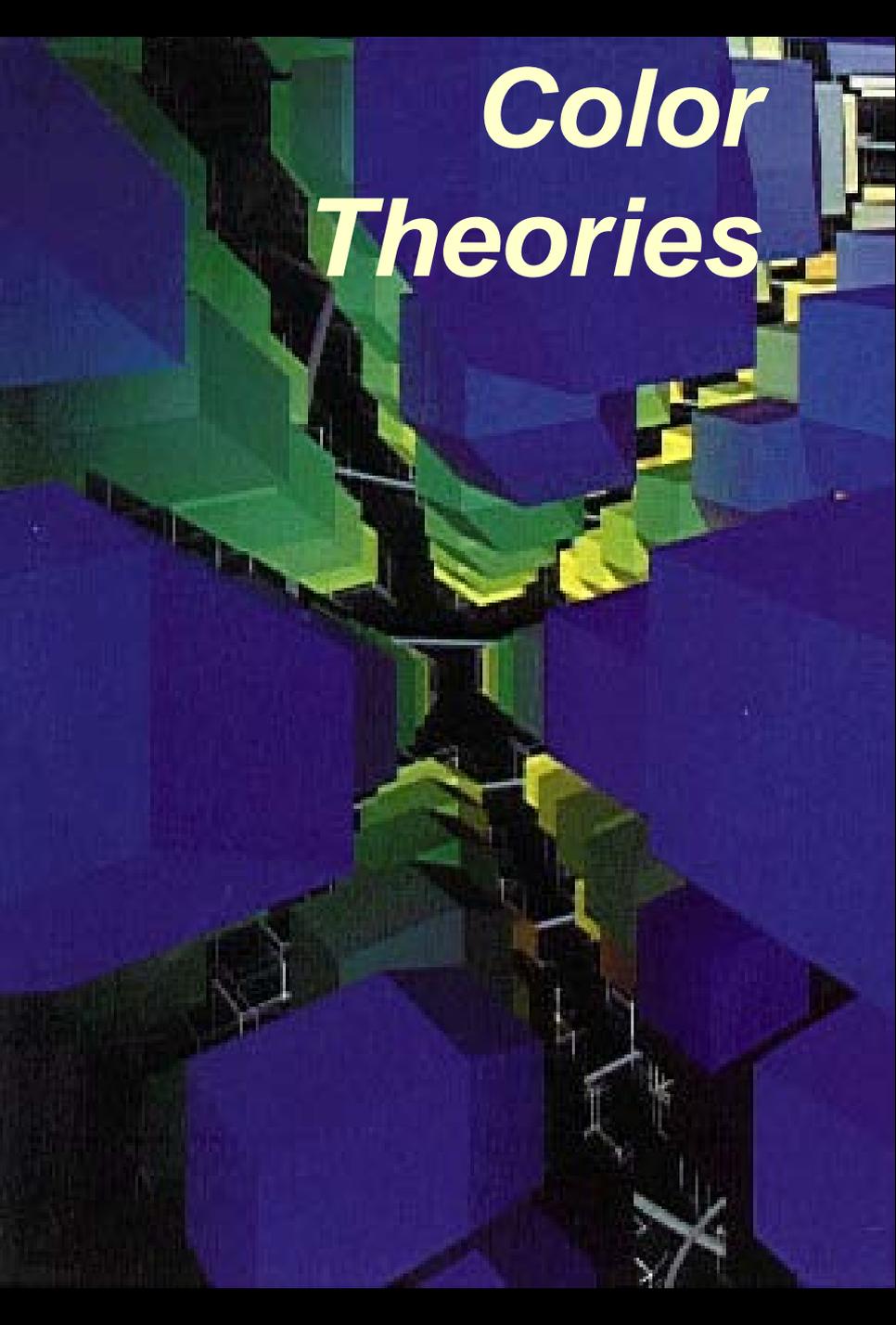


Color Theorists
Late 19th century

An abstract 3D visualization of geometric shapes, primarily cubes and rectangular prisms, in shades of blue, green, and yellow. The shapes are arranged in a complex, layered structure, creating a sense of depth and perspective. The lighting is dramatic, with strong highlights and deep shadows, giving the scene a futuristic or architectural feel.

Color Theories

Theories attempt to answer questions —

- *So...what IS color?*
- *...what are the fundamental colors?*
- *....how does color work?*
- *...how can I organize, model, or specify colors?*
- *...how does color perception happen?*
- *...how can I anticipate what colors will do together?*



***Color
theorists—
who are they?***

- ***Philosophers***
- ***Scientists***
- ***Artists***

- ***Each asks questions from a different point of view...with a different emphasis***



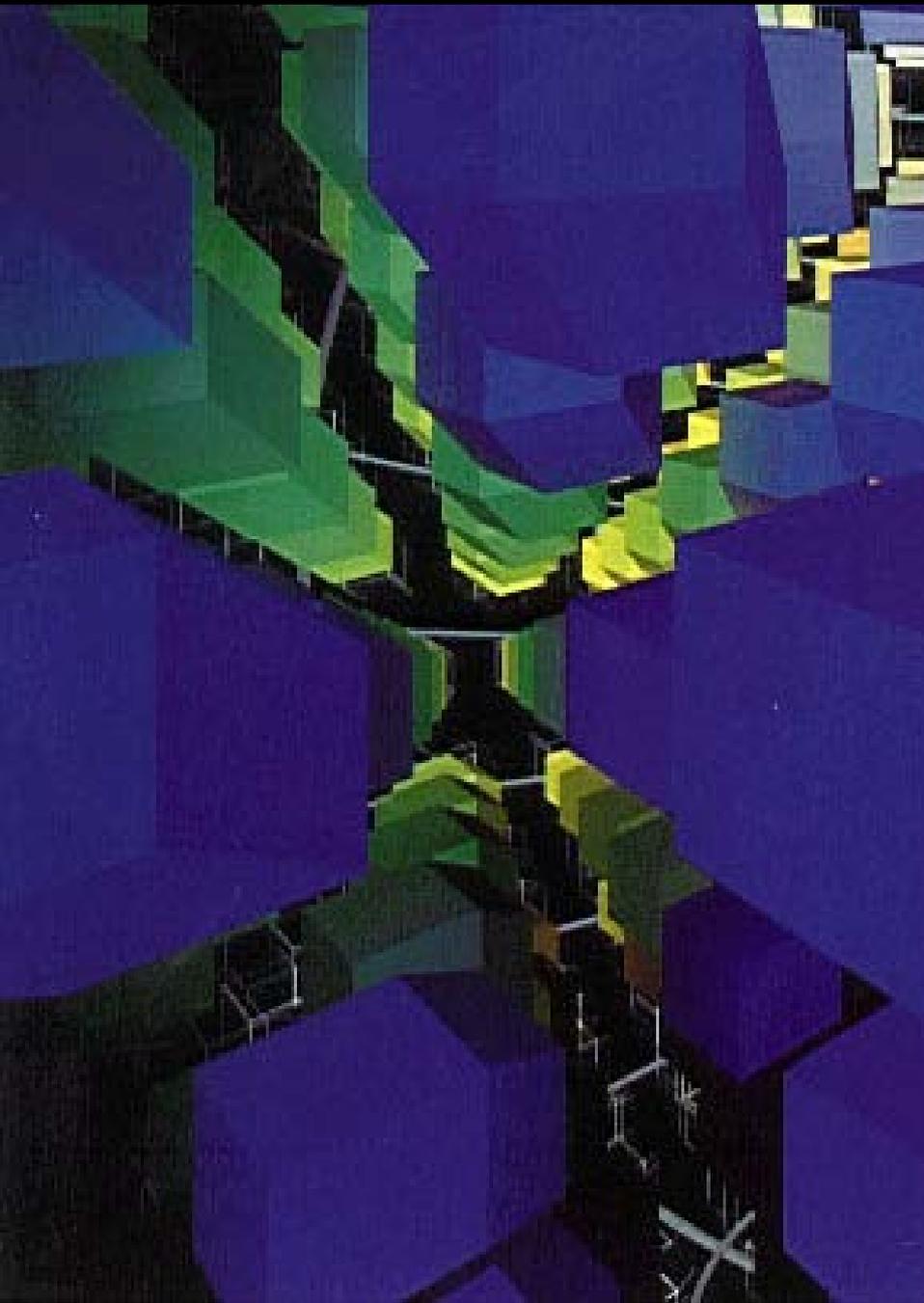
For each Color Theory

What is it trying to do?

Who are the major contributors?

What did they contribute?

Who benefited...who was influenced?



Earlier

Aristotle

Color/Hue due to Light-Dark

Leonardo

Aerial Perspective

Noted complementary phenomena

Color Composition observations

Forsius

Unacknowledged Color Wheel/Solid



Last Time

Newton

*7 spectral hues
color wheel
white light components*

Le Blon

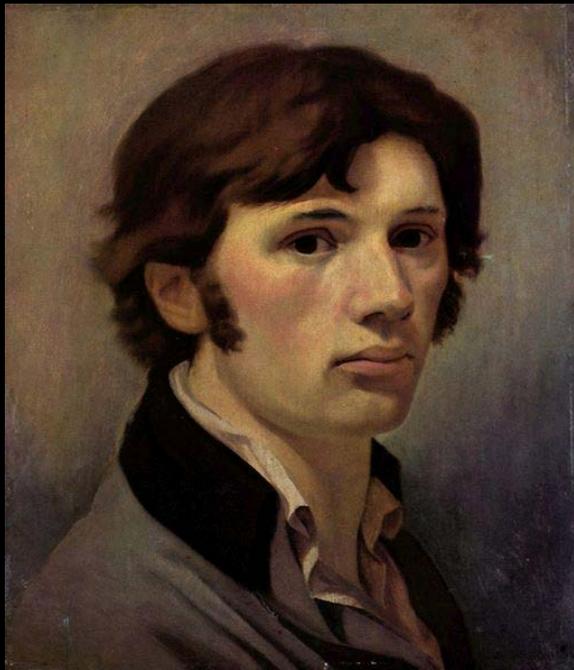
*Early 4-color process printing using
subtractive primaries*

Goethe

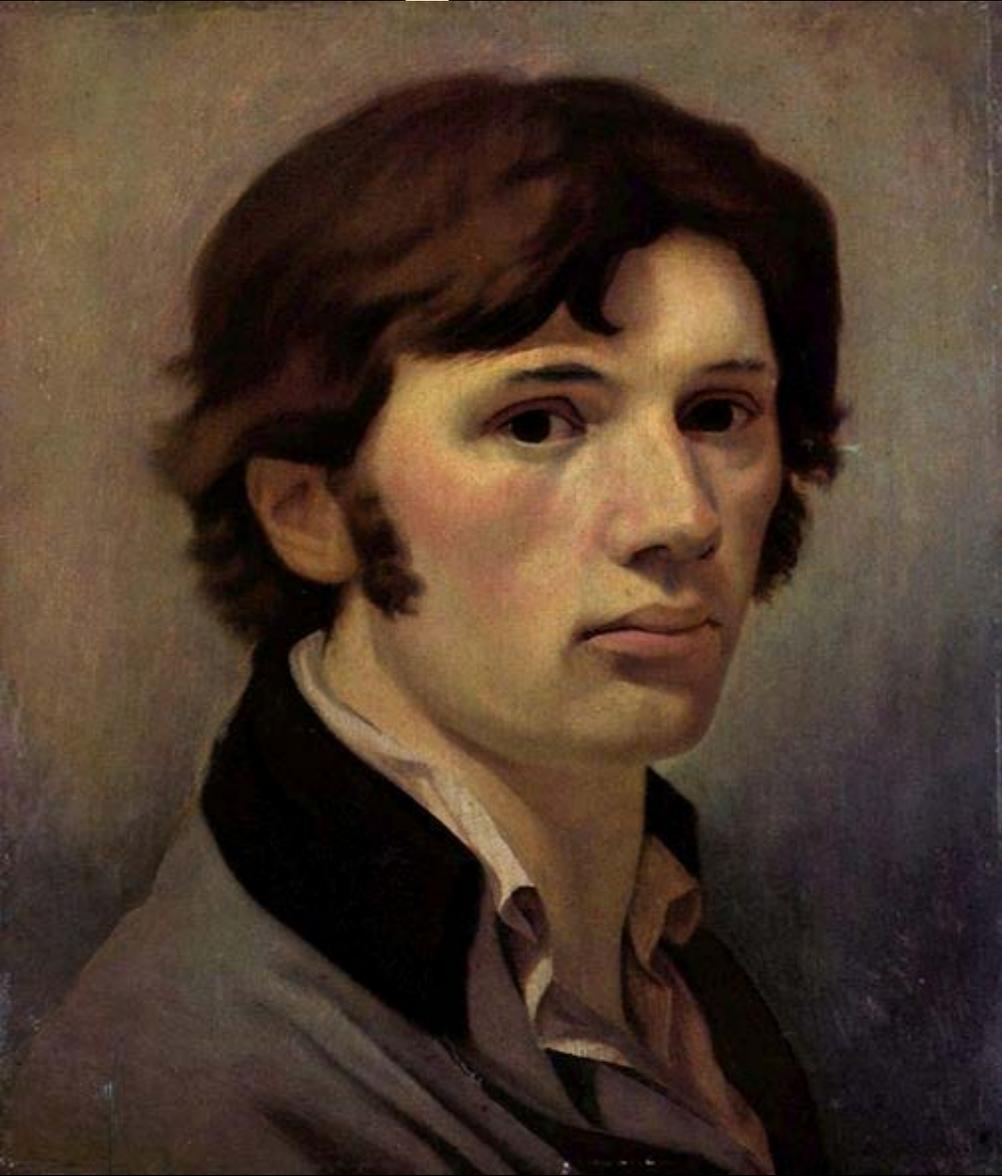
*Wrote Farbenlehre
Colored shadows — Impressionism
Infl.(Simultaneous Contrast & Successive
Contrast)*

Runge

- *Philipp Otto Runge*
- *(1777-1810)*
- *German Romantic painter*



Runge



Self-portrait, Philipp Otto Runge

- *Runge was close to Goethe, but Runge's original and extensive color theory has little to do with Goethe's theory.*
- *He published **Farben-Kugel** (Colour-Sphere) in 1810, building on Forsius' colour-sphere.*
- *Later in 1810 he died of tuberculosis.*
- *However, Runge did not successfully integrate theory and practice.*
- *John Gage, **Color and Meaning: Art, Science and Symbolism**, p.46-47
http://en.wikipedia.org/wiki/Philipp_Otto_Runge*

Runge

- German Romanticism
- Despite the straightforward logic of Runge's color sphere, much of his work with color was decidedly **romantic**.
- He **explored particular meanings for each color**. At one stage of his constantly changing ideas, he associated **Blue** with morning and God the Father, **red** with noon and the Son, and **yellow** with night and the Holy Ghost.

In his *Times of Day*, flowers and colors were paired to denote particular emotional and personality traits.

- He gave special attention to the polarity of blue and yellow.
- John Gage, *Color and Meaning: Art, Science and Symbolism*, p.185-6

Morning (detail), Philipp Otto Runge



Runge

- Runge's unpublished thoughts were not scientific, but in a metaphysical tradition.
- In a letter, Runge declares that "true art" only reveals itself through mystical religious experiences (of a sort which we might now call "epiphanies").
- In his own art, he celebrates "...the feeling of the whole universe with us; this united chord which...touches every string of our heart; the love which keeps us and carries us through life..."

