# *CHAPTER 14*

## *Colour mixing made easy*

***Introductory***

*This Chapter suggests a practical way of getting around the seeming obstacles discussed in the previous chapters. At first sight the method proposed may appear to involve important sacrifices, but upon further investigation it turns out that even its shortcomings can be interpreted as powerful advantages.*

*HOW TO MAKE A MAXIMUM OF COLOURS*

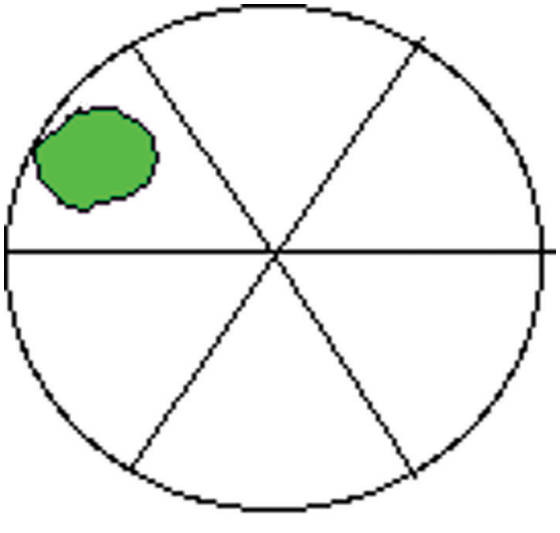

*Figure 1 : A region of greens to be explored*

*Figure 1* is a *colour-circle* within which is a region (henceforward described as the "*ballpark region*") containing twenty-five hypothetical greens. The first challenge is to find a way of mixing these and, by doing so, to establish the gen-

eral principle of *practical colour-mixing* being proposed. As should be clear from the previous chapter, it will be essential to extend the ball park region beyond the twenty-five colours and that to do so will, at some point, require progressing to the *colour-sphere*.

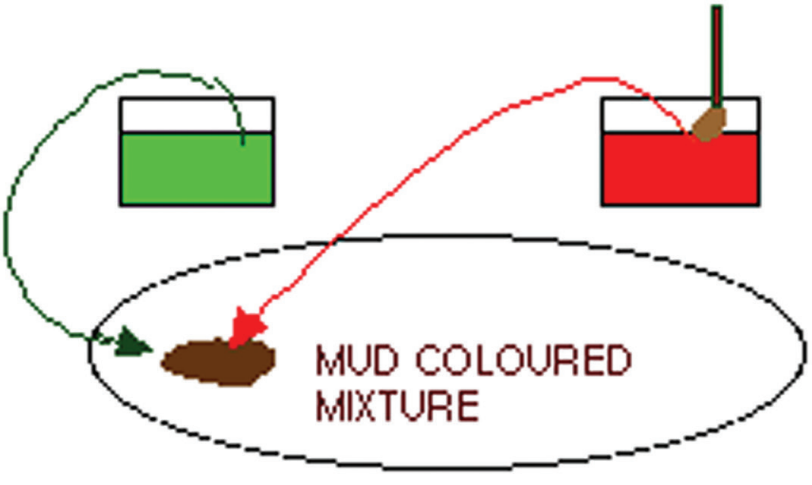


*Figure 2: A pot of red paint, a pot of green paint, a paint brush, a palette on which has been made a mud-coloured mixture.*

*Figure 2* illustrates the starting point of the method. It shows a paint brush, a palette and two pots of paint. One of these contains a green (which is as near as possible to the ballpark colours required). The other, a red (which is approximately complementary to it). The task to be accomplished is to use these two colours to create a row of five greens, starting with the pure green, such that each new mixture is only *just noticeably different* from the colour of its predecessor.

Let me imagine that I am trying to achieve this goal for the first time. The first practical step is to make a pool of green paint on the palette. The next, to dip the brush in the red pot with a view to taking a tiny amount of paint and mixing it with the green. "Whoops! I forgot to clean the brush after picking up the green paint", and, as a result, a small quantity of it gets mixed in with the red. Never mind, it is hardly noticeable and can perhaps be disregarded.

