CHAPTER 25

Chiaroscuro

Introductory

Edgar Degas defined a colourist as, "someone who can make a Venetian Red in a painting look like a Vermilion without actually touching it." It is said that he had Rembrandt in mind. Whether this is true of not, analysis of the Dutch master's work makes it clear that his use of whole-field lightness relations enabled him to ratchet up the colourfulness of selected colours in otherwise relatively low key colour schemes. In fact, it was a long established tenet of the academic teaching that darkness is needed to set off lightness. Since the Italian Renaissance, it has been known as "chiaroscuro", a practice which came to embody the rule that no two parts of a painting should be of the same lightness.[1]

Notice the similarity of this rule with the assertion of Professor Bohusz-Szyszko that no two colours in a painting should be repeated.[2] *The critical difference between the two is that the usefulness of chiaroscuro can be explained without reference to either hue or to saturation. However, although the theory is straightforward, the ability to master it is far from being so. This will be evident to anyone who attempts to make a charcoal drawing of any scene without repetition of regions of lightness.*

The first problem is that of sensitising ourselves to the lightness differences in the scene being depicted. When we try to do this we find ourselves faced with all the difficulties caused by the phenomena of ***lightness-contrast*** *and* ***lightness-constancy****. Fortunately, our eye/brains has evolved a finely honed method of wheedling out the needed information from the fractured and distorted visual*

1 For example, Turner as testified by Ruskin.
2 The subject of *Chapter 1* of "*BOOK 1 : Painting with Light*".

world it creates for itself, namely, our familiar friend ***comparative looking****. But for reasons that will become evident, even this trusty tool has its limits.*

Mach bands

Figure 1: Vertical Mach bands

Perhaps the simplest way of explaining the problem with which *simultaneous lightness contrast* confronts artists when painting from observation is to refer to a well known visual illusion. This was first demonstrated to the scientific community by Ernst Mach (1838-1916), a German physicist, philosopher and pioneer of *psychophysics*, who introduced the now famous "*Mach Bands*". As illustrated in *Figure 1,* these consists of a number of evenly pigmented grey stripes arranged in a sequence according to degrees of lightness. What Mach noticed was that the stripes (except possibly at the two extremes) appear to be graduated such that each is seen as darker on the side which abuts a lighter colour (left hand side) and lighter on the side that is next to a darker one (right hand side). Mach realised that the only plausible explanation for the illusory gradations was *simultaneous lightness contrast*.

Figure 2 shows a neat way of testing this conclusion. In it, four alternating stripes from *Figure 1* have been separated from their *Mach Band* context, such that the three of the seemingly graded achromatic band are now flanked by identical whites. Notice that this means that the degree of contrast at the two edges of each separate band is now identical. The fact that this manoeuvre causes the apparent grading from dark to light, or visa versa, in *Figure 1* to disappear, demonstrates that the perception of gradations is an illusion.

Figure 2 : The 2nd, 4th and 6th band separated from their context.

Other examples of Mack bands are provided by *Figure 3* and *Figure* 4. *Figure 3* shows that, when the vertical *Mach Bands* are made to be narrow, they can be perceived as fluted pillars. They certainly would be if they were to be placed in the context of a perspective rendering of a building, topped by capitals and given a pediment to support.

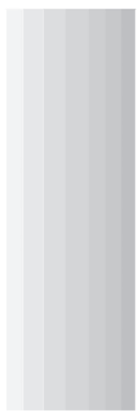

Figure 3 : Mach bands as a fluted pillar

Figure 4 shows that when the Ma*ch Bands* are turned on their side, such that they progress from darker at the bottom to lighter at the top, they meet the requirements of Claude of Lorraine's rules for depicting ranges of distant hills in a landscape.[3] As with the vertical *Mach Bands*, the individual bands appear as graduated. In this case, from darker at the top to lighter at the bottom.

3 The basis of what came to be known as, "*Aerial perspective*".

Figure 4 : Mach bands as landscape

A question

The question arises as to how would you set about depicting any one of these arrays of these seemingly graded achromatic bands? Since your eye/brain is telling you that the bands are lighter one edge and darker on the other, would you follow their guidance?

If you were to do so the result of your efforts would look wrong, since the whole point about *Mach Bands* is that they are not graded. The only way of depicting matters so that you will experience them as being graded as perceived is to make the bands exactly the same flat colour as they are in the original and leave the grading to the eye-brain.