Small Morning(?) 1808,
Philipp Otto Runge



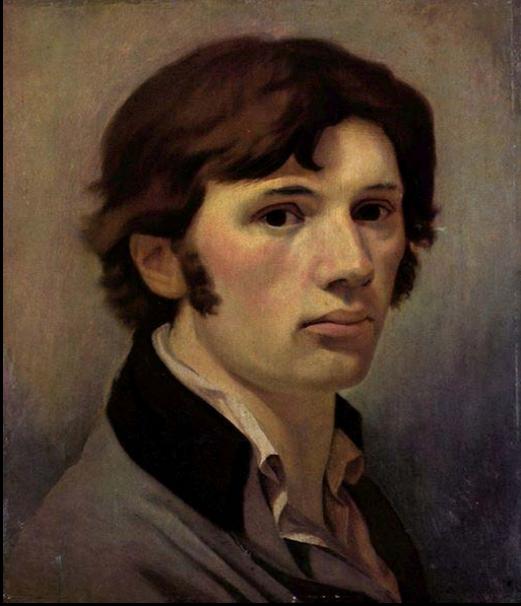
Runge

... Each leaf and...blade of grass teems with life and stirs beneath me, all resounding in a single chord....

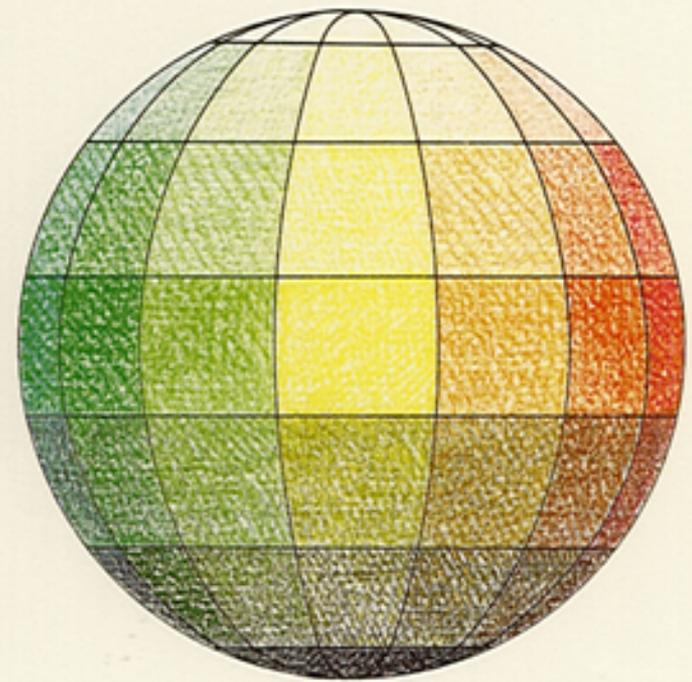
...I hear and feel the living breath of God who holds and carries the world, in whom everything lives and works; here is the highest that we divine--God!"



Morning, Philipp Otto Runge

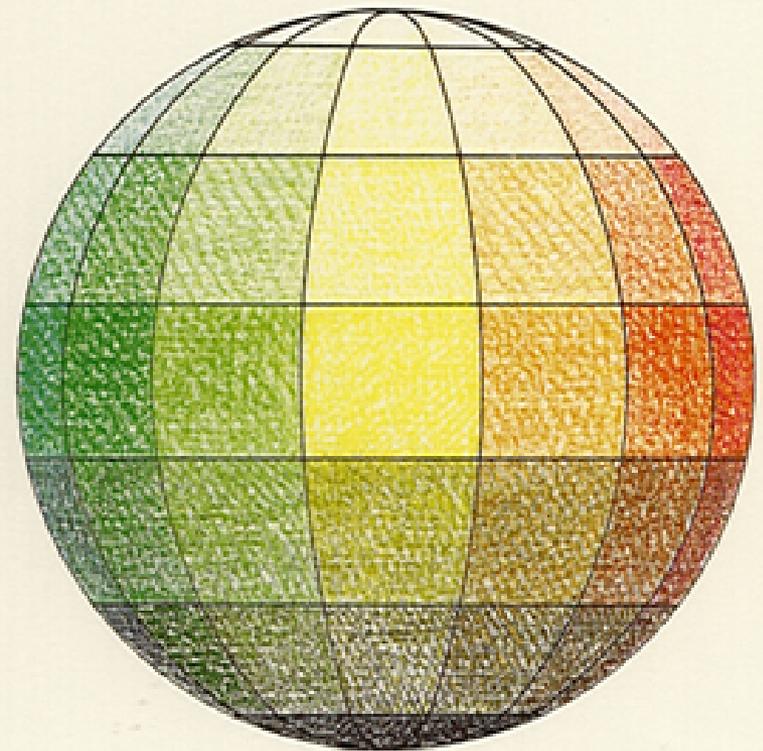
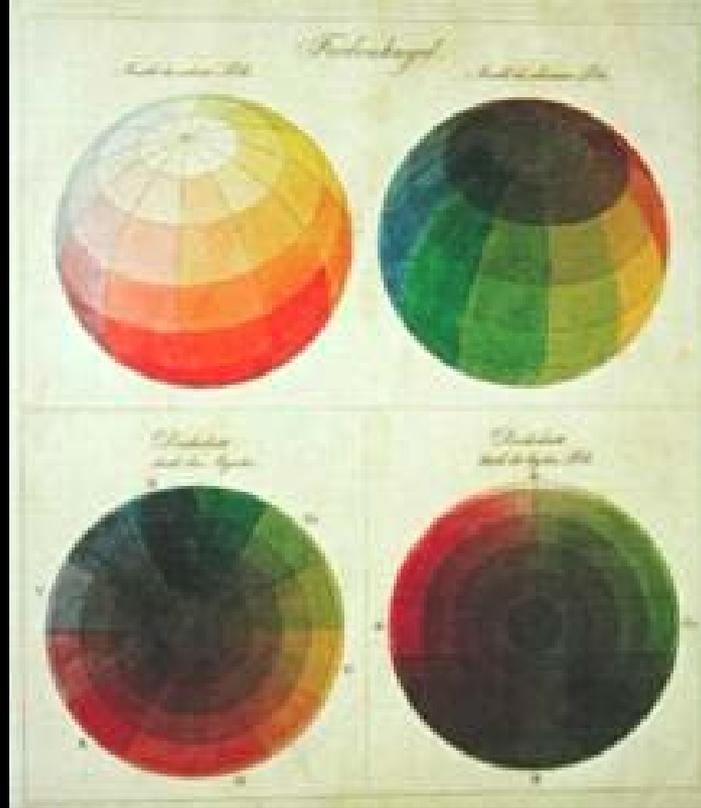
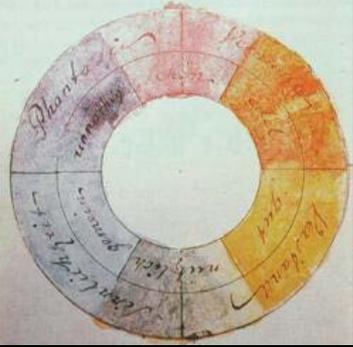


Philip Otto Runge



©echo productions

- + **First true 3D color model—a sphere (1810)** (though Forsius' s 1611 circle was also represented in a sphere)
- + Model (sphere) took into account **all three dimensions of color – hue, value, and saturation in an orderly arrangement, similar to contemporary color models.**
- At the top—white/tints
at the bottom—black/shades
at the center—neutral grays.
At the “equator” — pure, high-chroma colors
- Model included 6 primaries and 6 secondary hues



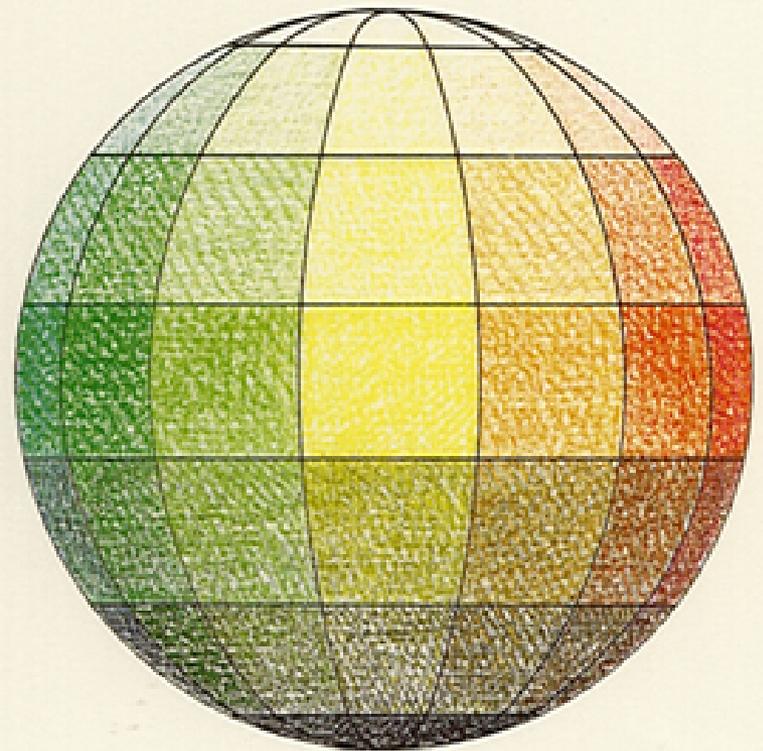
© echo productions

Runge

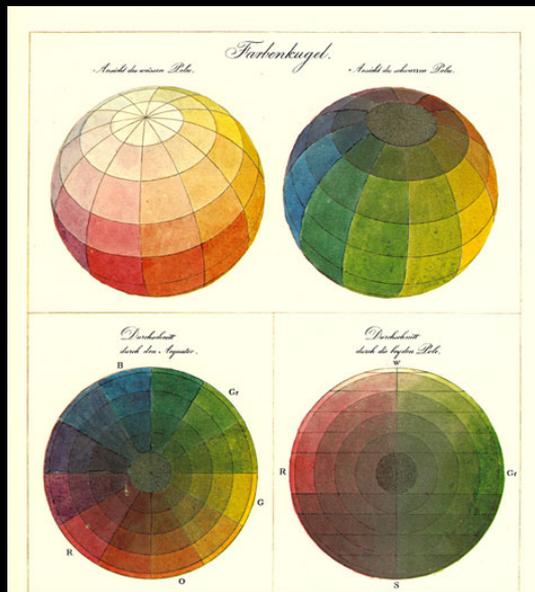
- *The Color Sphere (Die Farbenkugel)*
- *The first 3D model of color – moved from color wheel to a sphere.*

Runge color sphere

- **Note the simple, logical progressions of hue** (a color wheel around the “equator”)
value (black at bottom, progress upward to white)
and chroma (inner is neutral, outer is high chroma).

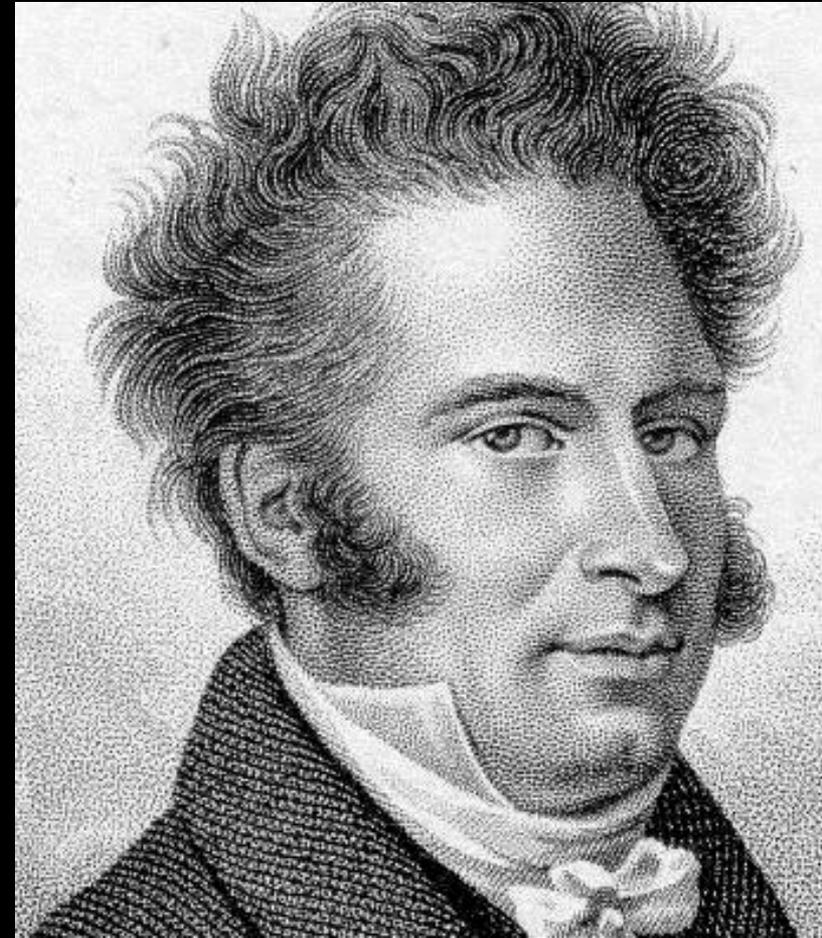


© echo productions



Michel Eugene Chevreul

- **1786-1889**
- **Wrote:**
*The Principles of Harmony
and Contrast of Colors (1839)*
- **Chemist and director of the dye house for
Gobelins tapestries in Paris.**



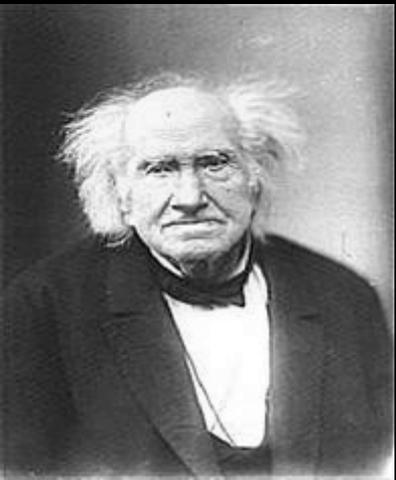


Industrialist ...not artist or colorist

Although he initially had no interest in exploring colours in the same way as artists, it is unlikely that any other chemist has influenced the development of art as much as the Frenchman Michel Eugène Chevreul (1786-1889).



