produced in the nineteenth century if not before.³ However, for anyone interested in the subject, the best book to read is indubitably, “*Seurat and the Science of Painting*” by W. I. Homer.⁴ It is a model of the best kind of scholarship, a fund of relevant information and introduces us to all the main authorities on the subject. I make no apologies for pillaging from this treasure-hoard.

The history

From surprisingly early on, scientists and artists rightly saw optical-mixing as a method of combining paint colours in such a way that they obeyed the laws of physics which govern the mixing of coloured light. Seurat’s name for this was, “*Chromo-luminarism*”, a slightly mysterious phrase which can be translated as, “*Paint-created effects of light*”. The scientist, Ogden Rood, one of Seurat’s main sources of information, gave the following account of its origins in painting:

“A method of mixing coloured light seems to have been first definitely contrived by Mile in 1839, although it had been in practical use by artists a long time previously. We refer to the custom of placing a quantity of small dots of two colours very near each other, and allowing them to be blended at the proper distance... The results obtained in this way

3 For example, Chevreul, 1839, Blanc, 1867 and Rood, 1879.

4 W.I. Homer, 1971.

are true mixtures of coloured light."⁵

Whether or not Rood was right in giving the accolade to Mile, the idea of optical mixing was soon to be well and truly in the air. For example:

- In 1839, the same year as Mile's article, Chevreul observed optical-mixtures between coloured threads in tapestries, noting that from an appropriate distance any two complementary colours create a "grey".⁶ He also used targets made up of alternating stripes of different colours to demonstrate the effect.
- Thomas Couture, the teacher of Manet advised: "*As much as possible use your colours pure, without mixing; if it is absolutely necessary to employ several colours to obtain exactly what you need, never go beyond three... Mix your three colours as you would twist three coloured threads, so that they could be distinguished... Veronese... seldom mixes his colours; in the skin where he requires many, rather, he gives samples, as it were, he places grey greenish tones by the side of red tones and, by doing so, manages to give extreme finesse to his colour.*"⁷
- John Ruskin, the widely respected English theorist and champion of Turner asserted that: "*Breaking one colour in small points through or over another is the most important of all processes in good modern oil or water colour painting.*"⁸
- Charles Blanc, acquaintance and enthusiastic supporter of Delacroix, gave us details of his hero's method.⁹ Thus, in one passage he illustrates the painter's use of optical-mixing by reference to a particular painting in which a pink flesh colour had been slashed with strokes of green (as in the paintings of Véronèse). This, he asserted, had the twofold effect of neutralising the pink and, when viewed at an appropriate distance, of creating a colour of unusual freshness.
- One could say that optical-mixing of the most general kind was, from the earliest days of the movement, the basis of the *Impressionist* technique. Central to their philosophy of avoiding the immorality of deception was the idea of making paintings which, from close, were seen as dominated by the paint as mark and material and, yet, from further away, blended

5 Rood 1879, already quoted in *Volume 3*.

6 Chevreul 1839

7 Couture 1868

8 Ruskin, 1857

9 Blanc, 1864

into a coherent image.

- There can be little doubt that Monet, Pissarro and the rest were aware of some of the local, complementary optical mixes that occurred in their paintings. Indeed, some have even gone so far as to describe Camille Pissarro as the first *Neo-Impressionist*. However, according to Pissarro himself and the general consensus of history, it was, “*Seurat who first put Impressionism on a scientific basis*” and who, more than any of his contemporaries, exploited the potential of optical colour mixing.
- Three-colour photography was invented, independently, in 1869, by Louis Ducos de Huron (1837-1920) and Charles Cros (1842-1888). Prints by Ducos de Huron were available for all to see at the *Exposition Universelle* in 1878. Cros, who was also a poet, was closely in touch with Felix Fénéon, Charles Henry and their circle. In these circumstances and considering Seurat’s hunger for relevant scientific information, it seems unimaginable that he was not aware of the pointillist characteristics of the early colour photographic prints.

Why were they interested

So, why were all these theorists and artists were so interested in Seurat’s ideas and practice? Here are four reasons:

- The huge increase in the number of pigments colours routinely used by artists.
- The quest for a method of depicting effects of light.
- The search for more exciting colour-contrast effects.
- The awakening of interest in abstraction in painting.

There follow sections on each of these topics.

A new palette of pigment colours

If science showed that optical-mixtures of different coloured paints behave like mixtures of different coloured lights, why not experiment with their use? The artists who adopted this line of thought initiated a radical reform of the traditional palette of colours. In theory at least, they abandoned the use of earth colours and restricted their palette to what they erroneously termed the “*prismatic colours*”. By this phrase they meant the pigment-colours nearest to the extremely pure

colours produced by shining white light through a prism.¹⁰ In view of their understanding of the theory of the three primaries and their interest in local interactions between complementary colours (see next chapter), the early *Impressionists* felt that they could best represent these with a basic palette of the three primaries and their three “*complementaries*” (otherwise referred to as “*secondaries*”). In this way they arrived at a six segment colour-circle from which they assumed they could mix all the colours they would need.

