CHAPTER 14

The mixed history of linear perspective

Introductory

Academic tradition divides the subject of "perspective" into two aspects, known as "aerial" and "linear". Aerial perspective concerns colour changes due to the influence on appearances of atmospheric particles situated between the eye and the object being viewed at a distance, and is dealt with in a separate volume.[1] In this book attention will be confined to linear perspective. Moreover, to avoid misunderstandings, it is important to stress that no attempt will be made to compete with the many existing texts on this subject which demonstrate that, when properly applied, the well-known laws can enable the construction of moderately realistic images without the need to actually look at anything. As far as I know there is nothing of interest to add to these, although, a great deal needs modifying in many of the texts on the subject which regrettably give us oversimplified and therefore misleading versions of this complex and elegant subject. Rather, in this volume, the laws of linear perspective are treated in a completely novel way: not as a set of instructions for the placement of lines on but as a tool for guiding looking strategies. This transformation is achieved by placing them in the context of ideas coming both from 19th century research into visual phenomena and from much more recent discoveries relating to the functioning of eyes and brains. In PART 2, the subject of anatomy will be treated in an analogous way for analogous reasons.

It is a matter of history that from the 15th century until well after the Second World War, first apprentices and then art students in Europe and in North America were routinely obliged to learn about linear perspective[2] and anatomy.[3] However, since the time of the Impressionists the value of both subjects as artistic

1 *"Painting with Light"*

2 Also sometimes referred to as *"scientific'"* or *"mechanical"* perspective.

3 To this day, it is rare to find a how-to-do-it book that omits these two subjects altogether, even if their treatment of them is often extremely minimal and not uncommonly misleading.

aids has been questioned. So much so that many artists have come to see them as straitjackets inhibiting creativity and self-expression. In the following chapters it will be argued that, although valid in their own terms, the criticisms relate only to the traditional way of using the two subjects. They have nothing to do with the content of this book which concentrates on ways in which both can be used as aids to seeing in new ways.

To explain how this can be the case, it will be useful to start by imagining a teacher pointing out a particular feature of a scene to her students. The purpose of doing so is to drawn their attention to something that might otherwise have been overlooked. If the students follow their teacher's suggestions, they will find that their visual awareness has been expanded accordingly. However, teachers are not always on hand and sooner or later, the students will need to find their own ways of seeing in new ways. Various alternatives are detailed in "Drawing with Feeling". These include:

- *Making comparisons (between model and copy, between different copies, between near symmetries, etc.).*
- *Taking advantage of mistakes.*
- *Analysis in terms of in front /behind relations.*
- *Looking for enclosed shapes.*

There it is explained in a great deal of detail just how effective an appropriate understanding of these simple strategies can be in helping people to sharpen their analytic powers and, in the process, expand and develop their visual awareness and sensitivity.

Another form of knowledge-guided looking depends on having an understanding of regularities of appearance such as those encoded in the rules of linear perspective and described in books on anatomy. Although these can tell artists nothing about the particularities of appearances which give individual character to each object, they can provide extremely useful ways of guiding looking behaviour. For example, if the laws of perspective tell us that the base-line of a wall should be sloping up towards us but we see it as sloping down away from us, we are challenged to find out why. By providing plausible explanations not only for this particular mystery but also for a whole list of others which artists are likely to encounter when drawing from observation, what follows in PART 1 will be enormously helpful to anyone who wishes to make progress without the help of a teacher.

The history of linear perspective

The purpose of this chapter is to introduce the history, the theory and the practice of using linear perspective with a view to showing in later chapters how knowledge of its rules can help artists to look in new ways. The rules were discovered (or rediscovered) and fairly completely developed at the time of the *Renaissance*, by a small group of men, amongst whom were the architects Filippo Brunelleschi and Leon Battista Alberti and the painters Piero della Francesca, Paulo Uccello, Leonardo da Vinci, Albrecht Dürer and Johannes Vermeer. These pioneers were faced with two related problems namely:

- How to make accurate depictions of *actual scenes in the real world*.
- How to make realistic images of objects and places *without reference to any real scene.*

The solution they found for making accurate depictions was to use a range of devices which enabled a more or less mechanical transfer of the elements of the scene directly onto the picture support. The earliest recorded example involved tracing around the image a building as reflected in a *mirror* (made of highly reflective metal). The idea of doing so was first explored by the architect/artist Brunelleschi and enabled him to draw an accurate if back-to-front image of the *Baptistery in Florence*. To solve the reversal problem, Brunelleschi punched a hole in the centre of the mirror on which the tracing had been made. By looking through this he could see the right-way-round reflection of his drawing in a second mirror placed in front of the first. Later, other artists used other devices. For example, Leonardo da Vinci made tracings of objects on pieces of *glass* through which he was viewing them. Later, he transferred the image he had produced onto his picture-support, using a *squaring-up* technique. Dürer also used or knew about a variety of other ingenious contrivances, including *perspective frames*. Not so very long afterwards, the *camera obscura* became available and was tried out by Vermeer and others. It proved to be the forerunner of a sequence of alternative *image-capturing* and *projecting devices,* leading eventually not only to the *photograph,* which could be squared up, but also to the *slide projector* and *computer printouts*.