“...an important French chemist whose work with fatty acids led to early applications in the fields of art and science. He is credited with discovering **margarine** and designing an early form of **soap** made from animal fats and salt. He also lived to 102 and was a pioneer in the field of **gerontology**.”



http://en.wikipedia.org/wiki/Michel_Eug%C3%A8ne_Chevreul

Gobelins Tapestries

- “The *Manufacture des Gobelins* is a tapestry factory located in Paris. ...
- It is best known as a royal factory supplying the court of Louis XIV and later monarchs; it is now run by the French Ministry of Culture.
- The Gobelins were a family of dyers, who in the middle of the 15th century...
-

http://en.wikipedia.org/wiki/Gobelins_manufactory

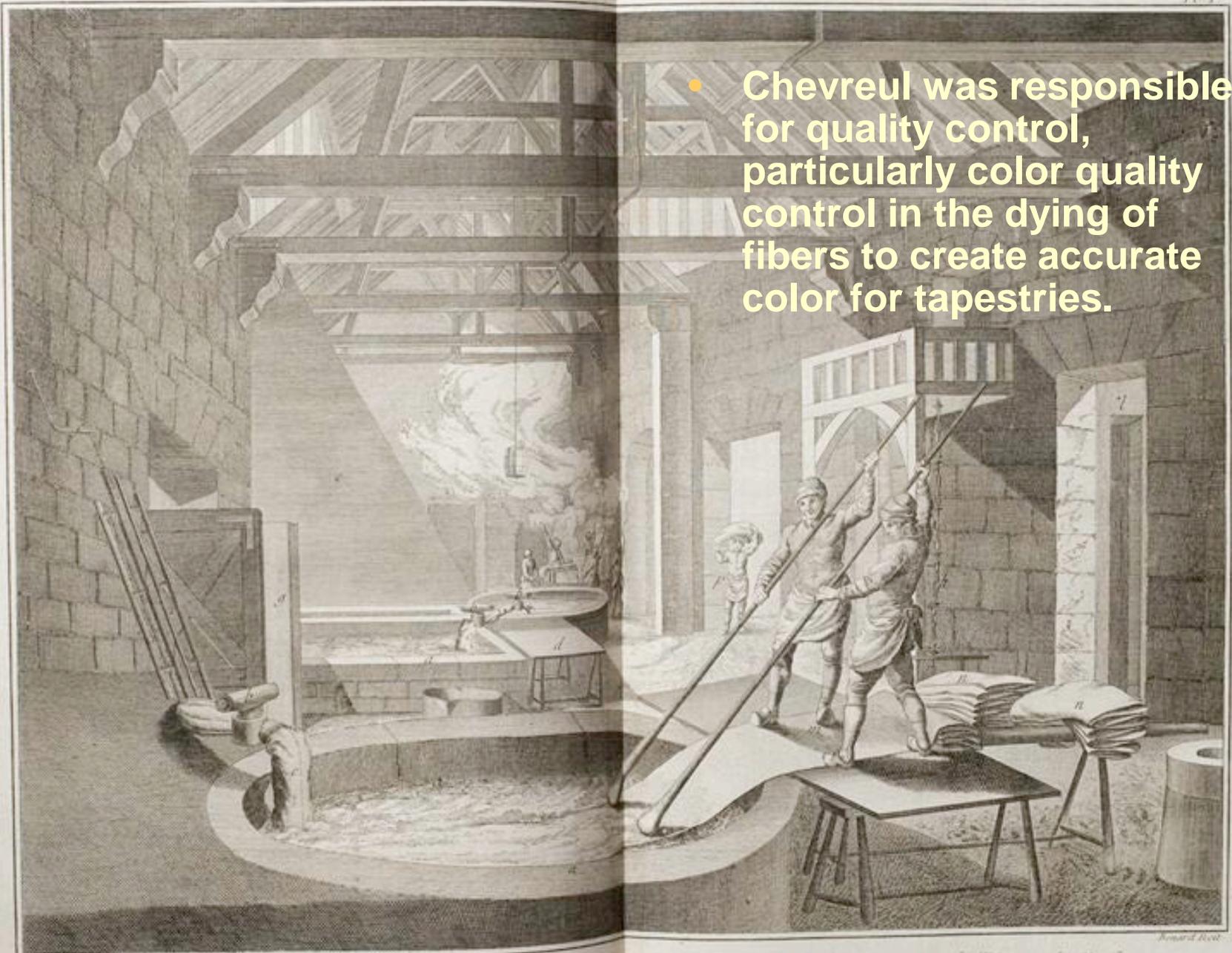


Gobelins Tapestries

- In 1662 the works... were purchased ...on behalf of Louis XIV and made into a general upholstery factory...under the superintendence of the royal painter, Charles Le Brun.
- The tapestry works have closed and reopened over the centuries as the politics of French royalty rose and fell
- ...The factory is still in operation as a state-run institution.”

http://en.wikipedia.org/wiki/Gobelins_manufactory





- Chevreul was responsible for quality control, particularly color quality control in the dying of fibers to create accurate color for tapestries.

Engraver's mark

Teinture des Gobelins, atelier des teinturiers et différentes opérations pour la Teinture des Étoffes.

Engraver's mark

Gobelins Tapestries



Gobelins tapestry at Fontainebleau Chateau

Gobelins Tapestries



Shepherds and Shepherdesses Dancing tapestry of wool silk and metal thread designed by Pierre Monier (1684-1688) woven for Louis XIV at the Gobelins workshop of Jean Lefebvre the Elder. Now at New York's Metropolitan Museum of Art.

Gobelins Tapestries



Shepherds and Shepherdesses Dancing tapestry of wool silk and metal thread designed by Pierre Monier (1684-1688) woven for Louis XIV at the Gobelins workshop of Jean Lefebvre the Elder. Now at New York's Metropolitan Museum of Art.



French textile chemist

As a trained chemist, Chevreul was appointed director of Gobelins in 1824.

He became responsible for quality control — including “color management” of dyes and final product color consistency.



Chevreul

Dye-color consistency

He concentrated on the problems of dyeing tapestry fibers, and therefore on the colors of dyes themselves.

As a chemist, Chevreul supervised the preparation of these dyes, and initially assumed that the color problems were in the dyes and dyeing process.



Chevreul

Scientific study of changing colors

Chevreul observed that a single fiber would look different in different parts of the tapestry.

He thought, at first, that his dyes had faded or were somehow defective.

Yet carefully mixed and dyed colours frequently failed to achieve the desired effect...when the tapestry was woven, the color looked different....but why?



Chevreul

the observation

The color changes were *not* caused by faulty pigments, but by the influence of neighboring colour tones.

Chevreul decided to investigate the matter on a scientific basis, and in 1839 published *The Principles of Harmony and Contrast of Colors*, a comprehensive attempt at providing a systematic basis to the perception of colours.

PLATE XV.



Chevreul's Influence Spreads to Artists

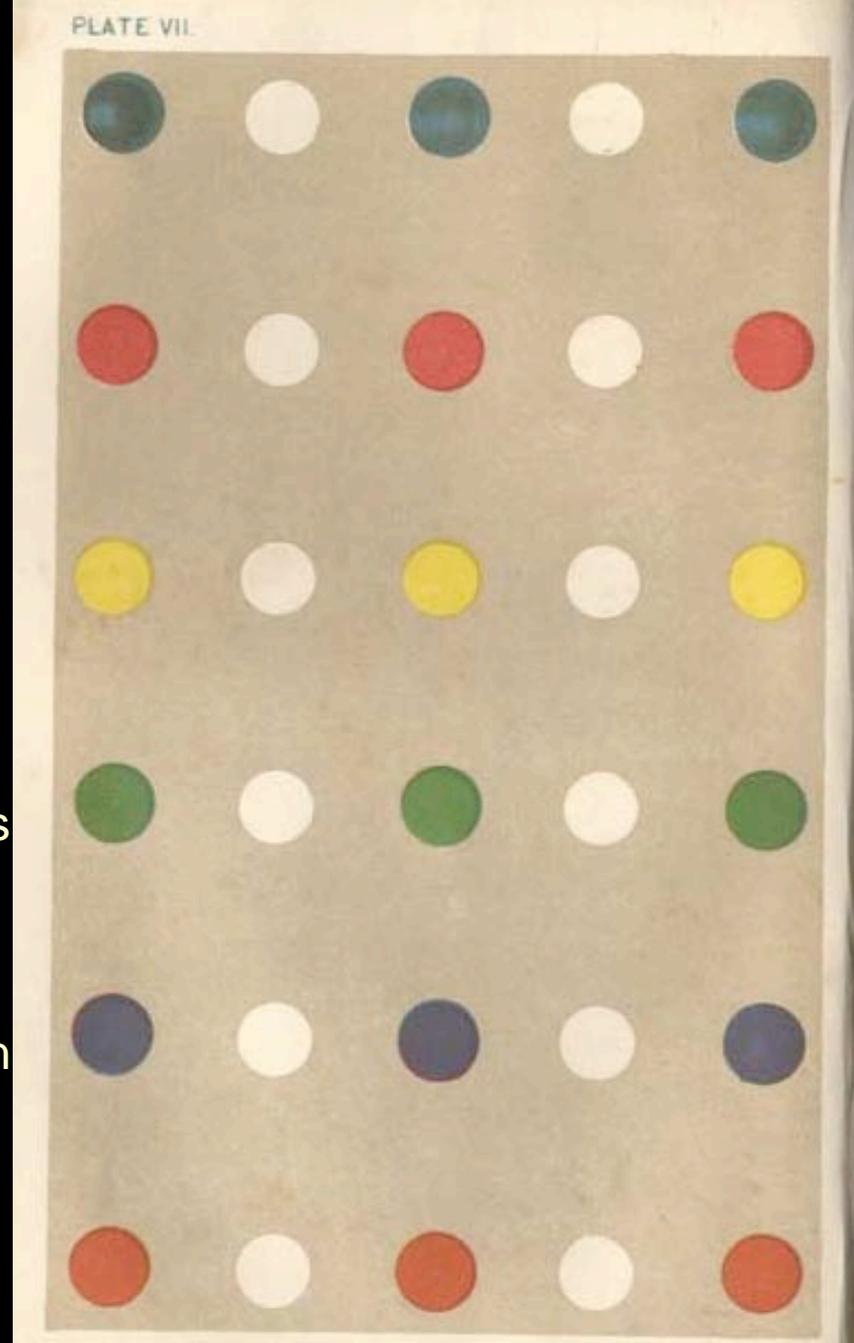
In 1828 Chevreul published his *first* discussion of colour: “Memoir on the influence that two colours may have on each other when they are seen simultaneously”,

...in which he announced the laws of simultaneous and successive contrast; but

...it was largely through the biennial courses of public lectures that he gave at the Gobelins until the 1850s that his ideas passed to painters,

...who began to take notice of these ‘laws’ in the 1830s, and to heighten their contrasts by juxtaposing complementary colours.”

John Gage, *Color and Meaning: Art, Science and Symbolism*, p.196



“binary assortments” from Chevreul’s 1839 *Principles...* text.

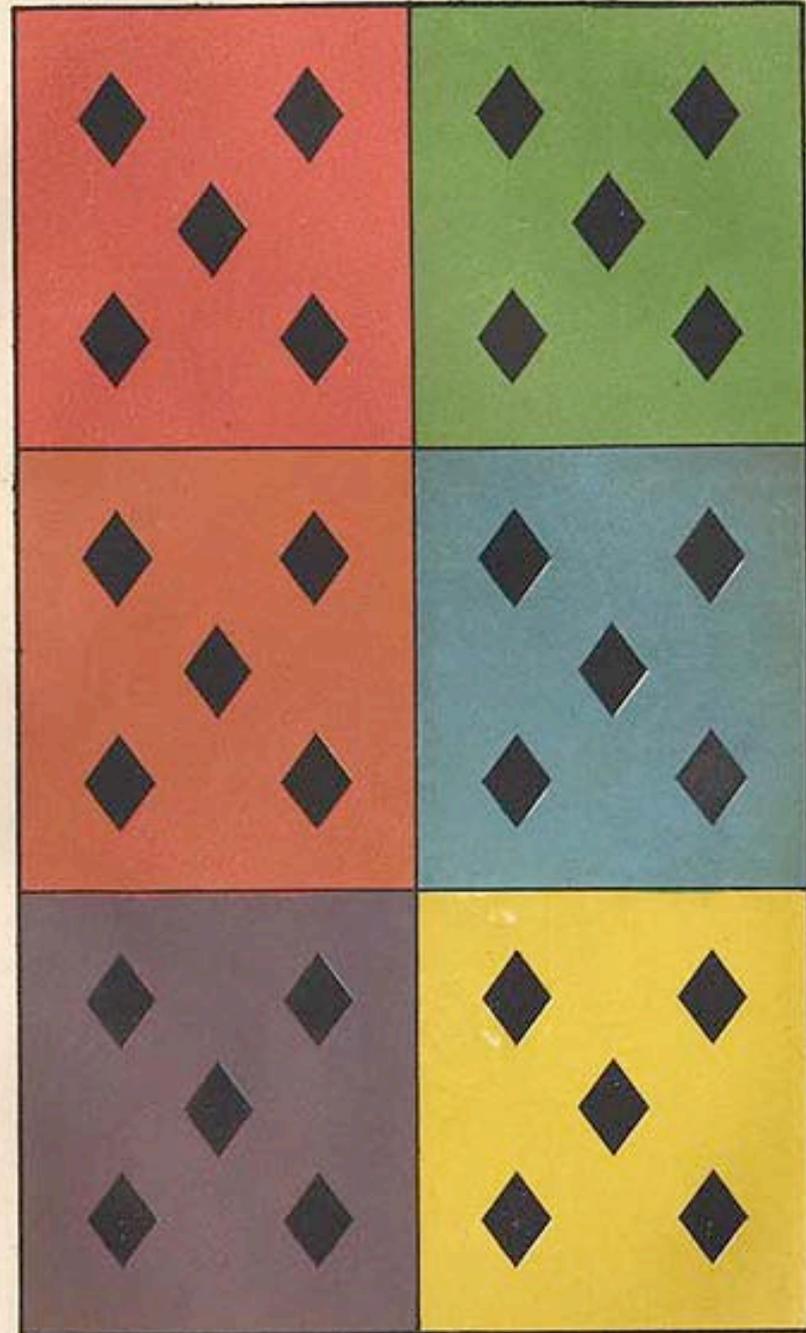
Chevreul

Simultaneous Contrast

His book dealt primarily with the so-called "simultaneous contrast" of colours, and contained Chevreul's famous law:

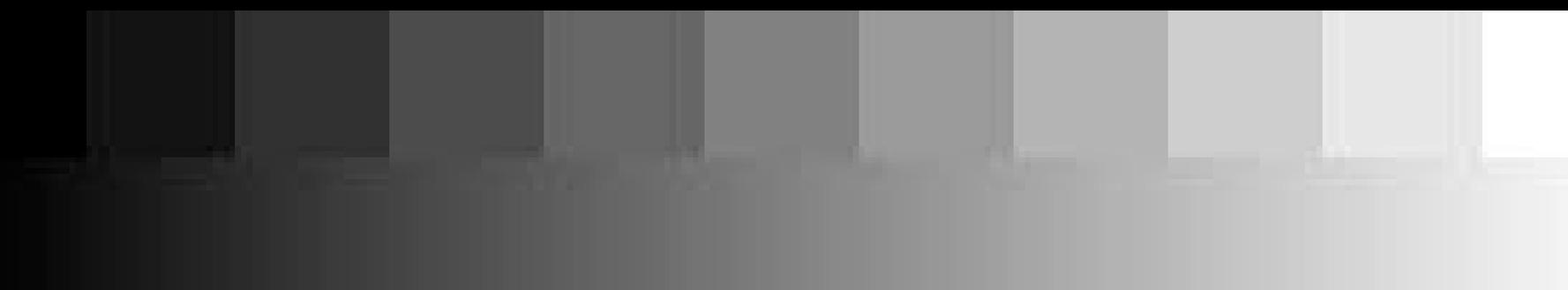
"Two adjacent colours, when seen by the eye, will appear as dissimilar as possible".

PLATE XII.