More pertinently to my present objective, the brush has picked up *too much red* and, when mixed into the pool of green on the palette, the result is a dirty brown." Ugh! *It looks like mud*." This discouraging start leads to a period of re-

flection. Two lines of thought suggest themselves:

- Reconsider the accidentally produced trace of brown left in the pot of red paint when the slightly greened brush was dipped into it.
- Reconsider the virtues of the "*muddy brown*" mixture on the palette.

Both offer solutions to the problem.

**The pool of brown**

Perhaps, if the accidentally produced trace of brown were to be stirred in thoroughly into the considerable quantity of red paint already into pot, the result might be a red that is only *just noticeable different* from unadulterated colour. Eureka! The experiment has provided a method for achieving our goal for, if the idea works with respect to the red paint, why not also with the green? It must surely follow that a brush, holding a small amount of red, which is stirred around in the relatively large quantity of green paint in the green pot, could perhaps produce a green only *just noticeably different* from the original.

Suppose now that, on trying the experiment, by some lucky chance, the desired *just noticeably different* green is produced. Does this mean that a satisfactory solution to the original problem had been found? Unfortunately not, for there is a big snag. As every practising artist should know, it is extremely difficult to control the exact quantity of paint on a paintbrush. The likelihood of picking up the right quantity of it for producing the right mixture every time is remote.

Accordingly, let us consider what would happen if we had picked up slightly too much. For arguments sake, suppose the ratio of red to green required to produce the desired result is one part of red to fifty parts of green and suppose that, due to the difficulty of picking up an exact amount of paint, more than enough paint has been added, say two parts in fifty. The unsatisfactory outcome would be a colour which is more than the desired just noticeably difference from its parent green. The question is, what will have to be done to restore the required ratio? The answer is not difficult to work out. Since the actually required amount of red has been doubled, it is obvious that the original amount of green must likewise be doubled. In this way the proportion of green to red will become 2 to 100, which is the same as the necessary 1 to 50. From this simple mathematics it is clear that a solution to the problem has been found, at least in theory.

At this point, if I had no experience of paint mixing I might feel that I had solved my problem, but being a practicing artist, it is almost immediately obvi-

ous that the practical implications of the method are likely to be horrendous. In the case of the pot illustrated, since it is more than half full, the first requirement would be find a new pot, big enough to contain the extra quantity of paint required. In other words, it would use up a lot of paint. Several misjudgments of the same kind would prove inordinately costly in terms of paint purchases.

Although the example just given illustrates an extreme case, every artist who has tried to modify the colour of a largish heap of paint will have experienced something of the difficulty of readjusting backwards after having just gone a little too far.

**A reminder**

At this juncture, it is worth emphasising that the potential difficulties inherent in the strategy of adding small quantities to large does not mean that it should never be used. Indeed, I have used it myself as a way of solving a particular painting problem, the solution to which required the production of a large number of premixed colours made according to rigorous criteria and stored in pots.[1] However, to achieve the required level of control, it was necessary to take a great deal of trouble and weigh the components of each and every one of the paint-mixtures very carefully, using a highly accurate scale.

Nor is my own somewhat atypical case unique. There are other everyday circumstances under which the strategy of adding small quantities to large is the most appropriate. However, in the present context, the intrinsic difficulty of the method, particular with respect to the practicalities of *painting from observation*, encourages the search for a simpler approach.

**The second and simpler solution: progressive mixing**

It is now time to turn to the second solution and see what it has to offer. As indicated, this involves reconsidering the pool of *muddy brown* on the palette. As it turns out, doing so has much to be said for it. There follows an explanation of why. It requires a few diagrams and a little rudimentary algebra.

*Figure 3* is the same as *Figure 2*, except that the words "*mud coloured mixture*" have been replaced by the symbols "R + G". The use of letters of the alphabet not only prepare us for the algebra but also reminds us that, no matter

1 The two series of paintings concerned (the "*Stirling Series"* and the "*Islamic Series")* are described in "*Painting with Colour*", the second book in this volume.

how unpromising it looks, the muddy colour produced is no more nor less than a mixture of *red and green (R+G)*. The next step is illustrated in *Figure 4.* In this, another pool of green has been placed in a separate region of the palette and some of the R+G (muddy brown) has been added to it to create R+G+G. Although this may well look nearer to black, it is the first step in the desired direction. After that, the idea is to repeat the process as shown in the text..