Mach bands in nature

The same applies when it comes to depicting simultaneous lightness contrast effects in nature. As illustrated in *Figure 5*, a well known example of this occurs where there are ranges of distant hills topped by a relatively light coloured sky. Each of the bands of grey gives the impression of being darker at the top and lighter at the bottom, but if a region within its edges is masked off, the result will be a colour almost as flat as those that make up the artificially produced *Mach bands*. *Figure 6* illustrates this by showing separated off segments from the sky and the hills. There is no gradation to be seen in any of these. Notice also that, unlike many depictions of it, the sky actually gets darker towards the bottom.

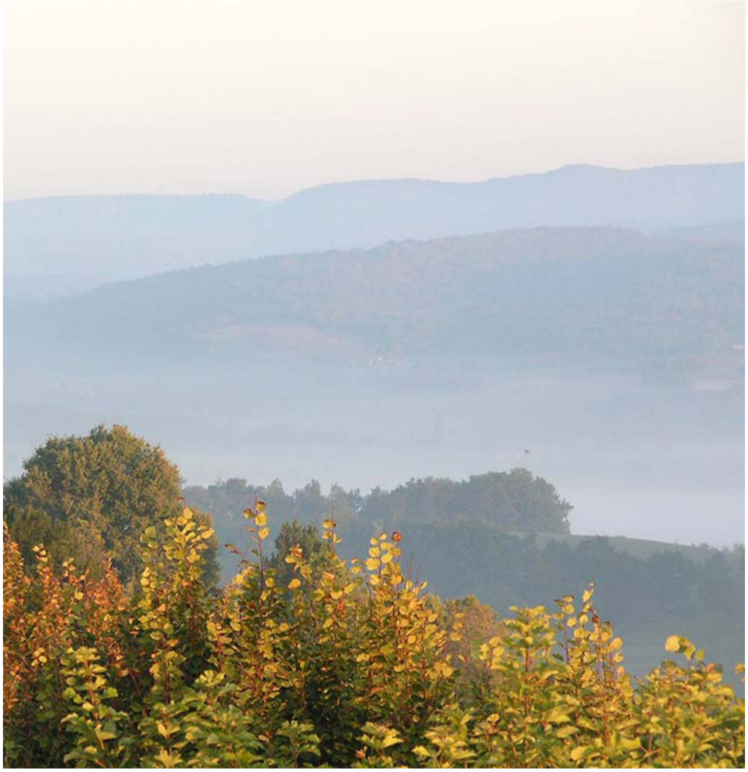

Figure 5 : Distant hills and sky, from the studio window

Figure 6 : Segments of sky, further hill and nearer hill

Painting what you see

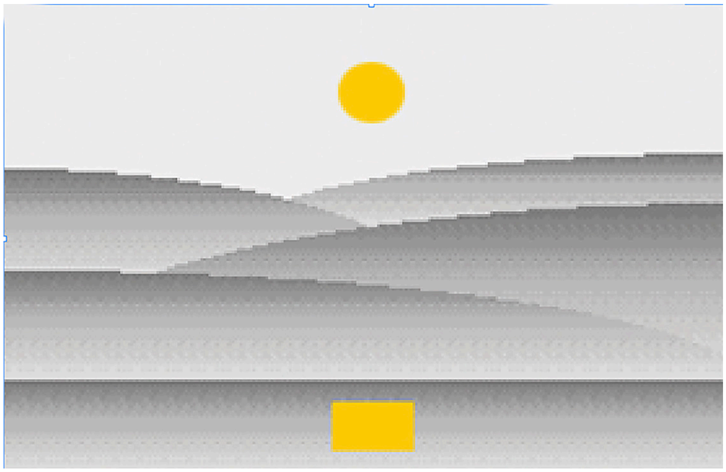

Figure 7: Schematic hilly landscape with illusory gradations represented

Figure 7 is a highly schematic rendering of the perceived lightness gradations in an imaginary scene, featuring a sky behind five ranges of progressively distant hills. Notice that the each range of schematised hills is graded from darker at the top to lighter at the bottom, while the sky grades in the opposite direction. In the sky a yellow disc is used to represent the sun, and, in the lowest band, a rectangle of an identical yellow is used to represent a sunlit house-front. The purpose of this image is to illustrate what would happen to *two regions of identical yellow* if the illusory lightness gradations were to be depicted as perceived, that is to say as graded from darker at the top to lighter at the bottom. There are two aspects of the outcome that are particularly worth noticing:

- That each of the darker greys found at the tops of all the ranges of hills turn out to be approximately the same level of lightness, as do each of the lighter greys found at the bottoms.
- That the round yellow in the sky appears to be roughly the same lightness (and, indeed, colour) as the rectangular one in the bottom band.