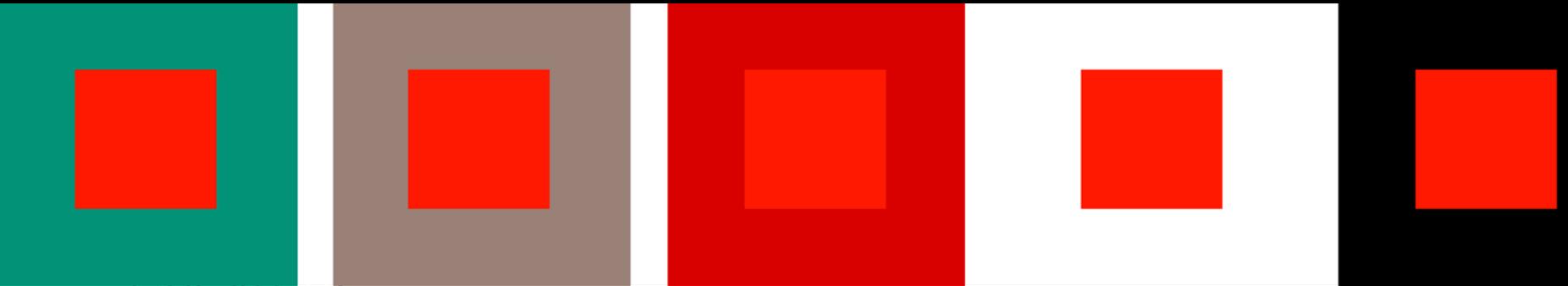
Simultaneous contrast — each value changes appearance in response to the colors/values around it.



psychological influence

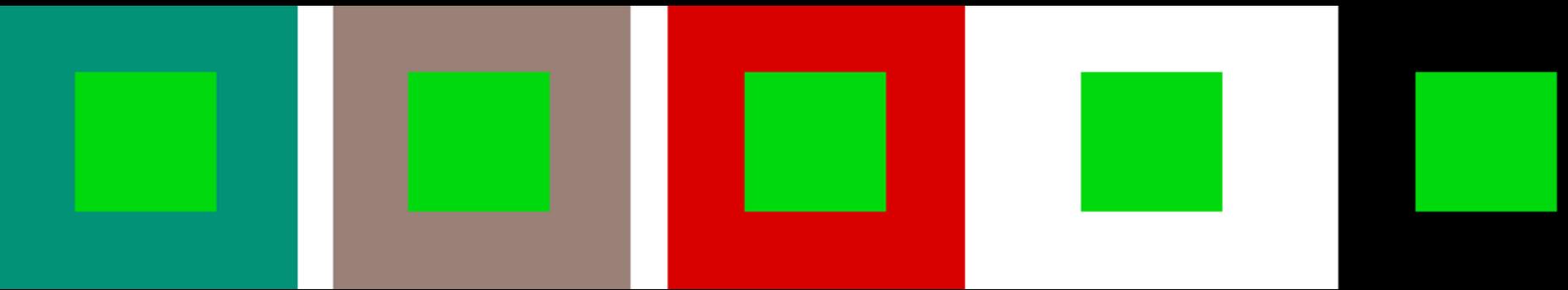
We are here confronted with the active role of the brain in the formation or perception of colours, and we should once more remind ourselves that colours are *effects* which are created in the world inside our heads.

The *mind* makes colors.



Altered color perception

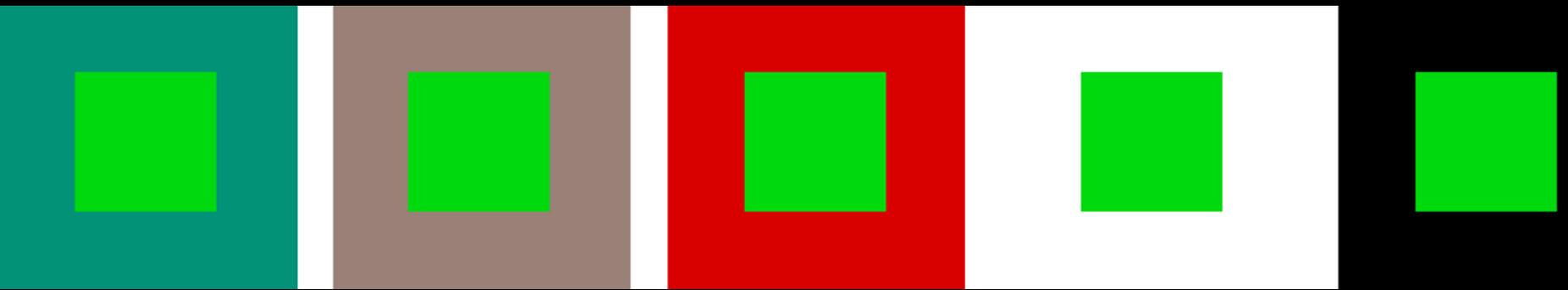
One and the same colour will have a brighter effect against a dark background, and a darker effect against a light background.



Chevreul

Altered color perception

A pure green will have a greener effect on a red background, and a yellower effect on a blue-green background



Chevreul

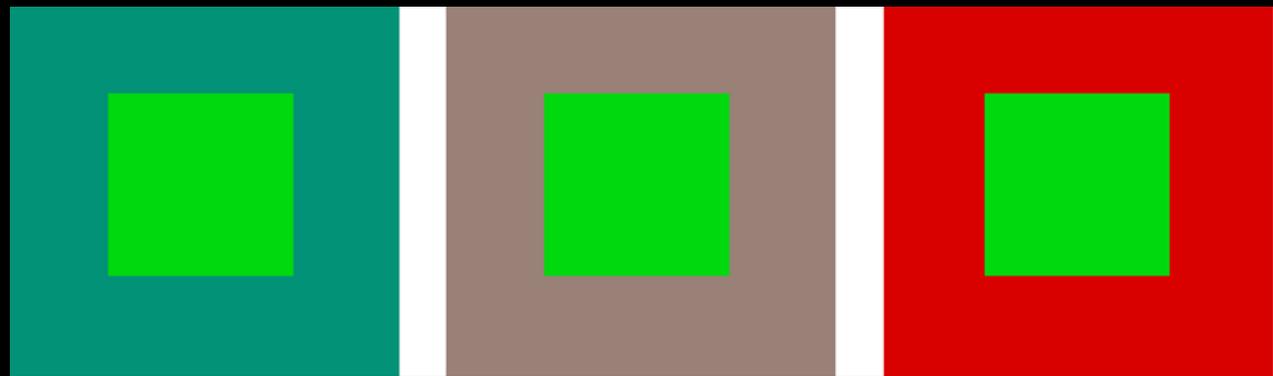
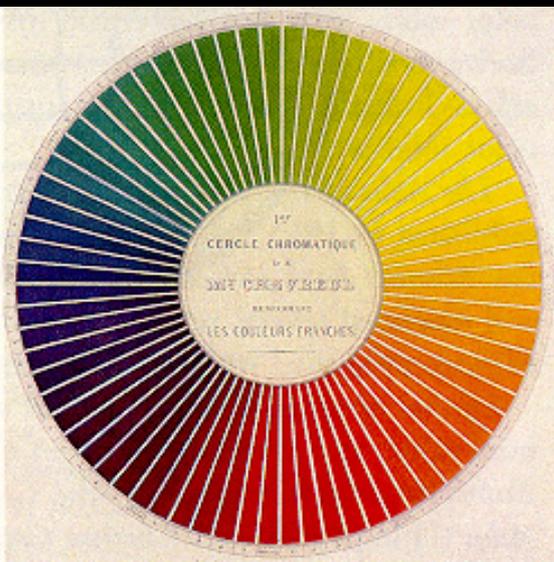
Altered color perception

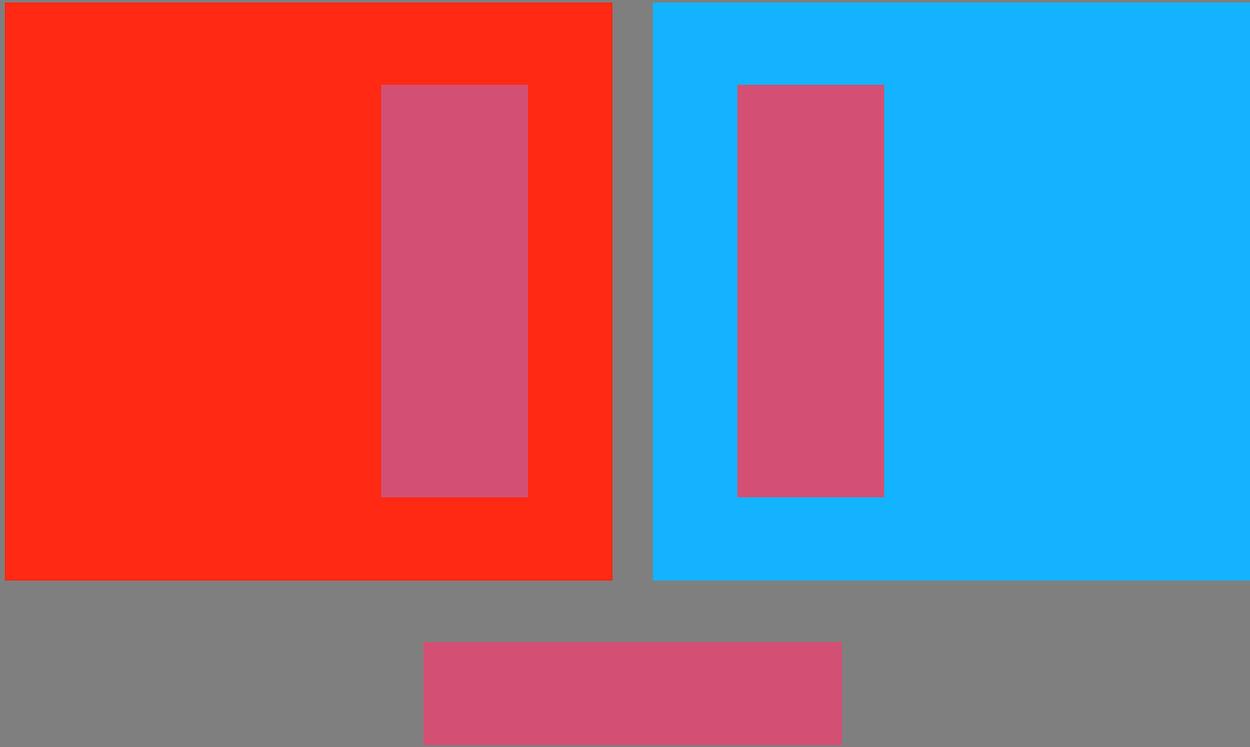
A pure green will have a greener effect on a red background, and a yellower effect on a blue-green background

Chevreul

Background repels

This simultaneous interaction of colours can be easily understood or interpreted using the colour-circle or the colour-sphere if we accept that the background colour will repel the colour of the observed colour field.





Any two juxtaposed colors, alter the appearance of each other.
The perception of a color depends on its context.



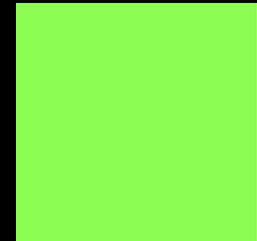
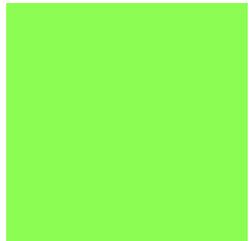
Any two juxtaposed colors, alter the appearance of each other.
The perception of a color depends on its context.

*2 - ALL LIGHT COLORS SEEM
MOST STRIKING AGAINST
BLACK.*

Simultaneous Contrast

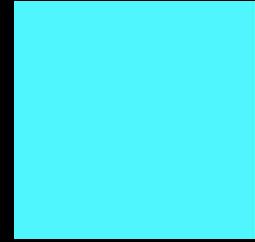
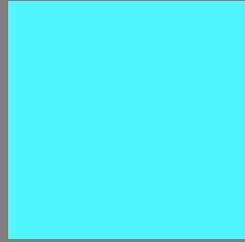
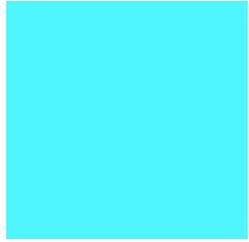
- <http://web.mit.edu/persci/gaz/gaz-teaching/index.html> A collection of Flash animations.
- <http://web.mit.edu/persci/gaz/gaz-teaching/flash/koffka-movie.swf>
- <http://web.mit.edu/persci/gaz/gaz-teaching/flash/white-movie.swf>
- http://www.michaelbach.de/ot/lum_wkoffka/index.html
- [75 Illusions — several related to simultaneous contrast](#)
- http://www.michaelbach.de/ot/lum_cobc/index.html
- <http://web.mit.edu/persci/gaz/gaz-teaching/flash/craik-movie.swf>
- <http://infohost.nmt.edu/~armiller/illusion/craik.htm>

- <http://infohost.nmt.edu/~armiller/illusion.htm> (varied optical illusions — mostly *NOT* simultaneous contrast.)



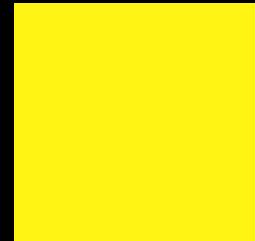
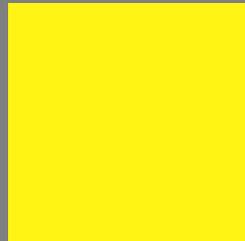
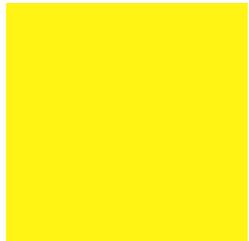
A high-chroma, high value color
looks more brilliant on black than
against white.

Both value and chroma are effected.



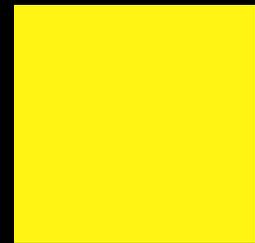
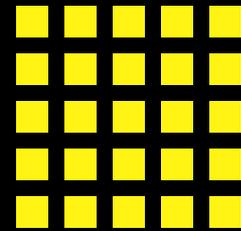
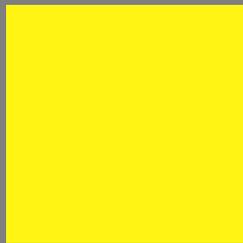
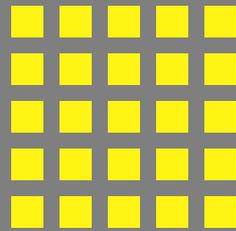
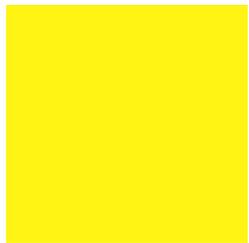
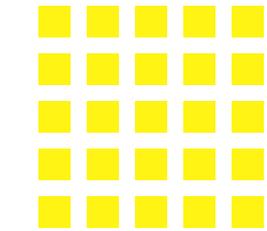
A high-chroma, high value color
looks more brilliant on black than
against white.

Both value and chroma are effected.