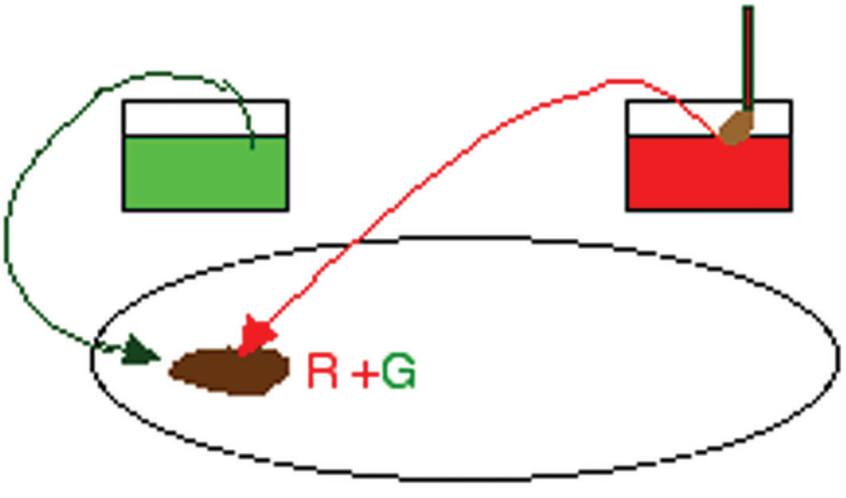


*Figure 3 : The same as Figure 2 with (R+ G) substituted for "mud".*

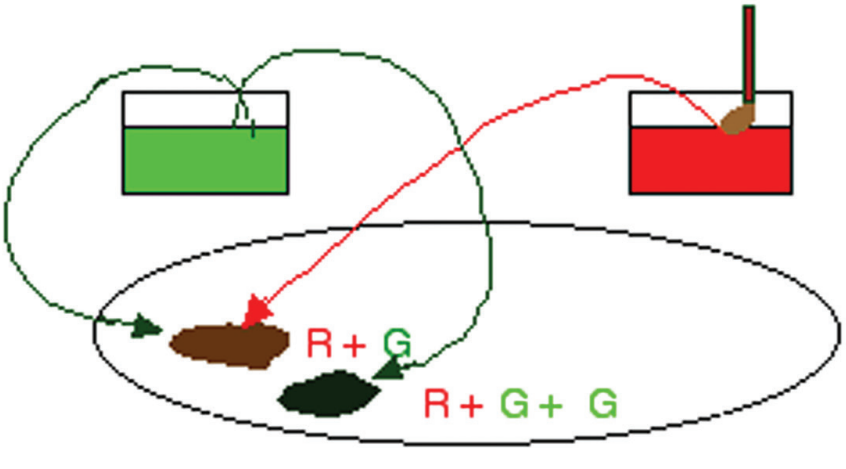


*Figure 4 : A second mixture (R+ G + G)*

After eight steps the process can be expressed in the following manner:

- R + G
- R + G + G
- R + G + G + G
- R + G + G + G + G + G
- R + G + G + G + G + G + G
- R + G + G + G + G + G + G + G
- R + G + G + G + G + G + G + G + G

And so on …

Clearly, the sequence could go on for ever. This being the case, it follows that we have discovered a systematic and reliable way of approaching the edge of the colour-circle where the sought after ballpark greens are to be found. Notice also that the method ensures that, in every mixture made, at least a trace of the red from the opposite side of the colour-circle will be found. The method is totally reliable[2] and, with a little practice, extremely efficient at producing the desired results.

**Explaining the mystery**

It is now time to refine the question asked earlier, which now becomes: "*Why is it that the progressive-mixing method so seldom appears in how-to-do-it painting books and articles?*" I offer three plausible answers indicated by my teaching experience. They are that:

- People only find solutions to problems of which they aware. Not everybody realises just how many colours there are in the canopy of a tree.
- The idea of using of complementaries to modify colours in the most fully saturated regions of colour space is *counter-intuitive.*
- We can never actually see the complementaries in the mixtures.
- Progressive mixing requires a lot of palette space and a cursory glance at the area afforded by the average watercolour box or, even, oil paint palette shows that this consideration was not in the mind of the palette manufacturers.