A solution to the second problem (that of constructing images from scratch without reference to existing objects) was of evident interest to architects, since it would provide an effective means of pre-visualising their ideas, both for their own purposes and as a means of communicating with clients. It would also be of

use to painters when they were required to paint mythical or historical scenes, for which there was no alternative but to resort to the imagination. Naturally both these groups were very exited when the *laws of linear perspective* were discovered and turned out to be ideal for serving these needs.

The first breakthrough came from Brunelleschi's mirror demonstration (just described)[4] and, in particular, from the realisation that *the entire baptistery could be seen through a tiny peephole*. This suggested the idea of a viewpoint from which eye-beams fan out along *lines of sight.* The notion of mapping lines coming from a variety of different viewpoints was the next easy step and, after that, it was a matter of working out the ramifications with a view to producing a set of construction rules. Brunelleschi in conjunction with his student and colleague Alberti, having grasped the nettle with obsessive enthusiasm, was soon well on the way to conquering the subject. Piero della Francesca, Paulo Uccello, Leonardo da Vinci and others worked out various important refinements. In short, the *Renaissance* artists clearly understood that there are two different problems which require two different solutions and they found a series of mechanical devices for the one and a set of laws for the other. Both worked extremely well for their respective purposes.

So what went wrong?

The only explanation that I can suggest is that the natural processes of history took over. As the laws of linear perspective were passed from generation to generation they were more and more slavishly followed with less and less real understanding. Somewhere along the line, the very different functions of the *devices* and the *laws* got confused, with the result that, nowadays, few, if any, writings on linear perspective make the distinction explicit. Also, remarkable for their absence are warning of the serious problems that can arise if anyone tries to use the laws as a *guiding framework* when drawing from observation.

The problem

Figure 1 is a photograph of a street in my hometown of *Castelnau de Montmiral*. It is a view which contains edges receding to a number of vanishing points at a number of horizons. To create a perspective framework that takes these into account requires making judgements relating to the critical orientations. As we shall see, doing so can be fraught with difficulty. In contrast, the search for them can prove both fascinating and fruitful, as the following chapters will make clear.

4 Also, described with an illustration in *"Drawing with Feeling"*.

Figure 1 : A view down rue Gambetta.

What then are the problems that face all who attempt to use linear perspective constructions as a means of facilitating the accurate rendering of actual scenes? Insights as to some answers emerge from two sources, namely research done by myself into the reliability of visual measurements and the study of well known eye/brain mechanisms. The research showed that *absolutely everybody has poor capacities for making the visual measurements of orientation, relative length and relative position.*[5] This is true even when people are tested on copies of *simple arrangements of straight lines drawn on a flat surface*. The studies of eye/brain mechanisms reveal a complex

5 *"What Scientists can Learn from Artists", Chapter 8.*

of ever present visual distortions created by the *constancies of orientation, size and shape* which explain some of the poor capacities and provides good reasons why attempts at depicting three dimensional, real world scenes are bound to be even more error-prone than those produced when copying lines on paper.[6]

Faced with the predicament in which this places them, what could be more natural than that artists should to look for ways of making life easier? And what more attractive than starting with a logically constructed and totally reliable *guiding framework* into which the elements of the picture can be snugly fitted? Assuming that the laws of linear perspective are reliable (which, if understood properly, they indubitably are)[7], then why should they not be used in this way and why should the result not be depended upon? The argument sounds very persuasive. Unfortunately, it is flawed on at least four counts.

The first flaw

The first flaw relates to the just mentioned difficulty of judging orientations. Don't forget, the need for the framework in the first place is to compensate for poor capacities for making such judgements. Why then should we trust ourselves when it comes characterising receding horizontal edges of varying heights from the ground which the rules say should *meet at the same vanishing point*? And, if we cannot judge them correctly how can we rely on any framework based on them? As we shall see in the next chapters, there are all sorts of reasons why the likelihood of getting orientation judgements right is very small, even if the buildings are modern, four-square and regimented. It is a chicken and egg, no win situation. We should not be surprised that in drawings by beginners, inexperienced amateurs and too many professionals the *guiding framework* so rarely fits the actual scene being depicted, as seen from the viewing position adopted. Nor is this the end of the matter. Once the framework is falsified, the fate of the artist is sealed. From then on he or she will have no alternative but to seek ways of compressing the proverbial quart into a pint pot (or vice versa) and face up to the need for an unremitting sequence of compromises.

To make matters worse, experience shows that if ever the realisation dawns that something is seriously wrong, few people seem to suspect that the culprit is the supposed rock upon which the whole edifice has been built. Sadly, even

6 *"What Scientists can Learn from Artists", Chapters 10 and 15.*

7 Although theoretically all lines in linear perspective constructions should be curves. As we shall see, this only becomes a matter of importance for views that are too large to be encompassed by the motionless head.

if they do, the chances are that by this time the picture depending on it will be beyond reasonable redemption. Since all the line lengths and orientations are interdependent, attempts to correct any one of them has implications for all the others. The task becomes like trying to fit a five cornered carpet into a four cornered room.

