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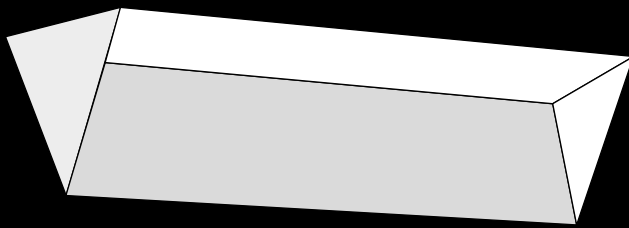
## **An Invitation to do Goethean Science**

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# goethean science

// three colour experiments from  
Goethe's *Contributions to Optics*



## Introduction

Goethe's *Contributions to Optics* does for colour what Euclid's *Elements* does for geometrical figures: it provides an exemplar of clarity, perspicuity and logic. Yet the fate of these two books could hardly have been more different. While the *Elements* became the most influential textbook ever written, the *Contributions* is all but forgotten. Nevertheless, this presentation of prism experiments has not been surpassed and Goethe's reflection on the method of the *Contributions* has become the most influential essay on Goethe's scientific method. In *The Experiment as Mediator Between Object and Subject*, Goethe remarks that "we must learn from mathematicians the deliberation required to place next in sequence only what comes next, or rather, to deduce what come next from what precedes". If we do this, we see connections between prismatic phenomena that are like the connections between stages of a geometrical construction or proof. In other words, we are able to see the logic of colour.

# doing

## *Goethean science*<sup>\*</sup>

### Step 1

- Become accustomed to looking through the prism.
- Hold the prism horizontally, placing your fingers on the small triangles at either end, so that the apexes of the triangles are pointing down. (See Illustration 1)
- Look through the lower face of the triangle (not the top). Begin to adjust what you see through the prism until you are familiar with how objects are refracted and brought into vision. See figure 1 opposite.

### Step 2

- Place figure 2 in front of the prism in such a way that the horizontal boundary between white and black runs parallel to the prism.
- On the horizontal boundary between white and black, coloured bands appear. On the left cyan appears below white and blue appears above black. On the right red appears below black and yellow appears above white. Horizontally, white appears opposite black, cyan opposite red, yellow opposite blue.

### Step 3

- Place figure 3 in front of the prism in such a way that the white band runs parallel to the prism.
- Begin by looking at the illustration close up. The two edge spectra appear again, but this time one above the other: red and yellow appear above cyan and blue, with white in between.
- Move the prism away from the illustration. The yellow and cyan bands move towards each other and overlap to produce green.

### Step 4

- Take figure 4 in place of figure 3 and repeat the procedure.
- Now the positions of the edge spectra are reversed, as are the colours of each spectrum: cyan and blue now appear above red and yellow, with black in between.
- Move the prism away from the figure. The blue and red bands move towards each other and overlap to produce magenta.

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<sup>\*</sup> Adapted from Goethe's *Contributions to Optics*, §§ 45–50