2 It is routinely used in Chemistry, by Pharmaceutical Chemists and by practitioners of Homoeopathy, under the name of "*progressive dilution*".

**A severe limitation**


*Figure 5 : A tree simplified into six regions of colour*

Interesting and effective though it may be, the progressive-mixing approach as just described is a long way from reaching its potential (the approximately one hundred and seventy-five ballpark colours). As already explained, mixing between any one pair of complementary colours can only produce one row of mixtures. As suggested earlier, this means that, in the green to red row being used as an example, only around five of these would look saturated (pure) enough to approximate to the primary green used.

*Figure 5* indicates the level of simplification that the use of five colours would entail when painting a tree canopy. The sixth region with the question mark is included to underline the point that if only five colours are available, it would have to filled in with a repeated colour. How then is this method going to cope with the ballpark of perhaps 25 usable greens proposed in *Figure 1,* or the hugely expanded additional possibilities offered by the three dimensional colour space as represented by the colour sphere in *Figure 2*.

**Going mad**

At this point, we need to remember the *near-complementaries* and how making use of them them made it possible, at least in theory, to create twenty-five greens that are only just noticeably different from one another. Doing so may still seem a tall order but don't panic. Paradoxically, all that is needed to render this task easy is to complicate matters even more. Instead of starting with a single red for mixing with the green when making the initial pile of "*mud*" colour, take your courage in both hands and load in as many near-complementary colours as possible.

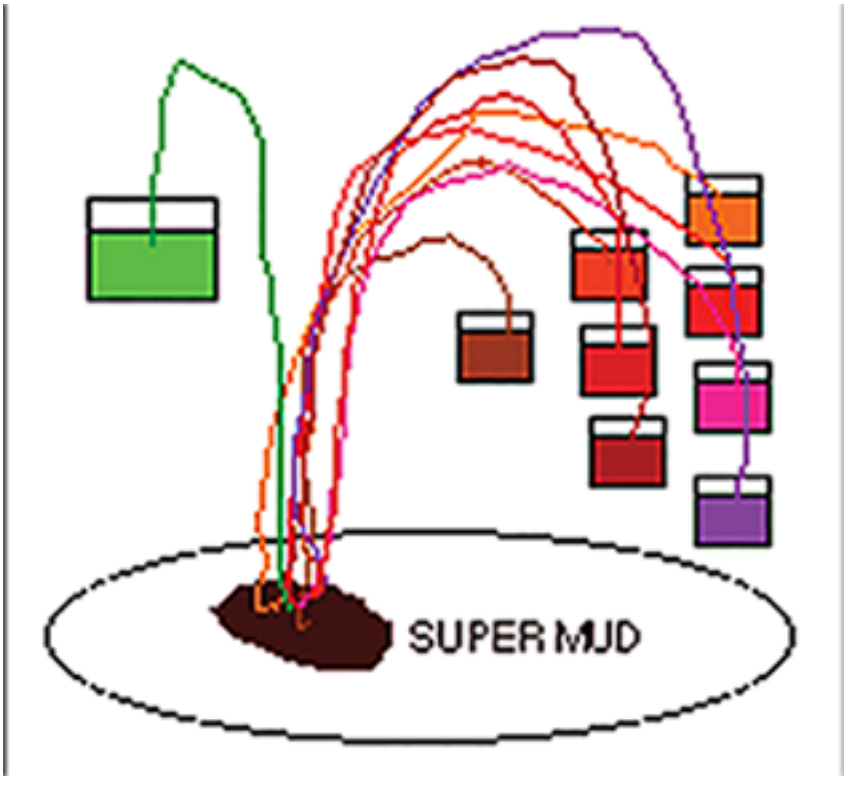


*Figure 6 : A gamut of colours*

*Figure 6* illustrates the idea with eight complementaries or near-complementaries, but much larger numbers can be used. The result should be what might be called "*super-mud*" (SM). The exact appearance of this will be totally unpredictable, although it will invariably be dark and murky. Once made, this highly

complex mixture can be used as a starting point for another round of progressive mixing. Essentially the same mathematics as before can be used to show the outcome:

