CHAPTER 16

Reviewing the ideas (1)

Introductory

We have now arrived at the final PART of "Painting with Light". In it are three chapters. The first (this one) reviews ideas that have been presented in previous chapters. As explained there, some of these have a long history, going back both to the Italian Renaissance and to 19th century developments in science. Others are much more recent, arising from advances in the relatively new disciplines of neurophysiology and computer modelling. From the point of view of the subject of "painting with light", the most important of the new insights concerns ways in which the eye/brain mediates our perception of surface solidity, surface form, illusory pictorial space and ambient illumination (the prevailing quality of light). It tells of two great breakthroughs. The first being the late 18th century realisation that colour and, indeed, all visual experience is made in the head. The second, the discovery, roughly two centuries later, of two functionally independent visual-systems. One of these has much to tell us about surface-reflection (the subject of the previous chapters) and the other about body-colour, the subject of the chapters that follow. This chapter is also in two parts. The first contains a review of the theory. The second moves on to a list of basic questions relating to it. Each of these is accompanied by a short answer.

THE THEORY

In the first chapter of this book, I explained my early reactions to what I described as the "*rabbit out of the hat*" dogma of Professor Bohusz-Szyszko, namely the one which asserts the need to mix some portion of complementary into all the pigment colours painted on a picture-surface. My first idea was that the usefulness of the complementaries might be explained simply in terms of

colour-mixing theory since the admixture of complementaries is necessary to create the range of colour nuance required to avoid repetition in complex paintings.[1] However, the discussion of Seurat's ideas about "*painting with light*" and their ramifications as presented in the subsequent chapters[2] makes it clear that there is much more to it than that. It turns out that the use of *complex, complementary-containing paint colours* can have a transformative effect when it comes to depicting any of the following qualities of appearance in illusory pictorial space :

- Ambient illumination (prevailing lighting conditions).
- Surface solidity.
- Surface-form.
- Shadows and shading.
- Sense of depth (illusory pictorial space)
- Inter-reflections at junctions between abutting surfaces.
- Harmony and discord.

Clearly all seven are of utmost interest to the artists and, for this reason, it is appropriate to reassess their implications in the light of the new evidence.

Key to the next step in the story is Edwin Land's seminal demonstration of *colour-constancy*.[3] The way he did it was to project a sequence of different *mixtures of the three light primaries* onto an arrangement of coloured papers pasted onto a flat surface (which he liked to call a "*Mondrian*" and, subsequent researchers, a "*multicoloured display*"). To the surprise of nearly everybody, what this showed was that, as long as all three projectors were switched on, no matter what the relative intensity of the light they were emitting, there was no change whatsoever in the appearance of the any of the colours in the display. This stability is the reason why the phenomenon is called "*colour constancy"*.

According to the ideas presented in this book, this *absence of change* is a result of the eye/brain separating out the *surface-reflection* from the *body-colour* and treating each separately. The neural algorithm that mediates this separation finds the least reflective area within each region of colour and generalises the remainder of the region to match it. This is why, when colours are repeated in a painting, we see them as the same despite the fact that they are reflecting different

1 *Chapter 13, "Colour-mixing made easy"* and *Chapter 14, "Finding a maximum of colours".*
2 *Chapters 8 , 9, 10, 11 and many other places.*
3 Chapter 9 in *"What Scientists can Learn from Artists".*

wavelength combinations. The same neural algorithm goes on to extract a great deal of useful information contained in the surface-refection. Thus it enables us to experience:

- The phenomenon of temporal colour constancy (colours being perceived as the same on different occasions)
- Our sense of surface solidity
- Our awareness of ambient illumination (prevailing lighting conditions).

It also contributes, along with other visual systems, to how we experience the rest of the qualities of appearance listed above.

The variables

Maurice Denis[4] famously asserted that paintings are essentially, *"arrangements of colours on a flat surface"*. As such they are perceptually equivalent to Land's multicoloured display. Accordingly, they exemplify the conditions necessary for separating *surface-reflection* from *body-colour* and, as just explained, for providing the *surface-reflection profile* that informs about the *flatness of the picture-surface*.