Although, the outcome of constructing an image in this way would be perfectly acceptable to some artists, others could well be greatly disappointed. They certainly would be if their original aspiration had been either to follow Claude of Lorraine's rules or to fulfil Degas' criteria of a colourist as someone who is able to use *whole-field lightness relations* to effect the colour of either the house-front or the sun. As it stands, the image is far from having the *lightness-range* necessary to dramatically change the way we see the yellows, which is why both the sun and the house front look both the same and relatively dull.

Painting what you cannot see

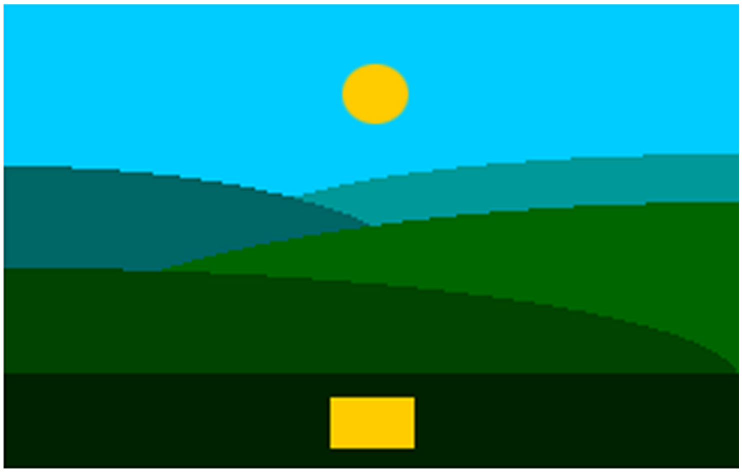

Figure 8 : Hills that are the same lightness from top to bottom

Figure 8 shows that to give the desired brightness to the sun and the house front, it is necessary to ignore all illusory gradations in lightness. Instead the hills must be painted as being much more even in lightness than they appear to be. If this strategy is adopted, the eye/brain will restore the illusory gradations in the painting, just as it did to recreate the illusory gradations in *Mach Bands* Also, it will produce a much more realistic range of whole-field lightness relations.

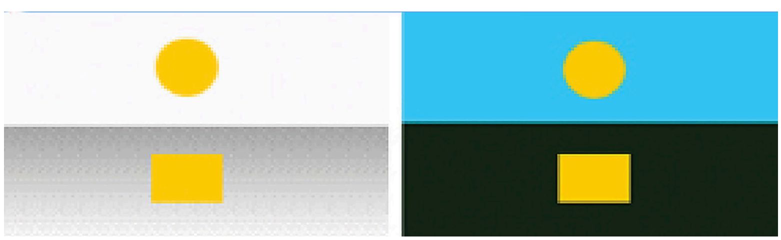

Figure 9 : Contrast effect illustrated

Figure 9 illustrates differences between the yellow discs and the yellow rectangles in *Figure 7* and *Figure 8*. Comparisons between them illustrate the effect of the different contexts on the appearances. It is hard to believe that all four of the yellows are made of an identical pigment colour. While *Figure 7* shows that without sufficient lightness contrast the yellows can only be relatively dull. *Figure 8* illustrates Degas and Rembrandt's idea that colours can be made more brilliant by means of context alone.

How bright is the sky?

Getting the sky-colour to be dark enough is another perennial problem for artists. Part of the explanation is likely to be a ramification of the *Mach Band* effect, since exaggerating the apparent contrast between sky and the adjacent, darker-coloured hilltop will automatically result in the sky seeming lighter than it should be. Interestingly, the tendency for artists to make skies too light relative to the lightness of the colours in the landscape was remarked upon by John Constable. Indeed he identified doing so as the main matter to be learnt by aspiring by landscape artists. Those who wish to avoid falling into this trap should, before applying any paint, spend a good deal of time comparing the lightness of the sky with the lightnesses of other relatively light regions in the scene.