- S.M + G
- S.M + G + G
- S.M + G + G + G
- S.M + G + G + G + G
- S.M + G + G + G + G + G
- S.M + G + G + G + G + G + G
- S.M + G + G + G + G + G + G + G

And so on …

Substituting the word combination "*super-mud*" for the word "*red*" in what I wrote when explaining *Figure 4*, we can say that "*with each step, the proportion of super-mud will get smaller in relation to the quantity of green. The sequence will go on more or less for ever for there will always be a trace of the super-mud remaining in the mixture*".

In this way, progressive-mixing will enable artists to get extremely close to the edge of the colour-circle where the ballpark region of greens is to be found. As before, the method will achieve this desirable result without any risk of losing some proportion, however small, of complementary colour in the mixture.

Don't forget that, as explained in earlier chapters of this book, this trace is vitally important if the aim of the artist is to use colour to enhance effects in their paintings of *pictorial depth*, *ambient illumination*[3] and, more generally *illusory pictorial space*.

**But there is method in it**

At this point, it may still be far from clear just how such a drastic and unpredictable method is going to help with control over colour-mixing. To clarify matters, it is time to take a cool look at the situation. The diagram in *Figure 7* is essentially a repeat of the "*numbers game*" diagram in the previous chapter.[4] It illustrates the idea of progressive mixing between any colour (symbolised by the 'X' in the diagram) and a super-mud made using a liberal selection of its com-

3 The quality of light illuminating the scene as a whole

4 *Figure 9*

plementaries and near-complementaries. The diagram would fit the case just explained if the 'X' were to represent a *green* and the super-mud were to be made of *red, orange and violet*, but also it would fit the case of a *yellow* with a super-mud made of *violet, blue and red*, or that of any other colour mixed with the colours to be found in the opposite half of the colour-circle. Indeed, there no reason why a few colours that are adjacent to the target colour should not be added to the mix (*yellow* and *blue* are the adjacent colours with respect to *green,* or *orange* and *green* are the adjacent colours to *yellow)*.

If the target colour is green, what happens as the proportion of it in the mixture begins to dominate appearances? The answer is that the gradations progressing in its direction no longer cross the colour-circle by a direct path from the target colour and its complementary. Instead, they come by some other route, plausibly any of the directions indicated by the arrows. Since there is no way of predicting which one, it may seem that the method cannot be of much practical use. However, appearances can be deceptive.

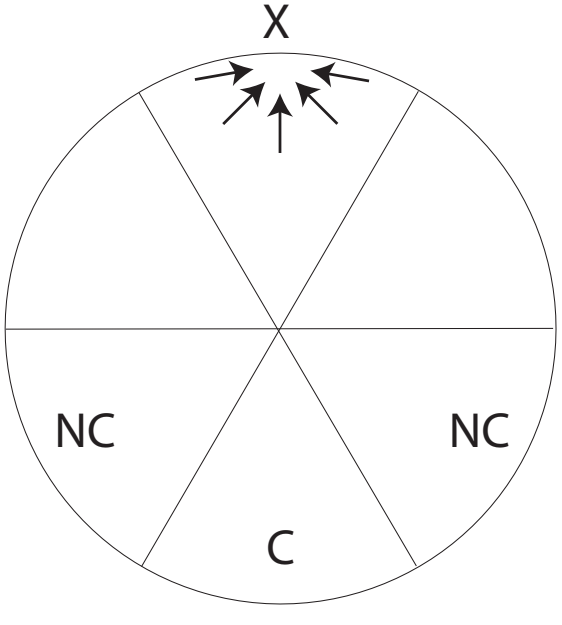


*Figure 7: Mud mixture diagram*

**Advantages and disadvantages compared**

As just indicated, the seeming disadvantage of the procedure just described is that the number of variables means that nobody could precisely predict the route taken by progressions produced in this manner. But is this a bad thing? Since, to discover new colours (as to discover anything new) it is necessary to go *beyond current knowledge into the unknown*, this particular method of colour-mixing will inevitably provide opportunities for extending the mixer's experience of colour possibilities. Far from being a shortcoming of the method, this must be regarded as a very considerable potentially advantage.