Seurat and Signac also made a point of eschewing all but the purest of colours. Accordingly, Felix Fénéon could assert that, “*Only prismatic colours play a role in the make-up of the paintings of Signac and Seurat.*”¹¹ Significantly, these two pioneers of *chromo-luminarism* were not content with a mere six parent colours. They realised that separate mixtures between any one these and one of its two neighbours *never* gave equally good results in both directions.¹² Clearly their palette must be extended.

Signac proclaimed that, “*The Neo-Impressionists absolutely repudiated all mixtures on the palette, except, of course, the mixtures of contiguous colours on the chromatic circle.*” His ideal was to create a colour-circle in which all the pigment-colours were not only fully-saturated but also capable of combining with their neighbours in either direction to create an extended range of fully-saturated colours. In reality, since no pigment colour, let alone mixture, is pure enough to achieve this goal, a best compromise had to be sought. We know what this consisted of in Signac’s case, since he wrote that his palette had, “*Always been composed of... cadmiums, vermilion, madder lakes, cobalt violet, ultramarine blue, cobalt blue, cerulean blue, emerald green, composed green no 1, composed green no 2, cadmium (yellow) light*”.¹³ Notice not only that the list contains thirteen colours but also that the plurals used in the cases of the cadmiums and madder lakes implies even more. Seurat it seems used a similar palette, using at least eleven colours, but almost certainly more.

We can assume that the precise number arrived by Seurat and Signac was at least in part a function of the range of pigment-colours available at the time. If they had lived in the 1970’s they could have taken advantage of the many new pigment-colours then available to get nearer to their ideal. A century later, an art-

10 Well known to us all as the colours of the rainbow.

11 Fénéon, 1889

12 For example, an ultramarine blue mixes well with an alizarin crimson to make a pure looking violet, but does not mix so well with any yellow to produce pure looking green.

13 Signac, 1935

ist friend, Alan Cuthbert wanted, for his own reasons, to establish the set of pigment colours that would allow him to mix the best range of as nearly-as-possible, fully-saturated colours. After extensive and thorough research, he settled for an ideal colour-circle consisting of eighteen pigment-colours. If Alan had been alive today, he would have been able to experiment with the various new pigment colours that have been made available in the last fifty years. There can be little doubt that their existence would have led him to include an even larger number of basic colours in his colour circle.

Equal lightness colours

Anyone experimenting with optical colour mixing will discover that the blending distance is greatly effected by the degree of lightness contrast between the colours involved. They will find that the greater the lightness contrast, the further away will be the viewing distance from which they blend.

They will also find that relative lightness has a great effect on the degree to which complementary colours enliven each other: The nearer the opposing pigments are to equal lightness, the greater will be the optical excitements produced.

Creating “light” with pigment-colours

With their palette of so-called prismatic colours, the *Chromo-Luminarists* set about “*painting with light*” according to the rules adopted by Seurat. The result went in the opposite direction to the keying up of colour that the *Impressionists* had achieved by placing relatively large patches of complementary colours next to one another. Here are two points made by Signac on the subject:

- “Red and green, if juxtaposed, enliven each other, but red dots and green dots make an aggregate which is grey and colourless.”¹⁴
- “Pointillism simply makes the surface of a painting more lively, but it does not guarantee intensity of colour...”.

For Signac the achromatic quality did not mean drab. On the one hand, as the quotation above indicates, he saw it as making the surface more lively. On the other hand and even more importantly, it represented the quality of the reflected-light which he and Seurat was intent upon painting.¹⁵ Presumably the colour

14 Here Signac seems to have got his theory wrong. In fact it would be a desaturated yellow or brown as demonstrated in *Figure 1*.

15 “*Painting with Light*”.

sensation in question is the same as the one that Cézanne was referring to when, early on in his career, he wrote to Pissarro, “*You are absolutely right to talk about the grey that alone rules in nature, but it is frightfully difficult to achieve*”. Later, we will come to a modification of Seurat’s ideas that offered him an approach to surmounting his difficulty.

The excitement of transition

The quotation from Signac mentions the way the *Pointillist* technique makes the surface of the paintings more lively. Felix Fénéon, the critic and Seurat-enthusiast was elaborating on the same theme when he wrote:

*“A pigment-based hue is weak and drab compared to a hue born of optical mixture: the latter, mysteriously vivified by a perpetual process of recombination, shimmers, elastic, opulent lustrous.”*¹⁶

Earlier, even before Seurat’s arrival on the scene, Charles Blanc, the critic and art historian who was an acquaintance and admirer of Delacroix observed that:

*“Separate touches of (contrasting) pigment will tend to form more pure and vibrant colours in the observer’s eye than would be formed by the more traditional mixing of pigments on the palette.”*¹⁷

Rood, another of Seurat’s sources of scientific information pointed out that:

*“There is a stage at which the colours are blended, although still somewhat imperfectly, at which the surface seems to flicker or glimmer.”*¹⁸

Viewing distance

As was soon realised by the artists involved in these exciting discoveries, viewing-distance was a crucial variable. From “*too-far*”, the separate colours would blend into one uniform region of colour. From “*too-near*”, they would be seen independently, with results depending on whether the opponent colours were juxtaposed, either when simultaneous colour contrast effects would come into play,¹⁹ or whether there is space between them, in which case, local interactions between them would be minimal. It was also clear that the blending point would vary with the size and the lightness of the dots used.