This seems simple enough. However it should always be remembered that every visually mediated perception can be influenced by information coming from multiple processing systems (both visual and nonvisual), using information from a wide variety of different modalities of sensory input. Accordingly, any interpretations suggesting the flatness of the picture surface are likely to be the outcome of neural computations based on multiple sources of information. For artists the important thing to remember is that all *except one* of the visual systems[5] that make these calculations can only interpret a solid flat picture-surface as what it is.[6] The exception is the system that has played such a large part in this book, namely, the one that provides us an entry into illusory pictorial space.

In particular, these other systems are responsive to texture and edges, such that the more-textured the surface of a painting and the more evident its edges, the stronger will be the indications of surface-flatness and objectness influencing the interpretations of the eye/brain. Accordingly:

4 One of a group of progressive artists at work towards the end of the 19th century, known as *"the Nabis"*.

5 Motion parallax, stereopsis, accommodation, focus-based and cognitive cues .

6 Motion parallax, stereopsis, accommodation, focus-based and cognitive cues .

- The presence of textured surfaces will interfere with the perception of illusory pictorial depth, according to the rule that the more evident the texture the stronger will be the interference. It is only when the viewer goes sufficiently far away from the picture-surface for the texture to become invisible that its influence disappears altogether.
- The influence of edges on the perception of objectness of a painting can be either reduced or removed by arranging matters so that its borders are nearer to the limits of, or extend beyond, the viewer's field of vision. This can be done either by increasing the size of the painting or by approaching it. The perceptual impact of the borders of a picture can also be reduced by putting it in a frame.

It is of critical importance to the ideas being presented in this book that even if edge and texture cues are nonexistent or weak, the *wavelength-based visual systems* will continue to provide a flatness reading and, thereby, discourage perception of illusory pictorial space. That is, they will do so, unless they can be deceived. Luckily for artists, the required deception is exactly what the combination of the fourth and fifth dogmas of Marian Bohusz-Szyszko brings about.

From the point of view of the artists seeking to create an illusory pictorial space and/or "*a harmony that runs parallel to nature*"[7], this is wonderful news. What it means in painterly terms is that the use of never-repeating, complex colours, containing complementaries and near complementaries has the automatic effect of:

- Liberating them to take their place in illusory pictorial space
- Ensuring harmonious whole field colour relations.

Exactly where the liberated regions of colour will appear to be in the illusory space will depend on cognitive cues, such as those provided by shading, overlap, aerial and linear perspective and previously acquired knowledge of objects as they exist in the world of our daily experience.

Complexity simplified

One of the most difficult to understand parts of the argument presented in this book is the idea that the reflected-light, despite being invisible with respect to our conscious awareness, can have a central role in the perception of surface, space and prevailing lighting conditions. However, once we give credence to this

7 A quotation coming from Cézanne

possibility, we realise its benefits to artists. For example, if we have no conscious awareness of something, its precise composition can hardly matter. We need no longer be daunted by the problem of accurately representing the more or less infinite variety and complexity of *reflected-light*. All we need is to find a way of mimicking its two unvarying characteristics.

When we consider what these are we realise we have a ready-made way of depicting them in paintings. Thus:

- The *wavelength composition* of reflected-light can always be characterised as a continuum containing all the wavelengths of light. This can be represented in paintings simply by ensuring that *all colours in paintings are complex mixtures containing contributions from both halves of the colour circle.*
- The *whole-scene distribution* can always be characterised by the fact that the wavelength composition of the light reflecting from any one surface or region of a surface is never the same as the wavelength composition of the light reflecting from any other visible surface or region of surface. This infinite variability can be represented in paintings simply by using progressive colour mixing as a means of abiding by the rule that no colour in a painting should be the same as any other colour in it.

In other words the problem can be solved by following the dogmas of Professor Bohusz-Szyszko.

QUESTIONS AND ANSWERS

There follow a series of questions and answers which provide a check list of ideas presented in earlier chapters. The questions are ones that, according to my long experience as a teacher, many readers may not have been able to answer before reading this book, but should be able to answer after having done so. They relate to the perception of light, the three primaries (additive and subtractive) and the practicalities of painting surface-reflection.

Seeing Light

- Question: Can we consciously "see" light?

  Answer: "*No. We can only experience what the brain derives from it and turns into conscious perceptions*."

- Question: "What light-derived conscious perceptions does the brain make available to us?"