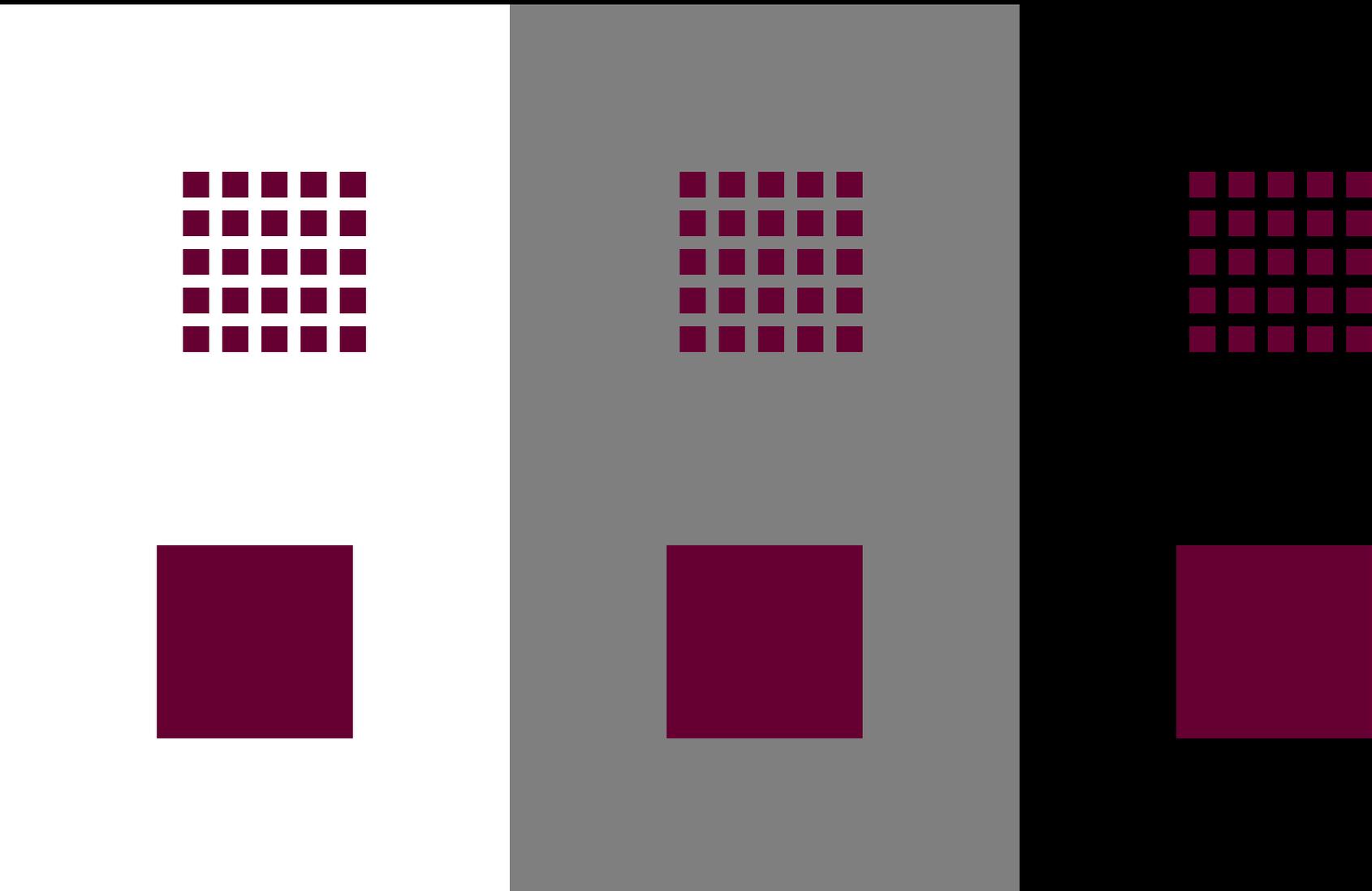
A high-chroma, high value color
looks more brilliant on black than
against white.

Both value and chroma are effected.

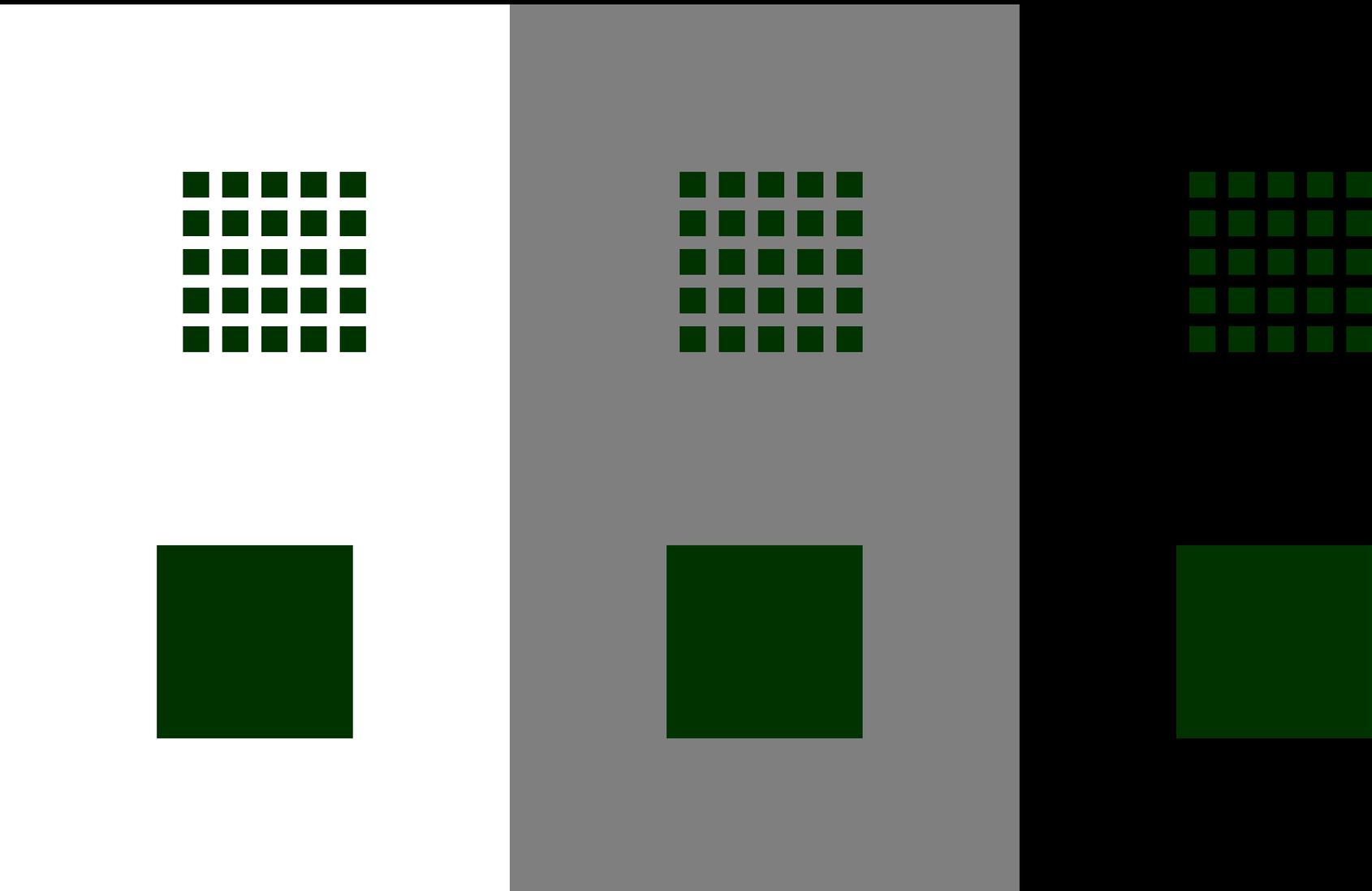


The variance in effect appears more powerful in small samples than in large.

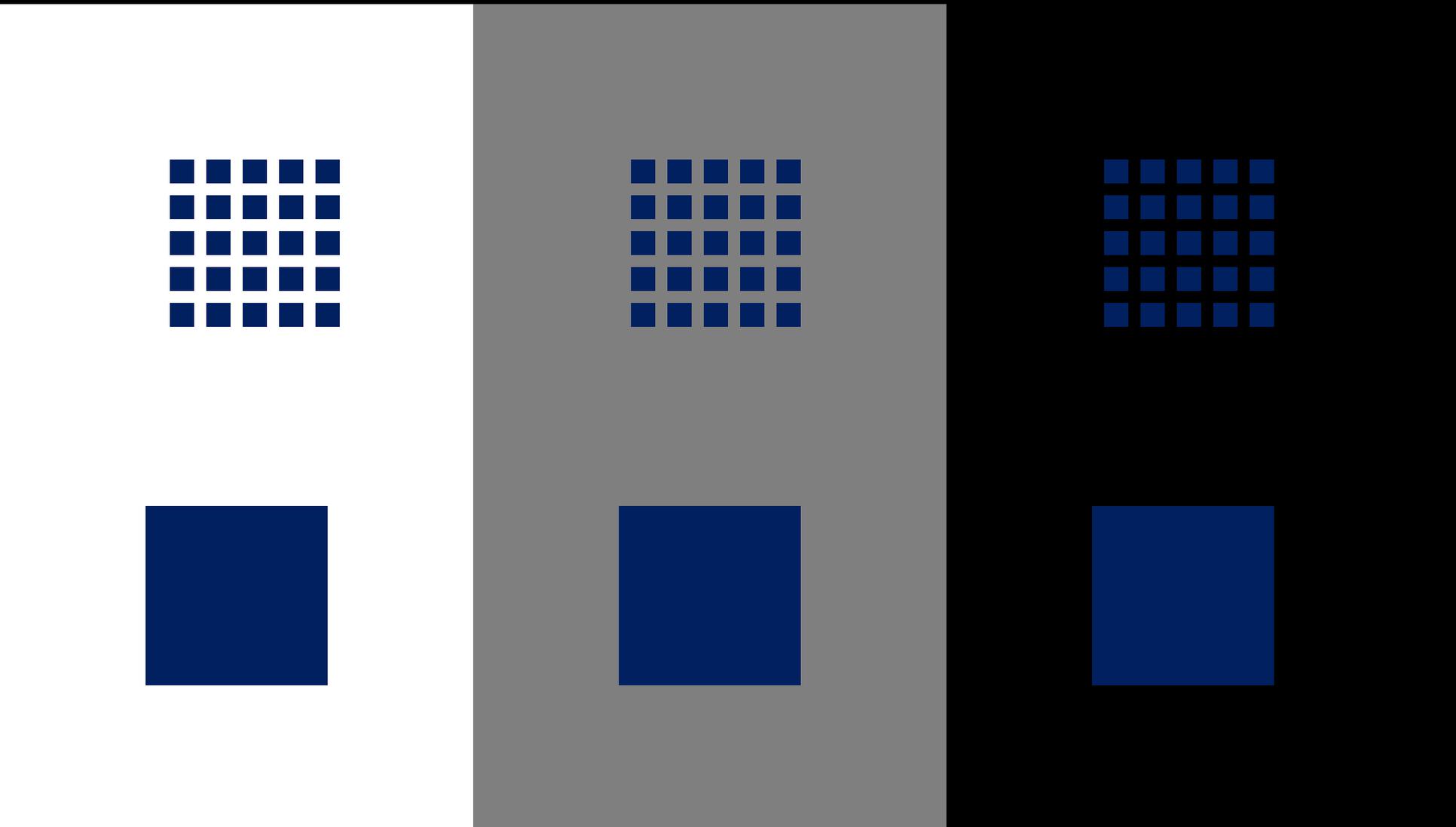
*3 - ALL DARK COLORS SEEM
MOST STRIKING AGAINST
WHITE.*



#3 All dark colors seem most striking against white.

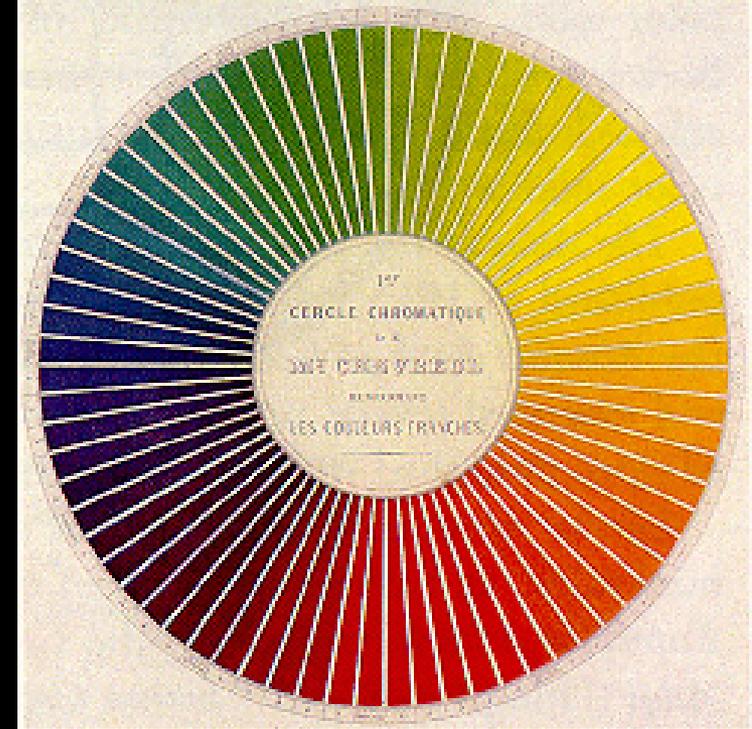


#3 All dark colors seem most striking against white.



#3 All dark colors seem most striking against white.

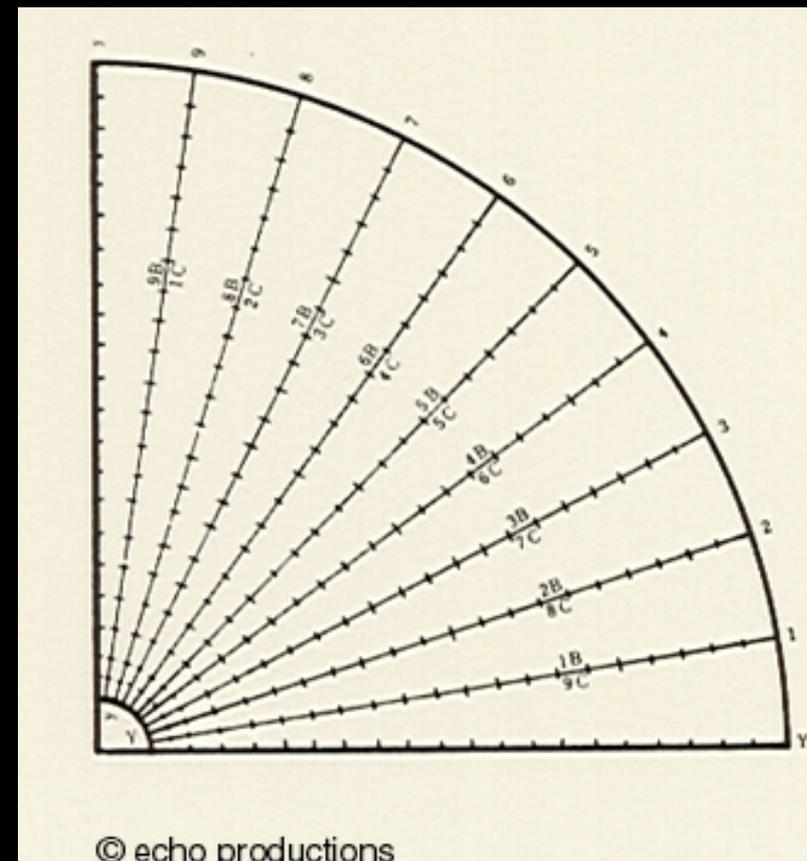
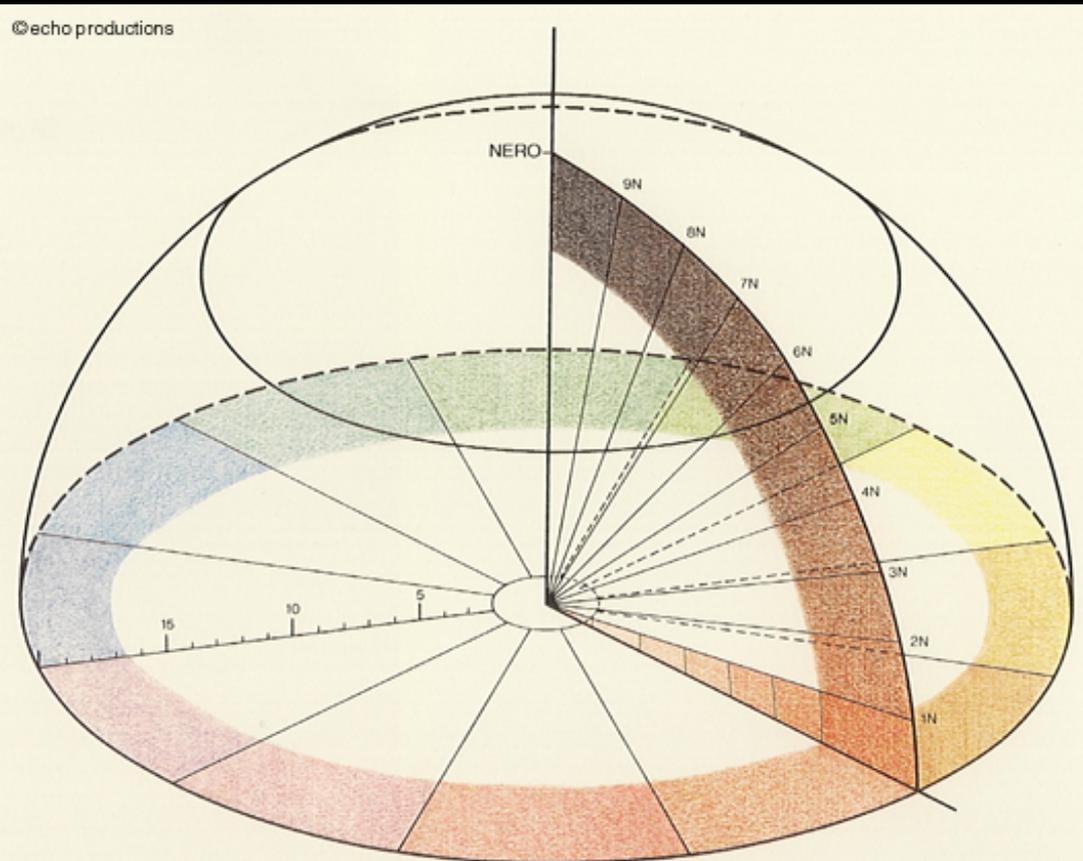
Michel Eugene Chevreul