16 Fénéon, 1891

17 Charles Blanc, 1867, *Grammaire des Arts du Dessin*

18 Rood, 1879

19 See next chapter

Pissarro, an early convert to and proselytiser for *Pointillism*, had a rule for calculating the appropriate combination of these two variables. His recipe was to paint the dots so that they would be of a size and a relative lightness that would blend at three times the diagonal distance across the canvas. This was a significant idea for it was the first time, since the discovery of the rules of *linear perspective*, that artists were making paintings that could only fulfil their intentions from a specific viewing distance. A corollary of this is that an ill-chosen vantage point would deprive the viewers of certain visual excitements. If wrongly placed viewers might easily wonder what all the fuss was about. For example, George Moore, the Irish poet and novelist, observed that:

*“Instead of improving upon pictures painted in the conventional way, with respect to their brilliancy of colour, they present the most complete spectacle of discolouration possible to imagine.”*²⁰

According to the ideas of Felix Fénéon, George Moore would have had a completely different experience if only he had taken the trouble to move forward until:

“The multicoloured specks melt into undulant, luminous masses”.

But, given the chance Fénéon would surely have insisting on him going closer still until the image disappeared and was replaced by a moment of magic when:

*“The technique vanishes and the eye is no longer attracted by anything but that which is essentially painting.”*²¹

These last words are of great significance: They indicate that a revolution was taking place in the way that at least some people were reacting to paintings. Possibly for the first time, here was someone implying that abstract dynamics might provide the dominant experience in painting. Moreover, Fénéon made clear that the dynamic elements in question were the abundance of local colour-contrast effects.

Footnote to Chromo-Luminarism

In view of all this enthusiasm, how is it possible to explain the rapid falling off of interest in chromo-luminarism? Perhaps the explanation is the same as that for the rapid falling off of interest in the more recent Op Art, or indeed the relatively short life of every single one of the numerous fashions in painting that

20 George Moore 1893

21 Fénéon, 1887

proliferated in the Twentieth Century. In other words, it may be because creative people are always on the move: Their creativity implies a process of evolution towards the next step.

Another plausible alternative explanation for the falling off of interest in *Pointillism*, is more banal. Every artist who has tried out the method will have discovered that understanding the theory is easier than implementing it in practice. However hard one tries, it is virtually impossible without the aid of mechanical or quasi-mechanical processes to make a number of different optical mixtures to blend at the same viewing distance. Even to get anywhere near demands a hugely painstaking effort.

No wonder that, when artists realised that many of the main advantages of *Pointillism* could be achieved by traditional colour mixing methods, most of them chose the easier way. After all the *Pointillists* had to sacrifice a great deal in terms of freedom of mark-making and powerful simultaneous colour contrast effects.²²

Does this mean that chromo-luminarism had exhausted its potential? Certainly not. For evidence I can cite my own case for, when I came to make the stripy paintings discussed in *Chapter 23*, I found myself going back over the ground that Seurat, Signac and their mentors had researched. I also stumbled upon all sorts of painterly delights of which they may not have been aware. Amongst these I noticed:

- Intriguing colour changes due to differences in viewing distance.
- Grids of lines floating off the picture-surface, creating an extremely subtle kind of illusory pictorial space of a kind that I had never before experienced.
- Kinetic optical effects of the most subtle and exquisite kind, with lines bending and flexing in indescribable ways.

More of these later, in *Chapter 23* on “*Viewing conditions*”.

Implications

This chapter has been about the Chromo-Luminarism, better known as “Pointillism”. Although not practiced by many artists today, it was indirectly responsible for one of the great watersheds in the history of painting. It did not

22 See next Chapter 21: “*Local interactions*”

only achieve its avowed goal of finding a particular, rather cumbersome way to “paint with light”. Much more importantly, it laid the foundations for a comprehensive understanding of how to encourage perceptions of an illusory pictorial space imbued with a sense of light.

Beyond that the Pointillists were responsible for:

- Demonstrating the potential of an extended palette of colours.*
- Introducing the idea that dark or neutral colours (blacks, browns, greys etc.) could be mixed, using combinations of much lighter more fully saturated colours that have been taken from opposite sides of the colour circle.*
- Focusing attention on new dimensions of local colour contrast dynamics.*
- Forcing artists to realise the significance of viewing conditions.*
- Nudging them in the direction of abstract art.*

In all, quite an achievement.