  Answer: "*On the one hand it enables us to see "body-colour (including shadows, shading and highlights) and, on the other, it enables us to experience solidity of surface, a sense of depth (including, illusory pictorial space) and an awareness of the prevailing lighting conditions*."

- Question: "Are *body-colour* and the properties of appearances that depend on the use of information residing in reflected-light, perceived in the same way?

  Answer : "*No. They are made available by separate visual systems and perceived in very different ways*."

- Question: "What are these?"

  Answer: "*Body-colour is perceived directly as colour, while sense-of-surface, spatial layout and quality of light are all perceived indirectly in ways that cannot be pinned down in words, but will be a part of everybody's everyday experience.*"

- Question: "What does this mean for artists?"

  Answer : "*It means that, while analysing body-colour is relatively straightforward, it is only possible to find out about the other aspects of visual experience indirectly*."

- Question: "How?"

  Answer: *By making comparisons between regions of similar body-colour. When we do, it is usually easy to see differences between them.*"

- Question: "What do these tell us?"

  Answer: "*They tell us about the relativities of the situation. Thus, one colour is either darker or lighter, more or less saturated and/or nearer or further in hue to a neighbour.*[8] *These judgements help us know in which direction we should move our paint mixtures*."

- Question: Is this the complete answer?

  Answer: "*No. It is also essential to extend the comparisons to take whole-field relations into account. This is necessary because every region of surface takes its place in the totality of the colour, lightness and texture hierarchies that exist in the scene being analysed. Thus, there will always be a lightest re-*

8 For example, bluer or yellower.

gion and a darkest one. In addition, there will always be a lightest and darkest representative within groups of similar colours found in the scene. For example there might be a darkest and lightest green, a darkest and lightest yellow, a darkest and lightest orange, a darkest and lightest red, a darkest and lightest violet, a darkest and lightest blue and/or a darkest and lightest grey."

- Question: "Can everyone see these differences?"

  Answer: "*If anybody can see them, then everyone can do so, unless (a) they cannot focus properly (for example, because they need spectacles and are not wearing them, or have a cataract) or (b) they have anomalous colour vision (the most common of which is colloquially called 'colour blindness').*"

- Question: Can seeing differences be difficult, even for people with 20/20 vision?"

  Answer: "*Yes. It is for this reason that it is worth remembering that no two surfaces or no two parts of any one surface can ever reflect light of precisely the same wavelength composition. Accordingly, if two regions of colour seem at first sight to be the same, it is worth persevering with the comparisons between them*."

- Question: "Are there any circumstances in which it will be impossible to detect differences between to regions of colour?"

  Answer: "*Yes. Sometimes the difference in reflectivity is below the threshold of conscious visual discrimination.*"

- Question: "Does this mean that the eye/brain is unaware of the difference?"

  Answer: "*Almost certainly no. The visual system that deals with surface-reflection is more sensitive than the one that deals with body-colour. As a result, it can and does make use of a great deal of information that is below the threshold of conscious visual perception*."

Light primaries

- Question: "What is the origin of the idea that there are three light primaries?"

  Answer: "*By the early 19th century it had already been demonstrated that the full range of "prismatic colours" as well as "white" can be matched with by mixing combinations of red, blue and green light beams (produced by superimposing beams light projected through three different filters). Early on, this discovery was correctly linked to the idea that there must be three different*

receptor-types in the eye, each maximally sensitive to the wavelengths of light associated with a different one of the three primaries."

- Question: "Can all the possible colour impressions found in nature be created by projecting mixtures of three light primaries onto a screen?"

  Answer: "*No. There are four reasons why not. One of these concerns the nature of additive colour mixtures and the other three; the involvement of the rod receptors. They are:*