- *Created a finely graded 2D color circle (72-hues)*
- *Study of dyes affirmed that red, yellow and blue are primaries and that orange, green and violet are secondaries.*

- **Also developed a 3D color model based on a sphere.**
- **Formulas for color mixtures at each region were given.**

Chevreul

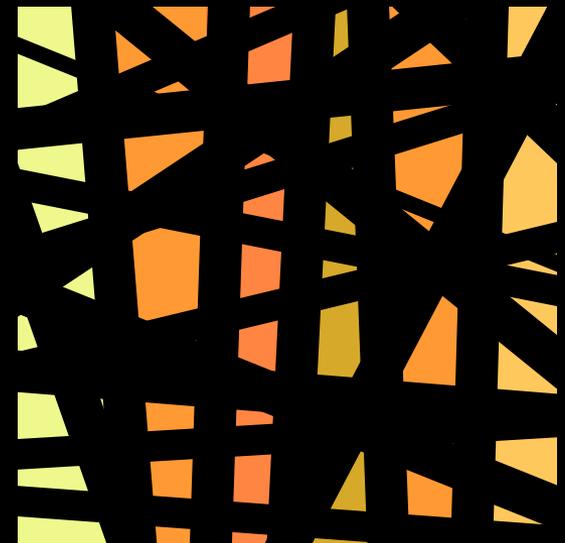
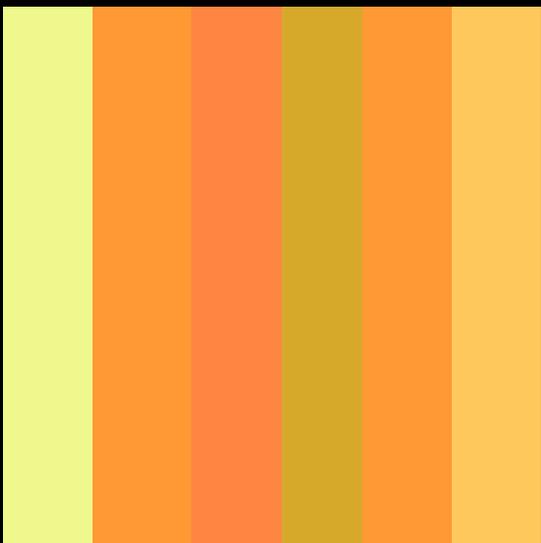




Chevreul: harmony tips

Adjacent hues tend to blend optically when separated, but differences are accentuated when juxtaposed.

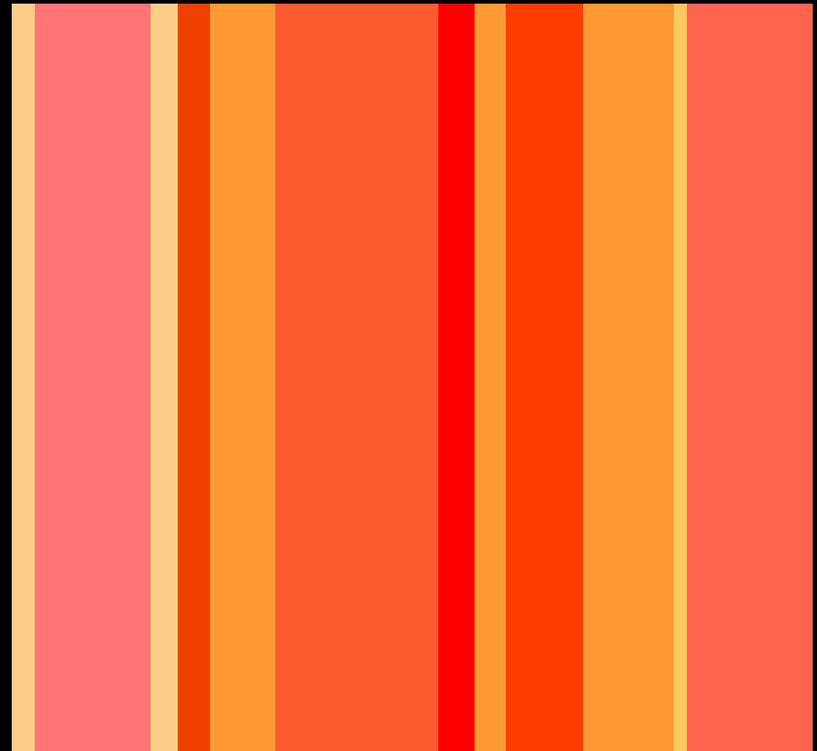
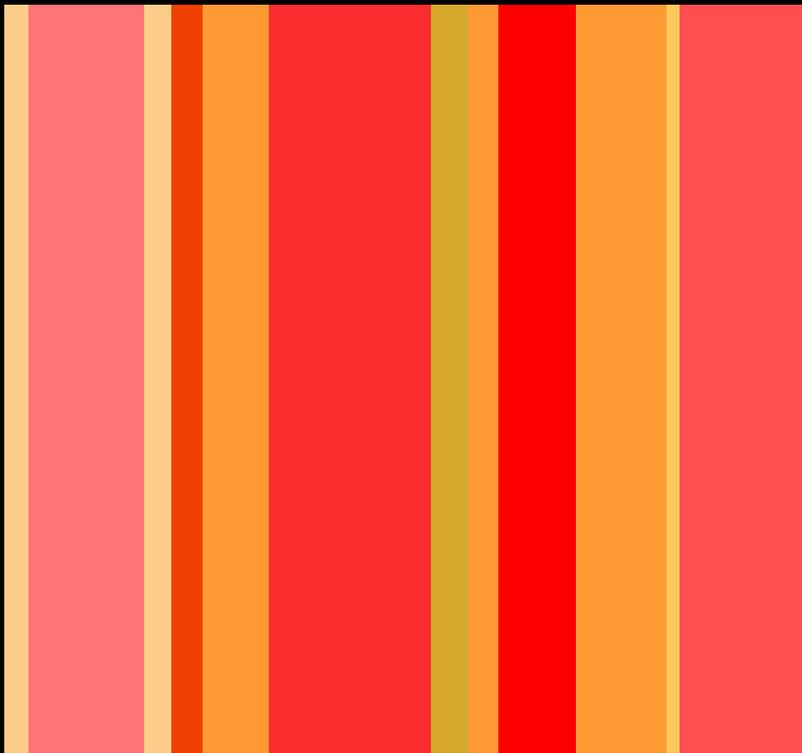
Thus color massing and fragmentation alters harmony.





Chevreul: harmony tips

***Analogous combinations are best
when the dominant hue is primary.***



“Analogous combinations are best when the dominant hue is primary.”

***Reliable advice?
Here RV
dominates and
Red is
subordinate.***



“Analogous combinations are best when the dominant hue is primary.”

Here Red dominates and Red-Violet is subordinate.



Chevreul: harmony



- ***“The contrast of the most opposite colors is most agreeable...The complementary assortment is superior to every other.”***
- ***—He offered many rules and suggestions for successful harmony.***

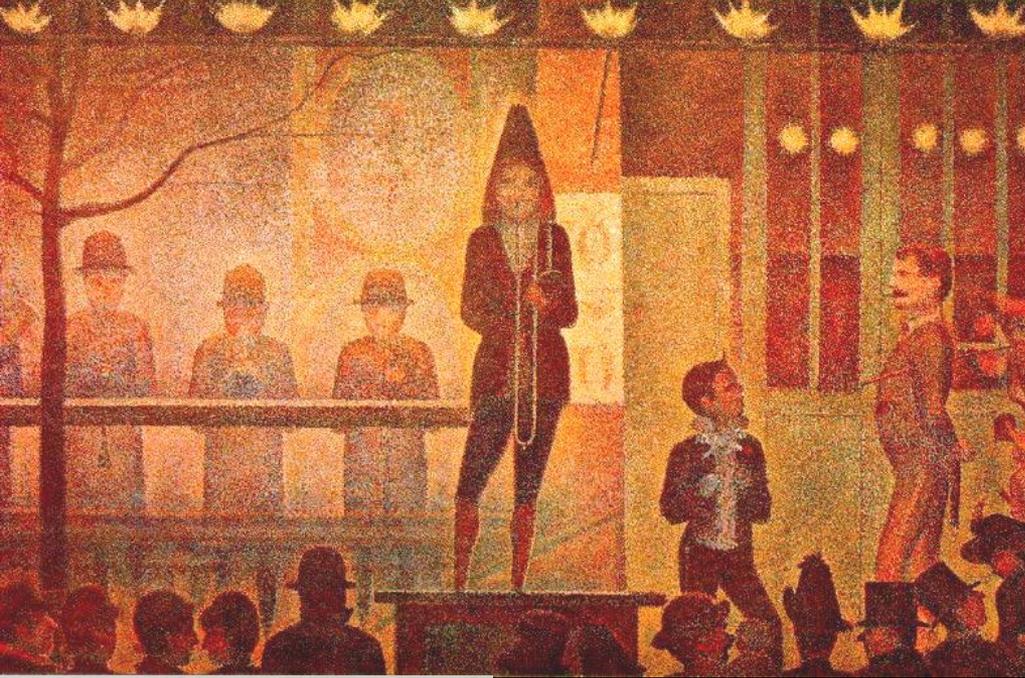
Chevreul's influence

- *Systematized the dye and tapestry industry's use of color.*
- *Many painters followed his rules.*
- *Major painters such as Monet and Pissarro were familiar with his work but basically rejected its applicability to their own work.*
- *Georges Seurat followed his work closely and applied it to his pointillism.*



Chevreur: size/proportions alter effect.

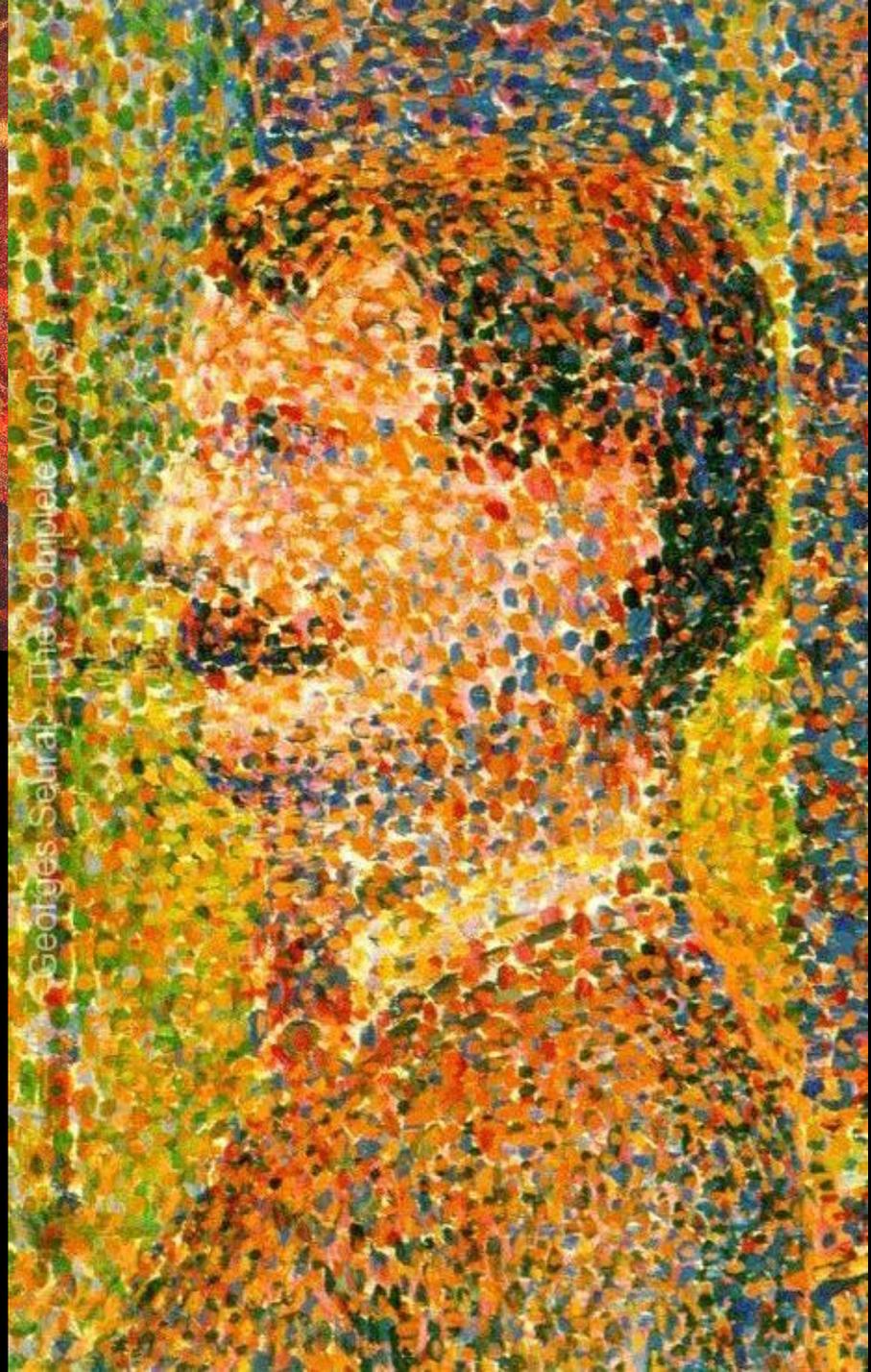
- ***Complementary colors used in **large** quantities will make each other more brilliant. (simultaneous contrast)***
- *****Small** samples of complementary colors tend to optically mix to create a duller sensation. (blending)***