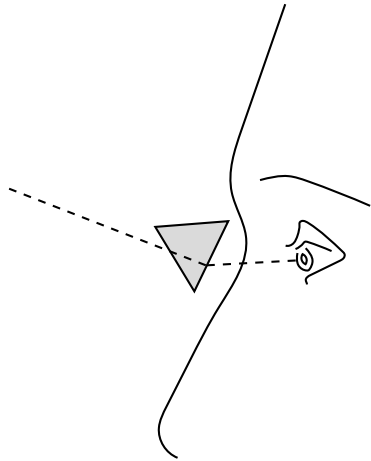


Figure 1

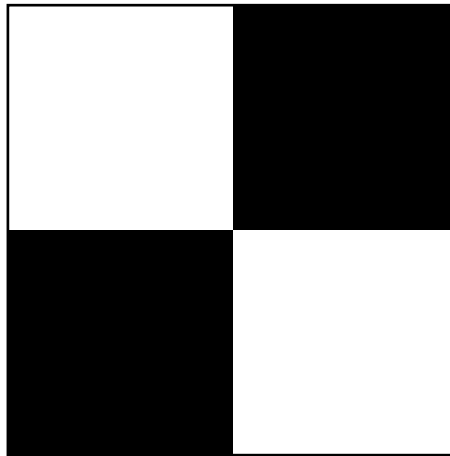


Figure 2



Figure 3

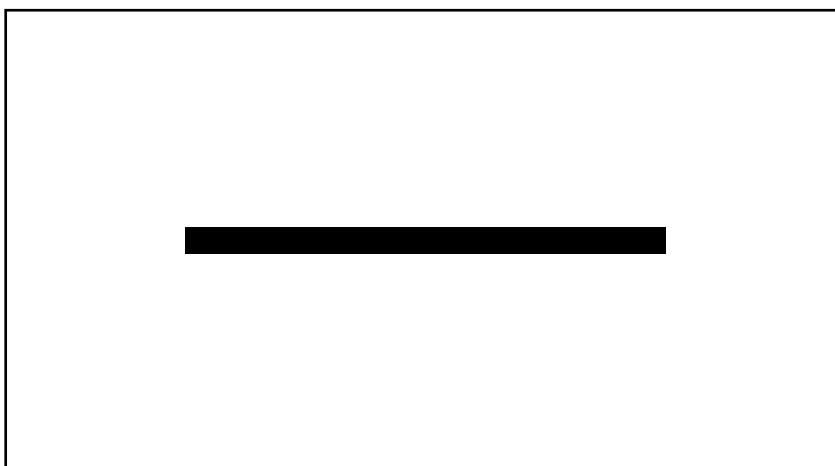


Figure 4

## The polarity of prismatic colours

Step 2 shows colours appearing in the opposing pairs: white and black, cyan and red, yellow and blue. As each colour pair consist of a light colour and a dark colour, the polarity of light and dark is expressed in each pair. This is what Goethe's calls the polarity of colours.

## On green and magenta

While the two edge spectra (cyan and red, yellow and blue) are produced by a single boundary of light and dark viewed through a prism, the colours green and magenta are produced by combining the two edge spectra in two different ways: by either bringing together the two colours that border white, or the two colours that border black. Step 3 and 4 show that where yellow and cyan overlap, green appears and where blue and red overlap, magenta appears. Here we have two kinds of mixing: one kind that mixes two colours by darkening, another kind that mixes by lightening. The two kinds of mixing are thus also polar to each other.

## Goethe's colour circle

The two composite spectra in step 3 and 4 contain the following two sequences of colours:

red	cyan
yellow	blue
green	magenta
cyan	red
blue	yellow

Each colour of one sequence is the complement of the adjacent colour of the other sequence. Moreover, one sequence can be transformed into the other by interchanging white and black (light and dark). As each sequence contains the two edge spectra, they can be combined by placing each colour of the edge spectra together. This gives us the following arrangement:

	magenta	
red		blue
yellow		cyan
	green	

This colour circle represents the relations between the prismatic colours: colour pairs are diagonally opposite and adjacent colours in the edge spectra (left and right) are adjacent in the circle. The two colours produced by combining two edge spectra (top and bottom) are opposite each other on the circle and between the two colours that produce them. The colour circle represents relations that are internal to the quality of the colours themselves, not external relations that express a causal relation between a colour and something other than colour. This colour circle, then, represents the logic of prismatic colours. This is why Goethe's *Contributions to Optics* does for colour what Euclid's *Elements* does for geometrical figures.

# further reading

## *Goethean colour theory*

Most of the first part of Goethe's *Contributions to Optics* is published with commentary in Rupprecht Matthaei's *Goethe's Colour Theory* (Studio Vista, 1971). This compilation is a good introduction to Goethe's writings on colour. Dennis Sepper's *Goethe contra Newton* (Cambridge University Press, 1988) contains a clear presentation and insightful discussion of the *Contributions* and puts them into the context of Goethe's critique of Newton. Ludwig Wittgenstein's *Remarks on Colour* (Blackwell, 1977) develop this idea of a logic of colour. Jonathan Westphal's *Colour: A Philosophical Introduction* (Blackwell, 1991) develops Wittgenstein's logic of colour using insights from Michael Wilson's work on Goethe, reprinted in *What is Colour? The Collected Works*, (Logos Verlag, 2018).

## experience **COLOUR**

Exhibition Catalogue

£15.00

This collaboration between the Field Centre and the Natural Science Section of the Goetheanum, Dornach, is a large format, hardback exhibition catalogue (273 pages) containing three sections. In *Exploring Colour*, the different colour phenomena that were explored at the exhibition are described and placed in context with introductions along with pictures of the exhibits. In the section *Understanding Colour*, exhibits that exemplify the historical approach to colour, in particular the experiments of Newton, Goethe and Wilson, are described with introductions alongside pictures of the exhibits. These experiments are then taken up in the in-depth essays by physicists and philosophers. In the final section *Applying Colour*, the artistic aspect of colour is addressed with works of art that are exhibited. This section is deepened with essays written by artists, art historians, therapists, educators and others influenced by ideas about colour. Please note that each copy requires individual delivery cost, second class delivery relates to UK addresses.

[www.rmlt.org.uk/shop/experience-colour-exhibition-catalogue](http://www.rmlt.org.uk/shop/experience-colour-exhibition-catalogue)