  1. *All mixtures between light primaries produce a colour that is lighter than the parent colours.*[9] *This means that no colour that is darker than the primaries can be mixed from them. For example, dark blues, dark greens, dark yellows, dark reds, dark violets, browns, dark greys and blacks cannot be mixed in this way. To create these colours, other much brighter light sources are required to create a context for the mixtures of the three primaries such that, by comparison, they are perceived as darker.*
  2. *Many colours that appear regularly in nature cannot be matched except by adding an additional light primary.*[10] *These are to be found in abundance every day towards evening. This is because at low levels of illumination, the rod receptors (whose peak wavelength sensitivity lies between that of the blue and green receptors) take a more noticeable part in colour vision. Colours influenced by inputs from the rod receptors may also be found wherever the surface being viewed is in deep shadow.*
  3. *The same problem with matching applies to expanses of a single pigment-colour that fills the whole of our visual field. Once again, the reason is that, under these circumstances, the inputs from the rod receptors have a visible effect on what we see.*
  4. *At all times of day and at all levels of illumination, the rod receptors play a part in the perception of the effects that make use of information residing in the reflected-light, namely sense-of-surface, sense-of-spatial-layout and sense-of-quality-of-light. Artists who are interested in representing these vitally important aspects of our experienced reality will need to take rod participation into consideration. The*

9 See *Chapter 8, Figure 1*.

10 One explained by the participation in colour perception of rod receptors which have response characteristics in between those of the blue and green cone receptors. .

same applies if they want to explore "harmony" and "discord".

In these contexts, the conventional three primary theory will not do, not even theoretically.

Pigment-colour primaries

- Question: Are there any three pigment-colours that can mixed to match all other colours?

  Answer: "*No. There are two reasons for this:*

  1. *All mixtures between pigment-colour primaries can only create a colour that is darker than the lightest of the parent colours (whether, for example, in a yellow/blue mixture a red/green mixture or a purple/orange mixture). This means that none of the colours that are lighter than the primaries can be mixed from them. These include light blues, light greens, light yellows, light reds, light violets, pinks, light greys and whites. Some of these can be mixed by adding white (for example, pinks, greys, etc.). Otherwise, to a limited but extremely important extent, lighter colours can be created by making use of the phenomena of simultaneous lightness contrast and simultaneous colour contrast. The way to do so is simply to place the paint-mixtures concerned in the context of much darker colours.*
  2. *There is no pigment-colour whose absorption/reflection characteristics corresponds to any theoretical primary. This is partly because none of them is in the right place on the colour circle. However, it is also because theoretical primaries require very narrow absorption/reflection characteristics that are far narrower than that of any actual pigment-colour (ideally at a single wavelength). All actual pigment colours have a spread of absorption/reflection characteristics. Occasionally this may be relatively narrow, but is more likely to be relatively wide. Thus, there are blues that reflect to some extent in the reds and others that reflect to some extent in the greens. There are reds that reflect to some extent in the blues and others that reflect to some extent in the oranges, There are yellows that reflect to some extent in the greens and others that reflect to some extent in the oranges, etc..*

  An important consequence of the complexity of absorption/reflection characteristics is that mixtures of tube colours (unless themselves mix-

tures) can never precisely match the absorption/refection characteristic of any other tube colour."

- Question: "How many pigment colours are needed to create the greatest range of other colours?"

  Answer: "*All the pigment colours available. However, as assembling them all on a palette is unlikely to be practicable or even desirable, it will be expedient to make a compromise." I would suggest starting with at east 16, including black, white, ochres, browns and desaturated greens.*

- Question: "What is the total number of colours that can be mixed from combinations of other colours?"

  Answer: "*This is a difficult question to answer precisely. Several different estimates have been put forward. However, whatever the estimate, the number will be very large, ranging between hundreds of thousands and a few million. It follows from this that, in theory at least, colour-mixing considerations place very few limitations on artists."*

- Question: "What is the maximum number of segments into which a colour circle can be divided?"

  Answer: "*This is another difficult question to answer precisely, but in view of the possibility of millions of colours, the smallness of the number surprises many people. We know it is at least 72*[11] *and less than 144. For my numbers games, I am likely to plunk for either a 100 or 120.*

- Question: "Where do the other hundreds of thousands of colours come from?"

  Answer: "*By mixing across the colour circle (for example from red to green, from blue to orange or from yellow to violet) and up and down the colour circle (between black and white). If there were 100 steps in each of these directions, plus the 100 around the circumference of the colour circle, the result would be one million (100 X 100 X 100). It is true that these numbers are very approximate and that any of them could be greater or smaller. Nevertheless however approximate it be, they suggest a very large number. Even the most conservative estimates, arrive at one in the region of 500,000,*[12] *which is quite enough to be going on with."*

11 As demonstrated by the Munsell colour circle with this number

12 For example: 72 hues, 60 levels of saturation and 100 levels of lightness gives a total of 432,000.

Depicting surface-reflection

- Question: "Is it possible to depict a sense of surface, a sense of spatial layout and a sense of quality of light in an illusory pictorial space without using complementary colours and the rules of Professor Bohusz Szyszko?"