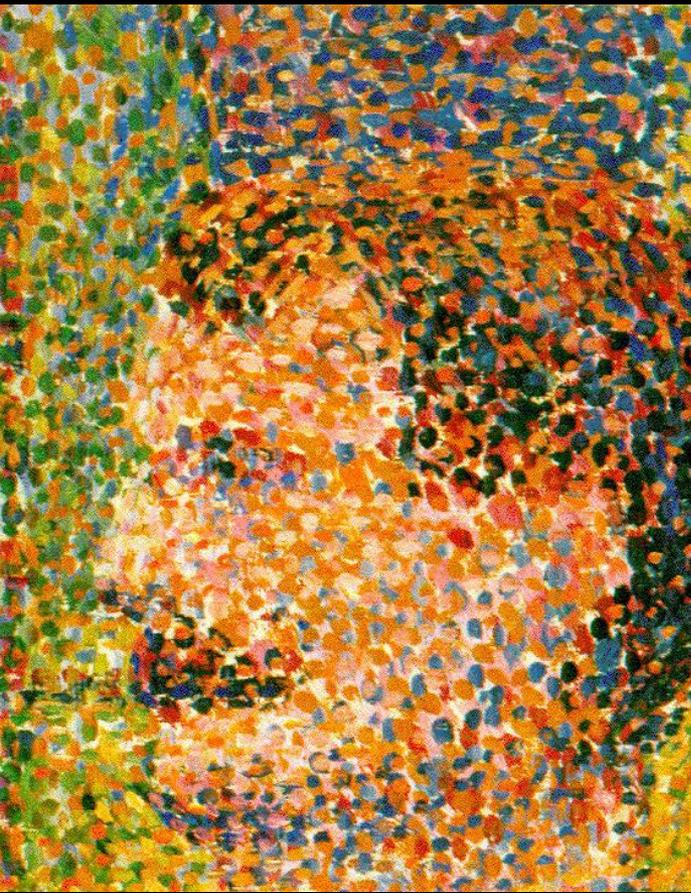
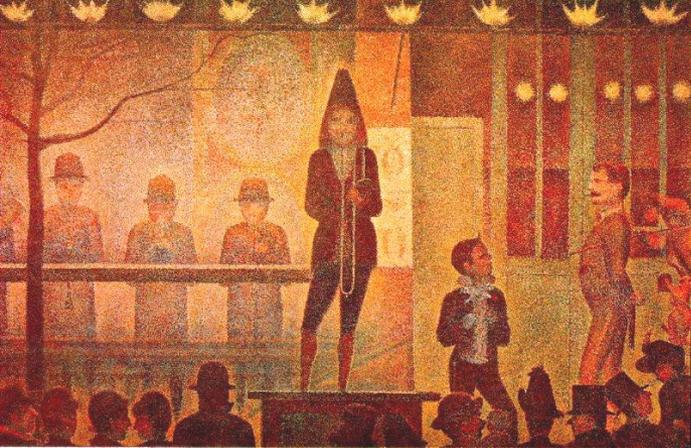
GEORGES SEURAT

Chevreul's influence

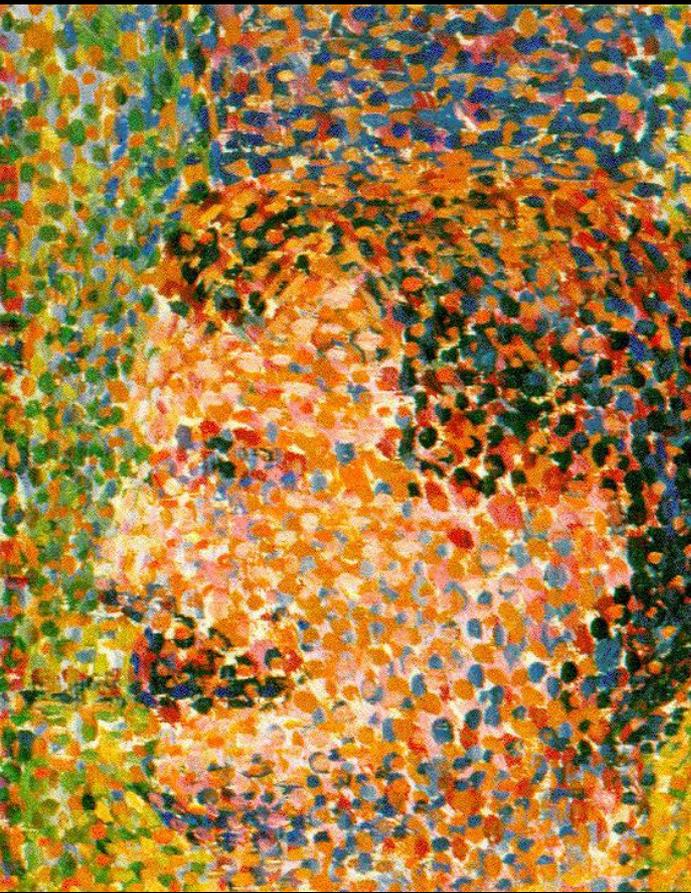
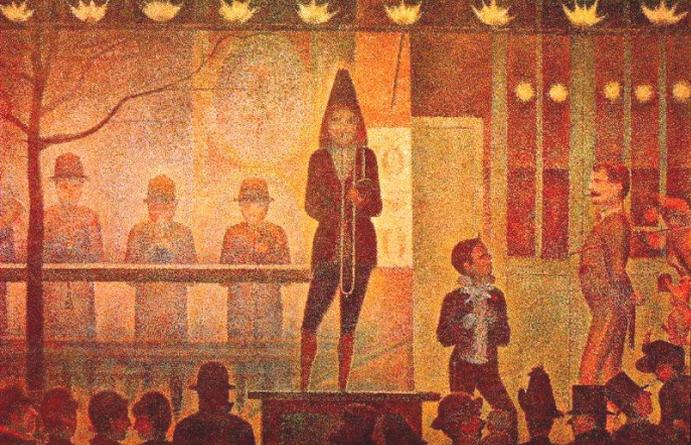
***Georges Seurat
followed his work
closely and
applied it to his
pointillism.***

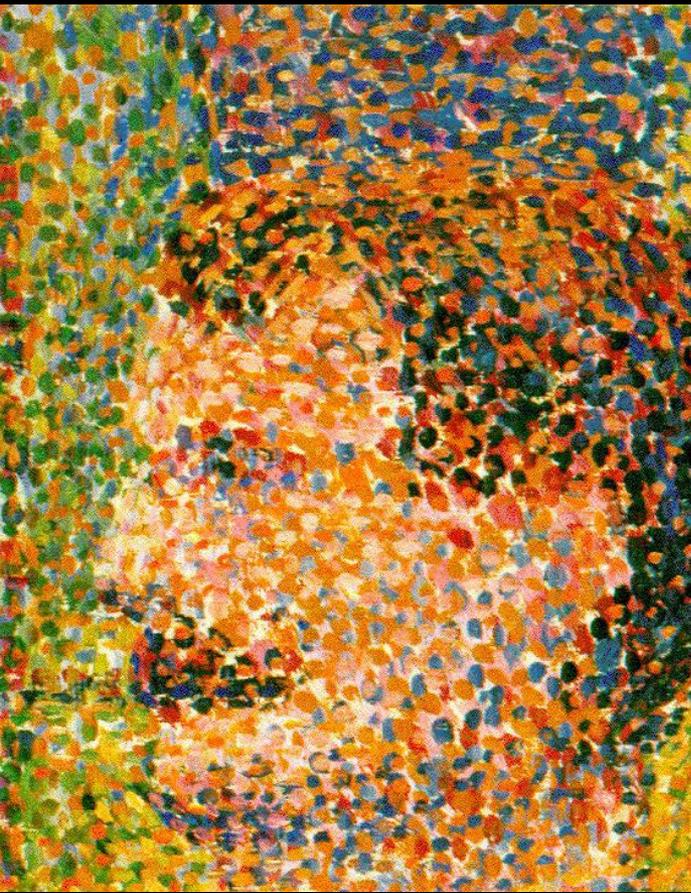
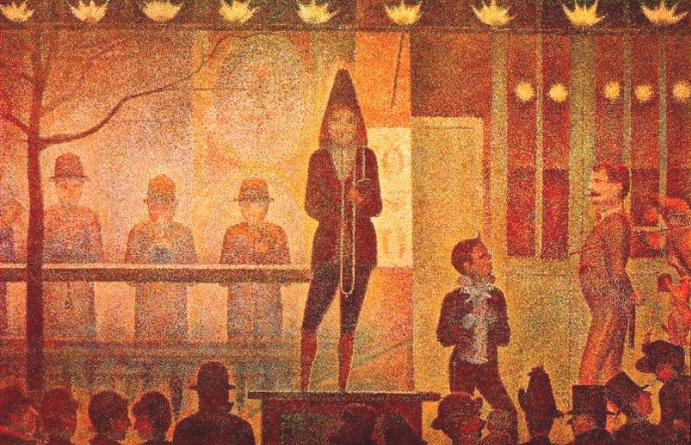


Georges Seurat, The Complete Works



- **Georges Seurat —
pointillism.**





‘S





Chevreul

- ***Attempted to explain:***
 - **Simultaneous Contrast**
 - **Successive Contrast**
 - **Optical color mixture**
 - **Principles of Harmony**



Chevreul

- ***Main contribution is a thorough explication of the effects of color juxtaposition:***
 - **Simultaneous Contrast**
 - **“Chevreul’s Laws”**
 - **13 individual, specific applications of his one general law**



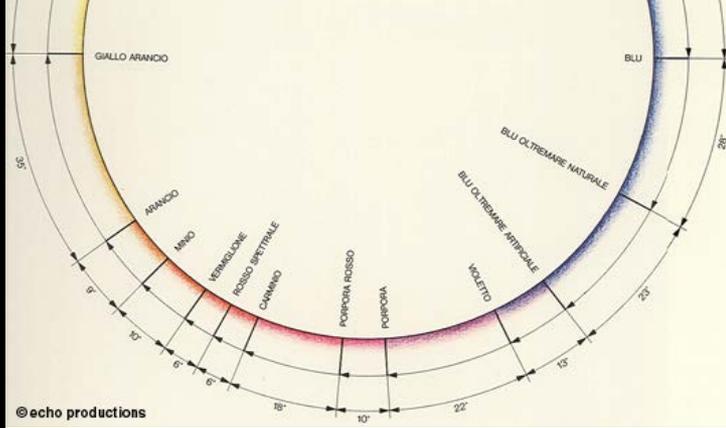
Chevreul

- ***Attempted to explain:***
 - **Simultaneous Contrast**
 - **Successive Contrast**
 - **Optical color mixture**
 - **Principles of Harmony**



Chevreul

- ***Main contribution is a thorough explication of the effects of color juxtaposition:***
 - **Simultaneous Contrast**
 - **“Chevreul’s Laws”**
 - **13 individual, specific applications of his one general law**

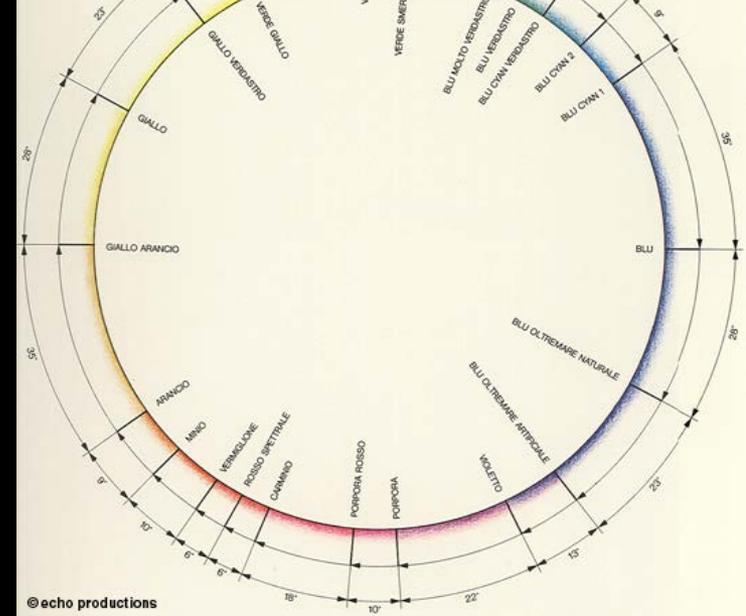


Ogden Rood

- An American color scientist, admired as a teacher and experimentalist. Rood also studied painting in Germany and continued to paint throughout his life.
- Optical mixing explained in greater detail.
- Refined definitions of complementary colors – *Circle of complementaries*.
- His color wheel used both hue names and pigment names—to aid artists in practical color selection.

Ogden Rood

- 1895—wrote *Modern Chromatics*
- Identified the three dimensions of color: *hue, value, and chroma.*
- Create a color wheel based on *optical complementary relationships.*



Ogden Rood

- **1895 – Modern Chromatics**
- Declared color to be “**a sensation existing merely in ourselves**” rather than being an absolute physical fact.
- “Color is but a sensation and has no existence outside the nervous system of living beings.”

Thus Rood advances past the idea that color is a part of an object “out there”, further towards our contemporary conception of *color as a subjective phenomena – within the viewer.*

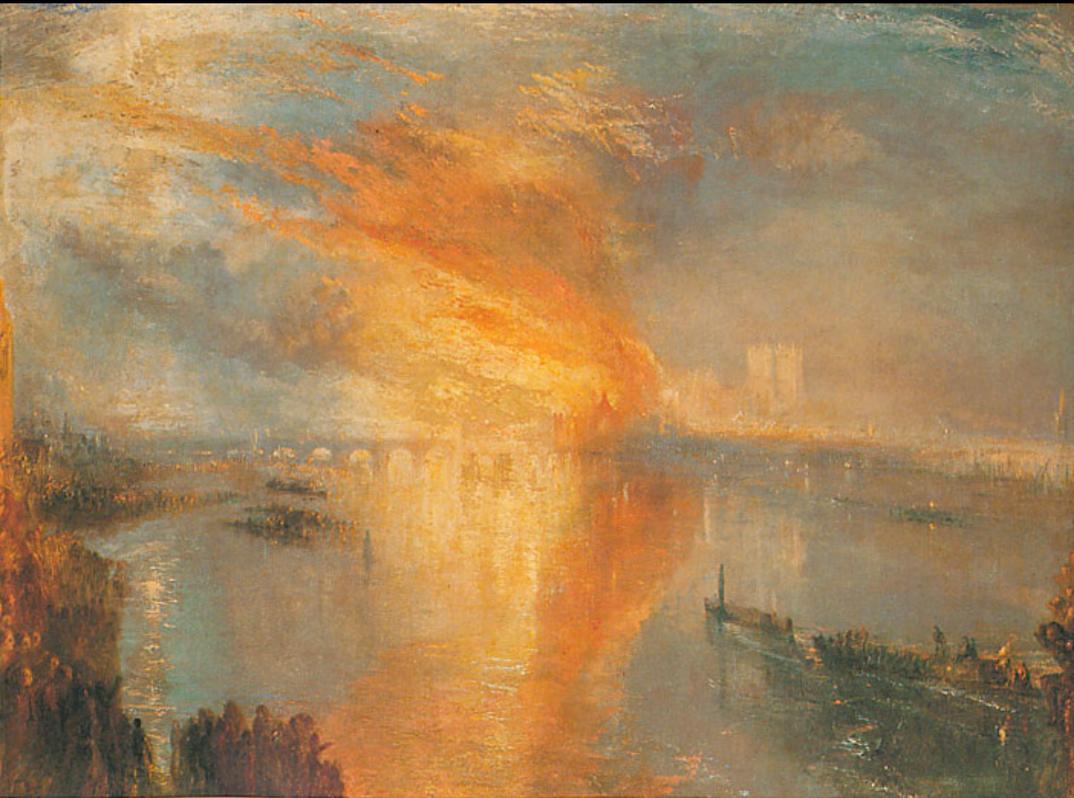
COLOR QUOTES

“Color is but a sensation and has no existence outside the nervous system of living beings.”