Are there any other advantages? And, what about other shortcomings? Are there any more of these? The easiest way to answer both these questions is to list credits and the debits, and weigh their relative importance to provide a balance.

**Credit**

- In principle, for the reasons explained, since the largest possible number of parent colours (in other words *the largest number of tube paints*) can be used, the largest possible number of mixtures can be made. In other words, the method is likely to find colours that would be otherwise unobtainable, no matter what selection of other tube colours are used.
- All mixtures made will contain some proportion of complementary colour and, therefore, will have the potential for producing the most convincing depictions of an *illusory pictorial space* featuring *3D spacial separation and* exhibiting qualities of *ambient illumination.*
- One outcome of the fact that the method ensures that all the paint applied to the picture surface will be mixtures containing complementaries is that, however pure they may look, they can be used as "*mud*" with respect to the production of subsequent mixtures. Since all the colours mixed in this way will almost certainly be unique, both the array of colours on the palette and the array of colours in paintings made using it will also be unique.
- After a little practice, it turns out that it is not so difficult to nudge the colour in a desired direction. And once this skill has been mastered, there is no reason why we should not to add in the colours that come more naturally to mind, namely those that are adjacent on the colour-circle. Furthermore, this process of nudging becomes easier and easier, as more

and more ballpark colours created by the method become available on the palette, enabling closer and closer control.

**Debit**

No matter how well the method is employed:

- It is impossible to match colours in nature
- It is impossible to mix preconceived colours.

Though both these debits are certainly the case, it is questionable whether either of them matters in practice since there is neither any other method of matching colours in nature nor any possibility of precision in preconceiving or imagining colours .

Moreover, both the examples of what many may consider to be debits have significant advantages:

- As explained earlier, not only does the theory make clear that the method of mixing just proposed has almost always got more chance of getting nearer to almost every possible match than more conventional methods, but also, with practice, it becomes progressively easy to achieve such proximity.
- Although the aim of mixing preconceived colours can help give direction to mixing activity, it can also mean much the same as not being interested in exploring the "*unknown*", which is hardly a good attitude for anyone aspiring to extend their awareness of colour possibilities.

**Balance**

The proof of the pudding is in the eating: Students of all levels of experience have felt themselves liberated by the method just described. It is true that the first attempts at using it can be somewhat confusing, but this is no more than a natural part of the learning process. It would be surprising indeed if there were no misunderstandings to iron out. For example, despite all my efforts at clear explanation, during the students' first experiments with the method, the mixtures they produce fall short of the goal of being almost as pure as the starting colour. In other words, they often turn out to be rather muddier than the colours sought for.

However, although likely to be frustrating in terms of any fixed and precise goal of the mixing activity, this is not necessarily a bad thing. The mixtures in

question will inevitably be in parts of colour space that would not otherwise have been explored. Moreover, they would include many examples of the wonderful ranges of colours (bordering on greys and browns) which exist in the hinterland of colour-space. It is for this reason that a little preliminary misunderstanding can lead to considerable bonuses.

Very soon, when the misconceptions are ironed out, it becomes easy to produce extremely pure looking colours, such that the only visible difference to tube colours, is a quality that is hard to describe, but easy to recognise. When students see a palette full of them, they are likely to exclaim ,"Wow, w*hat lovely colours!*".

**Some words of caution**

The reference to misunderstandings by students suggests two words of caution. The first, concerns "*dirty brushes*", which in general can be *encouraged*, on the grounds that the *dirt* is nothing other than a complex mixture of highly desirable near-complementaries. However, a good thing can be carried too far, since too much dirt can be difficult to control. When using watercolour, the worry is minimal, but with other types of paint, such as oil and acrylic, it can become serious. The problem begins when too much additional paint is needed to move a mixture in a the desired direction: a state of affairs that can be both frustrating and wasteful. Essentially it is the same problem as is discussed as the "*first solution*" to the problem of making small JND steps (see *Figure 3*). For this reason, it is prudent either to make liberal use of the palette knife or to follow the well established practice of using several brushes. There is no need to go as far as Seurat and the *Chromo-Luminarists* and have a brush for every hue on the palette, but it would do no harm at all to have a different brush for each ballpark of colours being explored. Thus, when greens are being applied, have a "*greens brush*", if flesh colours, a "flesh-colour brush", if blues, a "*blues brush*", etc. etc. In most paintings half a dozen brushes of each desired size should suffice.