  Answer: "*Yes, it is possible. The reason is that, as well as being responsive to variations in hue, the visual systems which extract information from surface-reflection are responsive to degrees of lightness and to variations in texture. Accordingly, in the context of the kinds of visual experience being discussed, these achromatic properties of appearance can be described as "primaries". As a consequence, perceptual phenomena based on information derived from reflected-light profiles can be depicted using variations in lightness (tone, value) and texture alone.*[13] *Accordingly, a "sense of surface", a "perception of spatial layout" and a "consciousness of the quality of light" can be produced in charcoal, pencil or ink drawings.*"

- Question: "If achromatic media can produce all these effects, what is the point of worrying about colour. Do we need the rules of Professor Bohusz-Szyszko at all? Are there any advantages in complicating matters with colour for these purposes?"

  Answer: "*Yes. There are several advantages well worth considering. One of these is that, far from complicating matters, the combination of using the extra range of possibilities provided by pigment-colours and of following the progressive colour mixing method advocated in Chapter 14, makes it so much easier to avoid repetitions. But a much more important advantage is the potential of the experiences made available. Maybe they are more special for some people than others, but they are particularly special for me. Indeed, they have been the catalyst to my life as an artist and teacher.*

- Question: "Can these richer results be achieved without the use of complex mixtures containing colour from both sides of the colour circle?"

  Answer: "*No. If colour is involved at all, the presence of the complementaries is necessary for deceiving the eye/brain into furnishing us with the richest perceptions of a sense of light in an illusory pictorial space."*

- Question: "Is it necessary to represent surface-reflection in cast shadows?"

  Answer: "*Yes, if we want our depictions of cast shadows to give the im-*

13 As can be seen from certain shaded drawings and paintings made before the arrival of the *Modernist Painters*. One of many examples would be the paintings of Johannes Vermeer.

pression of lying on the surfaces on which they fall. Otherwise, they will be perceived either as dark patches floating in front of the surfaces or, more probably, as surfaceless holes."

- Question*: "*Is it difficult to avoid producing floating patches and dark holes of this kind?"

  Answer: "*No. Just ensure that the shadow colours are complex mixtures containing colours from both sides of the colour circle."*

Blacks

- Question: Is it true that we should not use blacks in our paintings?

  Answer: *"No, but they could cause lots of problems unless they are made using mixtures containing complementaries or near complementaries."*

- Question: "Is this why teachers discourage using black out of a tube and advocate using ones made by mixing certain pairs of colours, such as French Ultramarine + Burnt Umber or Viridian + Alizarin Crimson?"

  Answer: "*Almost certainly, yes. The tradition of prohibiting black straight from the tube in favour of mixtures of the kind just indicated, started with the early Modernist Painters and has stuck with us ever since." Significantly, blacks made in this way fit the requirements of the rules of Professor Bohusz-Szyszko and, therefore have the properties associated with them in this volume."*

- Question: "Surely this means that we should follow their example?"

  Answer: *"Not necessarily so. When black paint from the tube is mixed with colours coming from both sides of the colour circle, it fits the Professor's requirements equally well."*

- Question: "Are there any disadvantages to using the tube-blacks?"

  Answer: *"Not in principle. Blacks from the tube, when nuanced with complex mixtures of colours from both side of the colour circle, can produce a very large number of subtly different blacks. However, it is just as possible to nuance blacks made from complementary pairs in the same way and, thereby, produce equally large numbers of variations. The problem is not the blacks, whether from the tube or made with mixtures of complementaries, but that too many artists fail to see or understand the need for this additional nuancing."*

Lighting

- Question: "Does the angle at which a painting is viewed make any difference to it appearance?

  Answer: *"Yes, very much so. As explained earlier, it is only from a viewpoint from which there is an acute angle between the eyes, the surface of the painting and the light source, that reflected light will not interfere with the purity of pigment-colours and with whole-field colour relations. The implication for paintings illuminated by multiple light sources (for example, where a studio has more than one window or where a number of spotlights are directed at the same picture surface) is that there may well be no viewing angle from which these properties are not compromised."*

- Question: "What are the main differences between natural lighting and artificial lighting in terms of the way in which they illuminate picture surfaces?"

