Chapter I

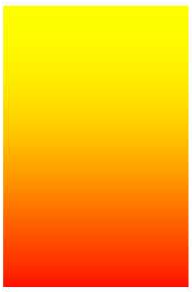
Section 5
Basic Definitions

BD I
A line is the place where one or more colours end, and one or more others begin.
Explanation:
a) If the line is contained by just two colours then the line is an end of the one and a beginning of the other.
b) If a relation between a sliding scale and another given colour contains a line, then the line is an end of the sliding scale and a beginning of the other colour.
c) If a relation between two sliding scales contains a line, then the line is an end of the one sliding scale and a beginning of the other.
Leonardo da Vinci claimed such a line to be mathematical, and I believe that nothing has better claim to be the empirical counterpart of Euclid's third definition in the Elements, Book I, namely, "A line is length without breadth".

Picture 1

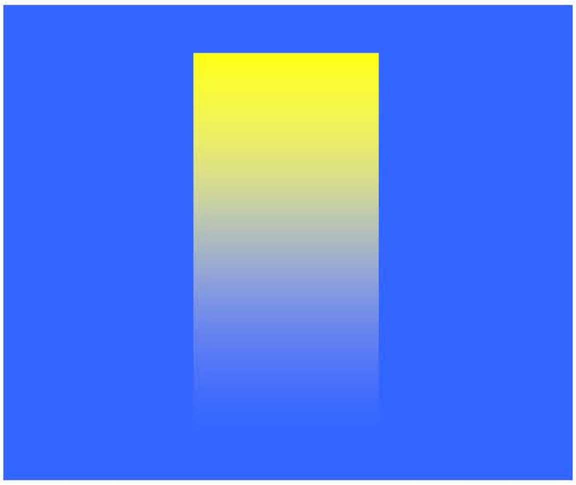
BD II
A sliding scale is a juxtaposition of different colours that contains no lines.
Explanation:
BD III contradicts the line definition, that is, either a colour relation contains lines or it contains no lines. This dichotomy is just as strong as the dichotomy between the straight and the curved in geometry; there is no third possibility.
Because the definition is in the negative, it is ostensive.

Picture 2



BD IX
The end of a line is a sliding scale.
Explanation:
This definition does not conform to Euclid's third definition in Elements, Book I, namely "The extremities of a line are points".
Given a certain line relation with no points, let the infield slide into the outfield in one direction. The line will dissolve into a sliding scale on each side. Picture 3 is an example.
An ended line is discontinuous. See BD VIII, definition of continuous line.

Picture 3



BD X
A discontinuous figure is one in which the infield contains a line that has an end or ends. Picture 3 is a discontinuous figure.

BD XI
A point is the meeting of lines.
Explanation:
Consider blue relating to white in a square line, i.e. a finite line. Two colours make the relation and only one line. If a point should appear, it is evident that at least one third colour must be added to the picture, either from within or from without, unto the square line.

Picture 4

Any line can have numerous points, depending on its length, but it cannot at the same time have an infinite number of points, because between two points there must be a colour or colours.

Chapter III.

1.7 Forbidden colours

Both Hardin (1998, pp. 123–126) and Arstila (2005, pp. 94–103.) discuss scientifically controlled observation reports on forbidden colours, written by Crane and Piantanida in 1983. One example is a scale between red and green containing no greys, no blues, and no yellows as intermediates.

According to Arstila, the subjects reported

> (…) that they had seen something they had never expected on the basis of opponent-process theory: wherever they looked in the field they saw a binary colour composed simultaneously of red and green. In the middle, these two colours had merged into a greenish-red or reddish-green field. (p. 96.)

At first glance these reports may seem to threaten the opponent process theory. If red-greens exist it seems that nothing inhibits the co-working of red-making signals and green-making signals.

However, as Arstila explains, Crane and Piantanida discern between two kinds of processes. The first is the *retinocortical* process, which starts with a signal from the opponent cell in the retina and, as Hardin puts it, "goes all the way up the visual processing chain". The second is, in Arstila's words, exclusively a *corticocortical* process. This means, according to Crane and Piantanida who performed the experiments in 1983, that the colours produced are so-called filling-in colours (see Chapter VIII, Section 2, for an example of filling in). This saves the theory of opponent process cells for the time being because one can, with Arstila, still claim that a scale from red to green is impossible when physical light is an indirect cause, i.e. when it affects an on-off cell.

Nevertheless, brain processes are to be conceived of as immediate causes of colours. (Jackson, 1977, p. 122.) If colours are to be judged ontologically on the basis of their immediate causes, there can be no difference between, on the one hand, red-greens and blue-yellows, and, on the other, other colours with relation to their possibility. Arstila agrees and stresses that, for example, red-green and orange are both phenomenally the same kind of colours. (p. 97.) In other words, there is no reason to distinguish between filling in colours and other colours when only immediate causes of colours are involved.

But it is an open question whether red-greens and other forbidden colours are exclusively filling-in colours. According to my observations, and others can easily make the same observations, many nature phenomena present us with forbidden colours. Described in common sense terms, green leaves turn gradually red or orange in the autumn in Norway. By logical inference opponent theory cannot allow these colour changes to take place. The sunsets make sliding scales from yellow to blue without any trace of green or grey, and there are sliding scales from orange directly to blue too, with no greyish intermediates. These scales are also, by logical inference, forbidden by opponent theory. In dramatic moments the whole horizon can slide from yellow to deep violet. Opponent theories contain no colours that match such a scene.

On my computer there is a colouring program, which I have used in designing the picture below. I am happy to present here three of the forbidden colours discussed, namely violet-yellow, red-green and green-orange. If you compare with the sliding scale of greys on the left you will see no likeness, that is, any greys in the scales to the right.

Picture 5