Also worth emphasising is that the value of complementaries in mixtures means that when cleansing brushes, there is no need to do it too thoroughly (except, of course, at the end of a day's work).

Another misconception that can arise concerns the initial pile of "mud'. It is only too easy to get the impression that it constitutes a sort of magic ingredient which can be used over and over again. If so, why not start by making a large pot

full of it, which can be used to add to all colour mixtures on all future occasions? It is a seductive idea but it goes clean against the theory being presented. At the core of this is the idea of a constant process of change: the repeated use of any one colour, even though it be made from a rich mixture of near-complementaries restricts the number of mixtures that can be made. What is needed is a constantly evolving *complex mixture* containing *complementaries* and *near-complementaries* in *no matter how small or great a proportion*. The beauty of the method is that this is easily achieved by allowing the natural processes of mixing to keep everything on the move. Every time another colour is added, another variable is brought into play and, inevitably this colour will, by dint of progressive mixing, find its way into all the mixtures being produced, creating an ever renewing range of nuances.

**Footnote**

Although the use of the word "*mud*" has proved its value as a teaching gimmick, it can be misleading, since the method is capable of producing a vast range of *very far from muddy* colours. As already indicated, these include many that are can be almost indistinguishable from pure pigment-colours. For this reason, once its introductory purpose has been fulfilled, I have found it preferable to abandon the use of the word "*mud*" and, instead, think in terms of "*complex-colours"*. It is a good shorthand for the kind of colours recommended by my teacher Professor Marian Bohusz-Szyszko. In other words, colours created by progressive mixing and intermixing, using pigment-colours from all parts of the colour-circle, though always including some proportion, however small, of near-complementaries. The Professor talked of "complementaries", but earlier I explained how, there are no perfect complementary pairs among the tube colours we can buy.

***Implications***

*One outcome of my research at the University of Stirling was the realisation of a need to extend Professor Bohusz-Szyszko's formulation. The ideas of Seurat to which his rules owed so much had been based on theory that placed too much weight on "complementary colours". Clearly, the Professor's fifth rule needed to be modified (particularly since true complementary pigment-colours do not exist). What is required was a way of thinking that embraced all the pigment-colours to be found in the whole of the opposite half of the colour-circle. The rule should now read, "All colours should be complex-mixtures containing some*

*proportion, however small, of colours drawn from a range of near complementary pigment-colours." Following this rule in the ways described in this chapter came to be known by my students as the "mud method of colour-mixing". For the reasons just explained, I now prefer to substitute the phrase"complex-colour" for "mud". Whatever it is called, it has many advantages.*

- *It allows artists to explore the entirety of the colour-space consistent with the ensemble of properties of the parent pigment-colours used: The more of them that are called upon, the larger will be the colour-space available for exploration.*
- *Given that the palette on which the paints are to be mixed is large enough and certain amount of time has been allowed for appropriate practice (a day or two should suffice), it is extremely easy to implement.*
- *It ensures that all the colours are complex and contain at least a trace of pigment colours from the opposite half of the colour-circle relative to the ballpark of colours being explored. Accordingly, it ensures that* ***all*** *the colours made with the method will be settle harmoniously into illusory pictorial space.*

*In all this, one crucially important factor has been missed out. No mention has been made of the role of translucency and opacity in determining the outcome of colour mixing. However, as we shall find in the next chapter, this is an important consideration even when engaged in "mixing by stirring" of the kind described in it. Two of the basic reasons for this are:*

- *That the colour appearance obtained by mixtures of opaque colours cannot be explained by the additive colour mixture rules. In other words they require a different colour circle.*
- *That the translucent/opaque dimension can have great importance when it comes to exploring the bottom half of the colour sphere.*