  Answer: *"There are two important difference. The first of these is that, while light from either of the two main natural primary light sources (the sun and the sky) strikes all parts of a picture surface with equal intensity, light from man-made sources does not. This is because the intensity of artificially generated light diminishes in proportion to the distance it travels.[14] Sometimes, we may not be aware of this. For example, we may not notice that the light from a single electric light bulb concentrates its energy in one part of a surface. However, if the light source is a spotlight focused on one part of a surface, the falling of on intensity in all directions will be evident. When the light source is a strip-light of a length that is equal to the width of surface that it is shining down upon, there will be a top to bottom fall off in intensity*

  In between these two extremes are the lighting conditions in daylit rooms into which no direct sunlight penetrates (a very common occurrence). Since, in such rooms, there are no primary light sources, all surfaces in them, including those of paintings, are illuminated entirely by secondary light sources.[15] If there is only one window then there will always be a diminution in intensity across the picture surface, with the part furthest from the window the least intense. Although, as explained earlier, these gradations are important to the way we experience paintings, their existence can easily be overlooked. The reason for this is that the visual sys-

14 This is easy to test by holding page of a book with small print nearer and further from a light bulb,.and seeing whether it affects the ease with which the text can be read.

15 In particular the light reflected back from all visible surfaces or regions of colour within them.

tems which mediate colour constancy are likely to have removed them from conscious perception. An idea of the extent of this removal can be obtained by taking a photograph of the painting concerned. Artists who have tried to photograph their work will know from experience that doing so is likely to reveal image-spoiling lightness gradations that were not visible to the naked eye."

- Question: How do these differences between natural lighting and artificial lighting affect colour relationships in paintings?

  Answer: *"The answer to this question can be obtained by comparing a painting viewed under natural or daylight studio lighting conditions with the same painting viewed under artificial localised lighting (whether from one or many light sources). At least some of the lightness and colour relationships between marks and regions of colour in different parts of the picture surface are likely to be different.*

  Question: "Does this matter?"

  Answer: *"It certainly can matter, but whether it does or not depends on the nature of the painting. It will be particularly damaging to any that prioritize:*

  1. *Whole-field lightness or colour relations.*
  2. *Local colour contrast effects*

  For example a Rembrandt, a Vermeer, a Cézanne, a Matisse or a Rothko[16] *would be seriously compromised.*

  However, it will have little effect on the readability of images.

- Question: "What is the second main difference between natural lighting and artificial lighting?"

  Answer: "*Natural lighting is to all intents and purposes equally intense at all wavelengths which is why is appropriate to refer to it as "white light". The light falling on painting illuminated by secondary light sources on a wall illuminated by daylight varies in this respect, but in most cases so minimally that it too can usually be considered as white light. The spectral properties of artificial lighting can vary much more. How much depends on the spectral emission characteristics of the light source. For example, it is evident that the now rapidly disappearing tungsten light bulbs produced a*

16 The full list of art works that would be diminished would be very long indeed.

clearly"yellow light". The case of the fluorescent light sources (including modern energy saving light bulbs) is less clear cut. In these, the light energy is generated by passing an electric current through a gas. What emerges is a number of narrow waveband emissions, with peaks that lie mainly in the invisible ultraviolet range. This state of affairs would not be fit for purpose if it were not for a coating of phosphors situated on the inside of the glass casing. These transform the wavelength characteristics of the light produced. A common aim of the manufacturers is to mimic natural lighting with its equal intensity spectral profile. However, they may decide to manipulate matters in ways that produce various qualities of white (for example,"warm white", "cold white" or tungsten bulb imitating "yellow" light). Unfortunately, no matter how laudable their intentions, they are restricted by the phosphors available with the result that the intensity profiles they achieve are not always as smooth as they would wish."

- Question: Does this matter?

  Answer: "*It certainly can do if the artists concerned have striven to get the colour relations exactly right according to some criteria that is important for the realisation of their aims. For example, colours that are of equal lightness in daylight are likely to be unequal in artificial light. There can also be significant hue shifts.*"

- Question: "Are there any advantages to using artificial light relative to daylight."