Whole-field lightness relations

Unfortunately, although it might seem straightforward enough, the accurate analysis of *whole-field lightness relations* is far from being so in practice. The complications arise from fact that the primary role of the *eye/brain* is to relate what it is looking at to its potential use. The first step in this process is recognition and among the very first steps in achieving this goal is to make groups of similar regions of colour. As differences in reflected light mean that no two regions of the same body-colour provide the same wavelength combination, this would be impossible if the eye/brain had no way of separating *body-colour* from *reflected-light*. But, as explained earlier, it does have a way of doing so, the result being the phenomenon of *colour-constancy*. But this alone would be of no use if the eye-brain could not also achieve *lightness-constancy,* which it does by resetting to a default range of lightnesses after each separate act of looking at each separate region of colour. In practice, what this mean is that, if the range of lightnesses in the real world input is greater than a default range it will squash reality into it. Alternatively, if the range is narrower than it, it will expand reality into it. A consequence of this is that all information about difference is lost. Luckily for artists and, indeed, for the animal kingdom as a whole, the squashing or stretching process takes time, Just enough of it for our *comparative-looking systems* to be aware of it.

To give a practical example of a problem created by *lightness-constancy*, imagine a scene within which the difference between lightest part and darkest part is great. Now imagine there is a region within this scene within which the range of difference is smaller (as will always be the case). Left alone the *analytic-looking systems* would fit the whole and the detail into the equivalent lightness ranges. To the extent it succeeds, it will classify the two different lightest regions as being of the same lightness and the two darkest regions as being of the same darkness. This means that, if artists paint what they see, the result will have more in common with *Figure 7* than *Figure 8*. One inevitable outcome will be many repeated lightnesses.

A numbers game

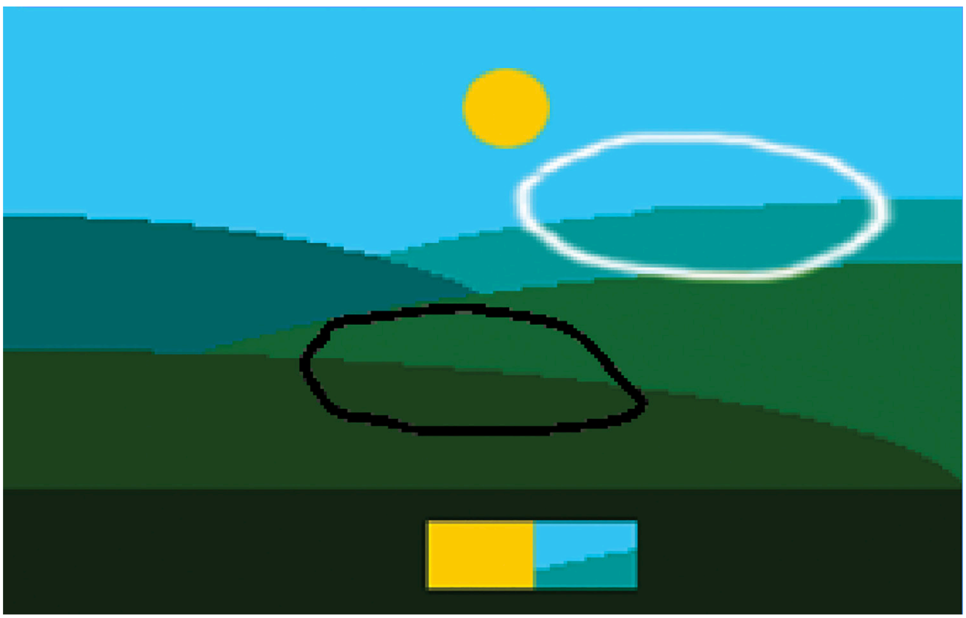

Figure 10 : Computing lightness in a real scene.

The influence on appearances of the combination of *lightness contrast* and *lightness-constancy* is so important that is worth illustrating by means of a simple numbers game[4]. Although the numbers used are arbitrary and the operation of eye/brain systems grossly oversimplified, this delivers the right messages. It starts by

4 This is an arbitrary number. For the purpose of the numbers-game any range of numbers would do.

positing a lightness processing region wit located in the visual part of the brain, with a lightness range of one hundred steps. This means that if we imagine that the eye/brain focuses exclusively on the region ringed by the white line in *Figure 10*, the blue/green of the hilltop will be given the value of *zero* and the blue of the sky, the value of *100*. Similarly with the two colours circled by the black line, the darker region be given the value of at *zero* and the lighter one that of *100*. Clearly something does not add up.