The second flaw

Figure 2 : As Figure 1 but with a selection of perspective lines added

The second flaw in the argument is a ramification of the first. It concerns the

difficulty of making accurate linear perspective constructions for scenes containing irregular elements. Just imagine how every difficulty would be exacerbated in a place like *Castelnau de Montmiral*, founded in the thirteenth century and evolving idiosyncratically ever since. The problem resides in the fact that it is the omnipresence of irregularity that gives this ancient town its character, individuality, its charm and its sense of history. *Figure 2* shows how this is true for the scene illustrated in *Figure 1*. Little is quite vertical, horizontal, parallel or straight. The superimposed perspective lines give some idea of the confusion that occurs when trying to create a perspective framework for such a scene. Capturing this is difficult enough even when measurements are made with a ruler on a photograph. Clearly everything would be much more difficult in a real world scene where there is no option but to rely on extremely fallible visual capacities for making judgements relating to the orientations of not necessarily horizontal features. Imagine judging the angle of a gutter, a beam or the line dividing the bottom edge of a building from the pavement. Similar problems would face anyone attempting to impose a linear perspective framework on the scene used in *Chapter 3*[8] *to* confront the problem of finding the eye line. Notice that, if we confine out attention to the one facade in the photograph that has been made more recently with the kind of modern methods that ensure straight edges, horizontal horizontals and vertical verticals, the whole process of tracing horizontal edges on the photograph is facilitated. Thus, if select out the pale green painted front of the pharmacy on the right, we find that it is relatively easy to find a horizontal edge and above and below edges that provide converging perspective lines that meet on it according to theory (as shown in *Figure 2*). However, as already suggested and in the following chapters to be made abundantly clear, it would be quite a different proposition if we were confronted with the actual scene. In that case a catalogue of new uncertainties would be introduced.

This lack of orderliness greatly increases the number of potentially unreliable visual measurements that need to be made if a satisfactory perspective framework is to be constructed. It may also engender visual illusions that render visually-mediated judgements doubly perilous. For example the *baker's facade illusion* which features in *Chapter 8*[9]shows how our eyes can be deceived into seeing lines as sloping down when they are actually sloping up. In this and many other situations, artists are up against a *shifting sands of appearances* which leaves them with a complete absence of reliable reference points.

8 *Figure 1*

9 See also Appendix A,

The third flaw

The third flaw will play a large part in what follows in *PART 1*. To give a foretaste of its potential importance, hold your hand up in front of you at book reading distance. Now, without taking your eyes of it, move it away from you until it is situated at arms length. As you do so, ask yourself whether you have the impression that it is changing in size and, if so, by how much. Next, repeat the process, but this time, look at the relationship between your hand and some object in the background. Unless you have done something similar before, you will almost certainly be surprised at the relative difference in apparent size resulting from this manoeuvre. Taking *context* into account is necessary if your aim is to get nearer to the reality captured by the laws of linear perspective. Not doing so confronts you with the phenomenon of *size constancy* and the considerable problems it can cause when drawing from observation.

The fourth flaw, will be explained later, when effects of eye movements on appearance have been demonstrated.

Summary and Implications

The problems confronted in PART 1 can be summarised as follows:

- *There is an important distinction between using linear perspective as a tool for constructing imaginary pictures and using it as a guide to drawing from observation.*
- *Recent writings on the subject of linear perspective rarely if ever make a separation between the two, leaving readers to find their own ways of relating theory to practice.*
- *Attempts to use linear perspective constructions as preliminary frameworks into which to fit representational pictures will confront artists with a range of insoluble problems.*

In view of this conclusion, should the use of the laws of linear perspective as an aid to making drawings from observation be abandoned? The argument for answering "Yes" is that, despite our poor capacities for making visual measurements, it is perfectly possible for anyone to make accurate drawings of natural scenes that are in virtually perfect linear perspective without recourse to the laws in question. For example, all who have properly understood the drawing lesson described in the first volume in this series could do it.[10]

10 "*Drawing with Feeling*"

Until not so very long ago, being convinced by much evidence of the truth of this last statement, I would have numbered myself amongst the sceptics. But all this has now changed. It has done so as a result of being pushed reluctantly by student demand into explaining the underlying principles of linear perspective. Much to my surprise, when I set my mind to doing so, I found myself embarking on a fascinating journey, full of unexpected discoveries. The next chapter describes the demonstrations I evolved to meet student demand. The process of developing these was full of unexpected twist and turns and the discoveries made remain astonishing for many of those who witness them.

The remaining chapters in PART 1 retrace the steps of my journey of discovery and show how its revelations can put to practical use. Many of the lessons which emerge are very unlike any other teachings that I have come across.