  Answer: "*Yes. In some cases it can help indifferent paintings look better. For example, spotlighting can greatly improve the look of a painting in which the whole-field relations are badly managed. For example, it can be used as a compositional device to give a greater prominence to the face of a portrait than it would have in natural lighting conditions. Or it can be used to emphasise the "golden section", a tactic that could well give a comforting sense of familiarity to spectators. Whether consciously or not this potential for artificially improving indifferent paintings is much used in art galleries. Unfortunately it is also used on paintings where the result is to undermine a fundamental virtue of the painting. For example it would be criminal to do any such thing with a Cézanne, a Matisse, a Bonnard, a Morandi or a Rothko painting.*[17] *Indeed, if authenticity is the aim, it would be a pity to use spotlights when illuminating the paintings of a large pro-*

17 Again the full list of art works that would be diminished would be very long indeed.

portion of the acknowledged masters."

- Question: "Are there any other advantages to using artificial lighting?"

  Answer: *"Many people believe that there are two of them. One is that it provides stability and the other, that it can be used in the absence of daylight. Both of these advantages can be very seductive. The former overcomes the difficulties due to the constantly changing nature of natural light. The latter makes it possible to work in the evenings, at night or on dark winter days.*

  These are indeed advantages but what is gained should always be set off against what is lost. For myself the loss would be catastrophic. Under such lighting conditions I could not make the kind of paintings that interest and excite me.

- Question: "What about paintings reproduced on computer screens or by means of slide projections? Have they any important advantages?"

  Answer: "*That depends on the kind of experience you are trying to generate. Images on computer screens are self-illuminated and slide projections are purely reflected-light (because the are viewed on reflective screens). Neither provides the information that enables the eye/brain to separate out body-colour from surface-reflection. Accordingly, they both produce colour experiences that could not be imitated in paintings. These have a special qualities and if these are what artists are seeking, they should be explored. But, as with the artificial lighting just discussed, what is gained must be set off against what is lost, namely the real surface/illusory space dynamic. Many painters, including myself, would regard the sacrifice as being too great."*

Implications

In the Chapter 1 of this book,"Painting with Light", I told of my first meeting with Professor Bohusz-Szyszko, at which he told me of five dogmas. These, he assured me, provide artists with "all they need to know about painting". The preceding chapters can be considered partly as a validation of his claim, and partly as a catalogue of its limitations. However, knowledge of these does not undermine value of the dogmas. On the contrary, it provides opportunities to extend and deepen their validity.

Does this mean that anyone who has read and understood the contents of this book is fully equipped for all aspects of painting? The answer is certainly

"no", although it could be argued that the dogmas represent the fundamentals, and that everything else is but icing on the cake.

What then are these"fundamentals" and what the "icing on the cake"?

***The fundamentals**:*

1. *Arrays of pigment based colours painted on flat surfaces and the colour-based phenomena relating to the experience of looking at them have interested painters over the centuries.*
2. *For many long years artists described as "colourists"[18] used lightness and texture variations as their means of creating illusory pictorial space. However, since the arrival of Modernism in painting, the role of colour has taken on a new importance in the depiction of it.*
3. *The creation of what Cézanne described as "a harmony that runs parallel to nature."*
4. *The dynamics that can be generated when illusory space is played off against real-surface perceptions.*
5. *The potential of whole-field abstract relations as visual excitements in their own right.*

The icing on the cake

Consists of the subjects discussed in the second part of this volume,"Painting with Colour". The best known of these relate to colour-contrast and lightness-contrast phenomena. Less well known, but well worth investigating are affects of viewing distance and viewing angle on appearances. However, understanding theory is not the same as using it, which is why we need one more chapter in this book "Painting with Light". This will not only provide simple guidelines to painting practice, but also remind us that theory too often leaves out the feelings, which are the most essential factor of all. Knowing the principles of how to explore colour space and being aware of all the other possibilities described in this book will only lead to academicism unless the knowledge is put at the service of the emotions. True colourists are excited by colour explorations, they enjoy the music of colour and they are elevated in spirit by the arrival of space and light into their paintings.

18 For example, "the Venetian Colourists" (Bellini, Titian, Giorgione, Tintoretto, Etc.)