Now let us consider the image in *Figure 10* as a whole. In this case we find that the band of dark green at the bottom becomes the *zero*, and the yellow disc and rectangle become the *100*. From this global perspective, the darker of the two colours within the white ring is very far from being *zero* and the lighter of the two colours can no longer be *100*. Consequently they will have to be revised. As the jump in lightness between the circled hilltop and the dark green band is now considerable, the lightness of the hilltop may have to reassessed on the scale representing the image as a whole. Perhaps it should be as high as 70 or even 80. Meanwhile the blue of the sky within the white line is certainly darker than the yellow disc and its lightness scaling will have to be revised down, say to around 90. This would leave the lightness ratio between the two colours in the white ring when considered in the context of the whole image as something like *75/90*, a great contrast with the *0/100* in the whole image. Analogous factors apply to the region ringed by the black line. Since the lighter of the two colours within this ring is darker than the darker colour within the white ring, the numbers ratio, when considered in the context of the whole image, might be something like *30/50.* Once again very different when compared with the *0/100* produced under localised analytic-looking conditions. In both cases, if we paint what our analytic system is telling tells us, we will leave no room for giving lightness values to the darkest and lightest colours in the image as a whole, since this contains colours that are both lighter and darker than the darkest and lightest of the colours within the selected rings.

So what can we do about this seemingly problematic situation? Since all analysis requires the use of analytic-looking systems, we have no choice but to operate by means of *same/different judgements*. The problem is that the lightness constancy system recalibrates as it goes. As the recalibration is automatic, there is no way to stop it happening and thereby obscuring difference. Luckily this does not matter as much as it might seem at first sight. The reason is that, if the comparisons are rapid enough (using glances lasting no more than one third of a second), it is possible to catch the *lightness-constancy system* in the process of adjusting, and thereby provide reliable difference information. Accordingly, sequences of rapid comparisons can be used to build up a surprisingly reliable map of the lightness relativities within any scene as a whole. But be warned any dallying will mean that crucial information about relativities will be lost.

Although the both the numbers game and simplified landscape illustrated in *Figure 8* and *Figure 10* are both highly schematic, the issues demonstrated are fundamental to the creation of lightness/darkness dynamics ('*chiaroscuro*') in all paintings, particularly those made from observation. They also provide the basis for Degas' definition of a colourist, and the reason why Rembrandt was able to make an earth-red seem like a vermilion.

Corners and facets

Figure 11 : Mach bands and walls meeting at a corner of a room

Figure 11 shows a very common manifestation of the *Mach Band* effect. It happens at virtually every corner of every room where the walls are painted in a uniform colour (in the example illustrated, both surfaces are painted from the same pot of white paint). This is because the lightness of any surface is to some extent influenced by the angles at which it is viewed. What we actually see is this relatively small difference as exaggerated by the eye-brain. Again, the solution that will enable artists to maintain a plausible lightness-space is to ignore appearances and paint both surfaces as flat minimally graded colours of much less contrasted degrees of lightness, as illustrated in Figure 12.[5]

Figure 12 : Segments of Figure 11 without the contrast effect.

Another example.

Figure 13 shows several examples of the *Mach Band* problem in one scene. I will pick out two of them.

Figure 13 : Mach band problems again

5 Not totally flat or uniform since no two regions of colour in nature are ever quite the same.

Figure 14 : Right hand side pillar

In the first example, *Figure 14* shows a detail of *Figure 13.* In this the shaded side of the pillar (facing us) is contrasted with its two edges:

- On the one hand, by its much lighter, sunlit face, making it look darker in comparison to its left hand side.
- On the other hand, by the much darker colour of the door, making it look lighter that its right hand side.

Figure 15 : Junction between step and door frame

The second example from *Figure 13* is illustrated by comparing it with *Figure 15.* It concerns the shadow on the step and the wooden door. Due to the lightness-contrast between the shaded and the adjacent sunlit parts of the step, the shadow looks very dark and the sunlit parts look very light. However, when we look at the far end of the surface of the step to the part which is not bordered by the cast shadow, it appears to be less light, even though the sunlight shining on it is identical.

Again artists need to take this incompatibility of perceptions into account.

If they wish to get as near as possible to veridicality, they will have to do their best to compensate for the *contrast-effect* and trust the eye/brain to restore it when confronted by their finished painting.

Implications

This is the first of three chapters which investigate problems that artists experience due to the distorting effects of lightness-contrast phenomena. It is therefore appropriate to leave the summing up of implications to the last of the three.