~ *Nicholas Ogden Rood*

Ogden Rood

- As an artist, Rood knew the works of Turner and John Ruskin. Like the Impressionists, he considered Turner to be the painter-colorist most worthy of careful study.



Ogden Rood

- As a scientist, he was acutely aware of the theories of Newton, Young, Goethe, Chevreul, von Helmholtz, and Maxwell.

Moreover, he had at his disposal the most recent optical instruments for studying the additive and subtractive properties of colored lights, colors and their complementaries, reflected or transmitted colors [pigment colors], the effect of various lights on pigments, retinal blending, and the like.

His technique of flicker photometry for comparing the brightness of colors was considered an important contribution to the science of color.

He was able to explain a number of misconceptions about a color and color vision, and among other things, he proposed a different alignment of complementary hues from those of Chevreul, Charles Blanc, and David Sutter.



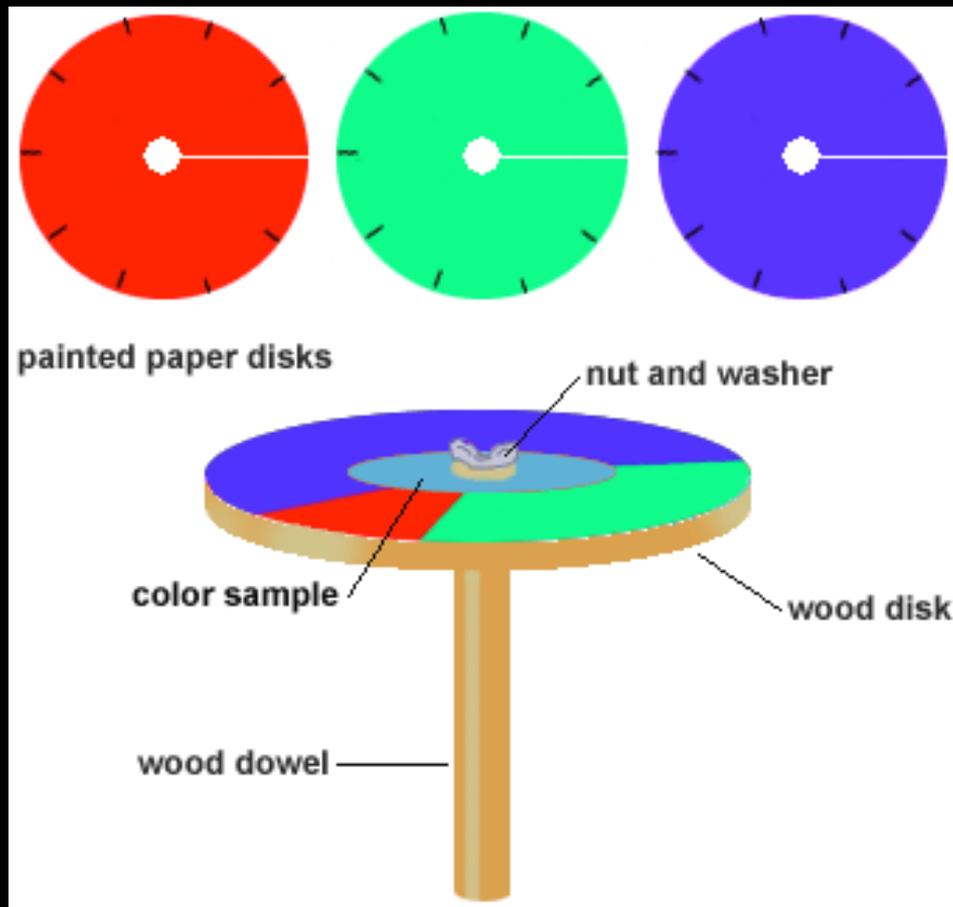
Ogden Rood

- Rood's books were known by Seurat and influenced his pointillist techniques, though Rood deplored pointillist painting.
- ‘Modern Chromatics, written for both physicists and artists, came to be known as “*the Impressionist's Bible*,” although Rood doesn't seem to have known about Impressionist painting until after 1879. Ironically, when he did discover it, he didn't like it!

He is reported to have said: “*If that is all I have done for art, I wish I had never written that book.*””

Ogden Rood— how do you find true complements?

Rood used spinning disks to generate luminous/optical mixtures from pigment.



**On this disk,
optical/light
primaries can be
varied in
proportion...**

...then spun...

**...to see the
resulting “mixture”
of those proportions.**

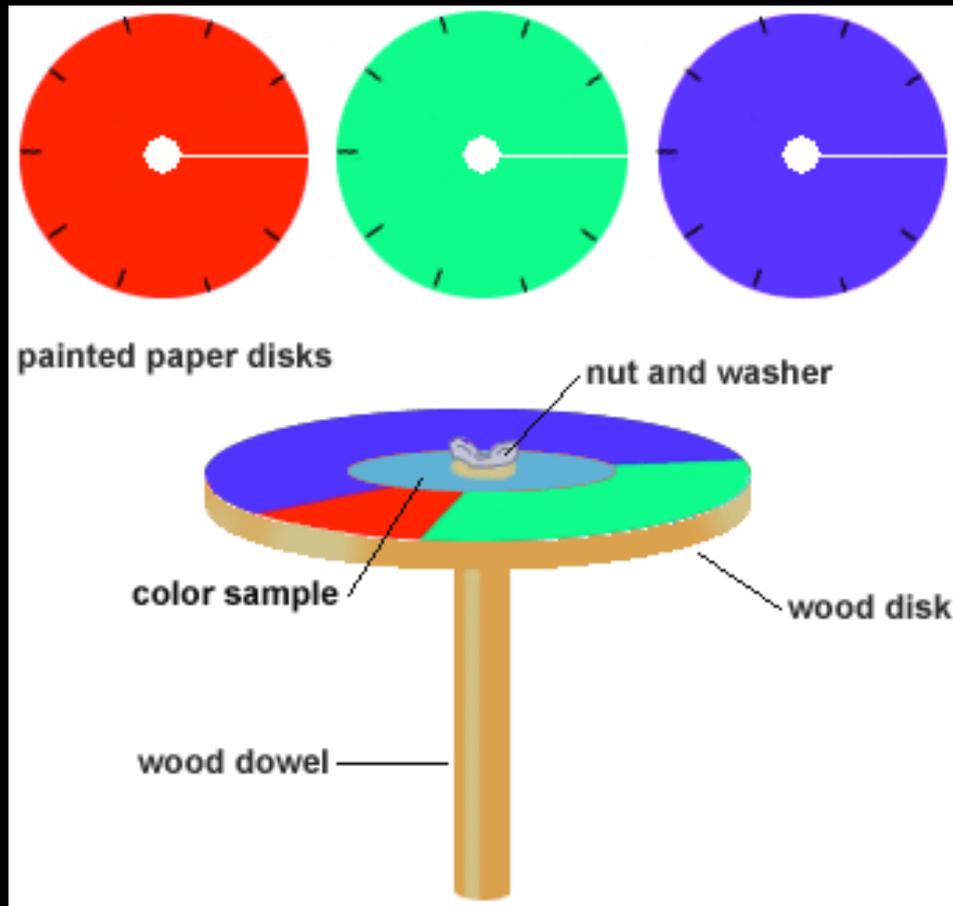
<http://www.handprint.com/HP/WCL/colortop.html>

YouTube disk-spinners

Somewhere, someone is spinning colors.

Quicky spinner —
red+white=pink

<http://www.youtube.com/watch?v=968LGm7LIfw>



Spinning the wheel—
white:

<http://www.youtube.com/watch?v=d7otIN5RUBw>

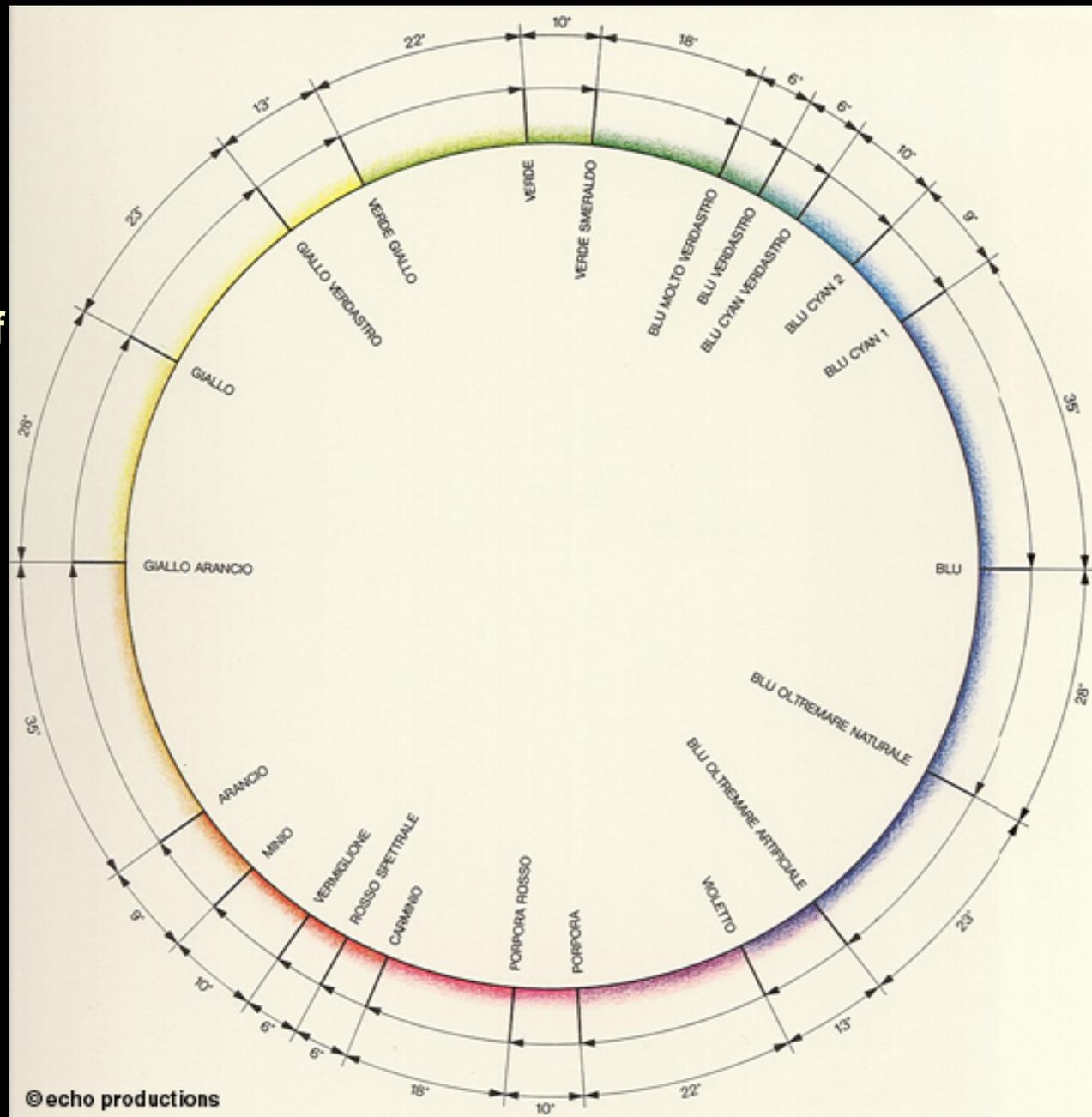
<http://www.youtube.com/watch?v=OGZ1uw81M1w&NR=1>

Additive Color:

<http://www.youtube.com/watch?v=ceaScLP8s3M>

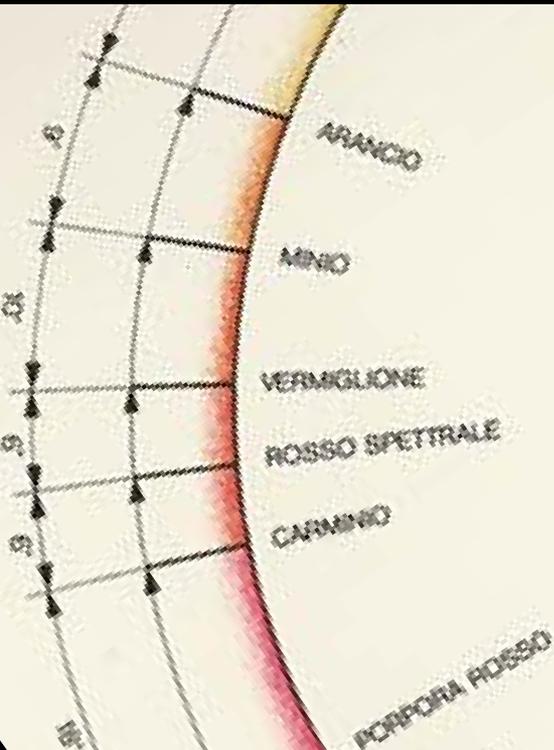
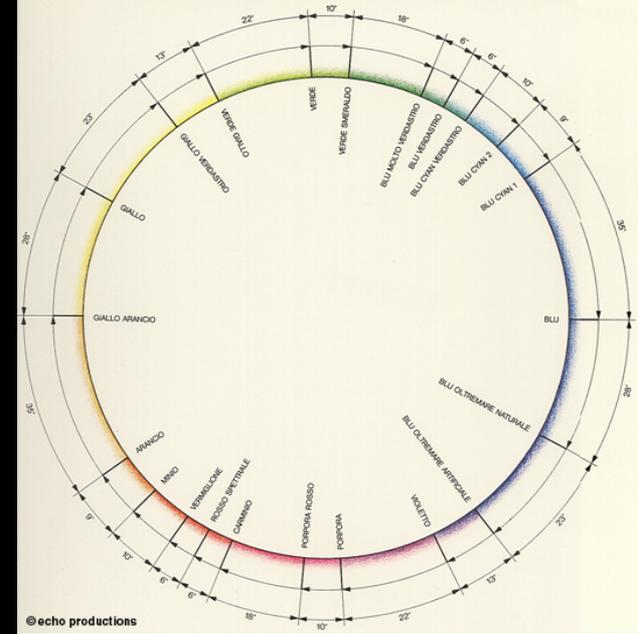
Ogden Rood

- Refined definitions of reliable, optical complementary colors – *Circle of complementaries*.
- Used familiar painter's pigments/paints.



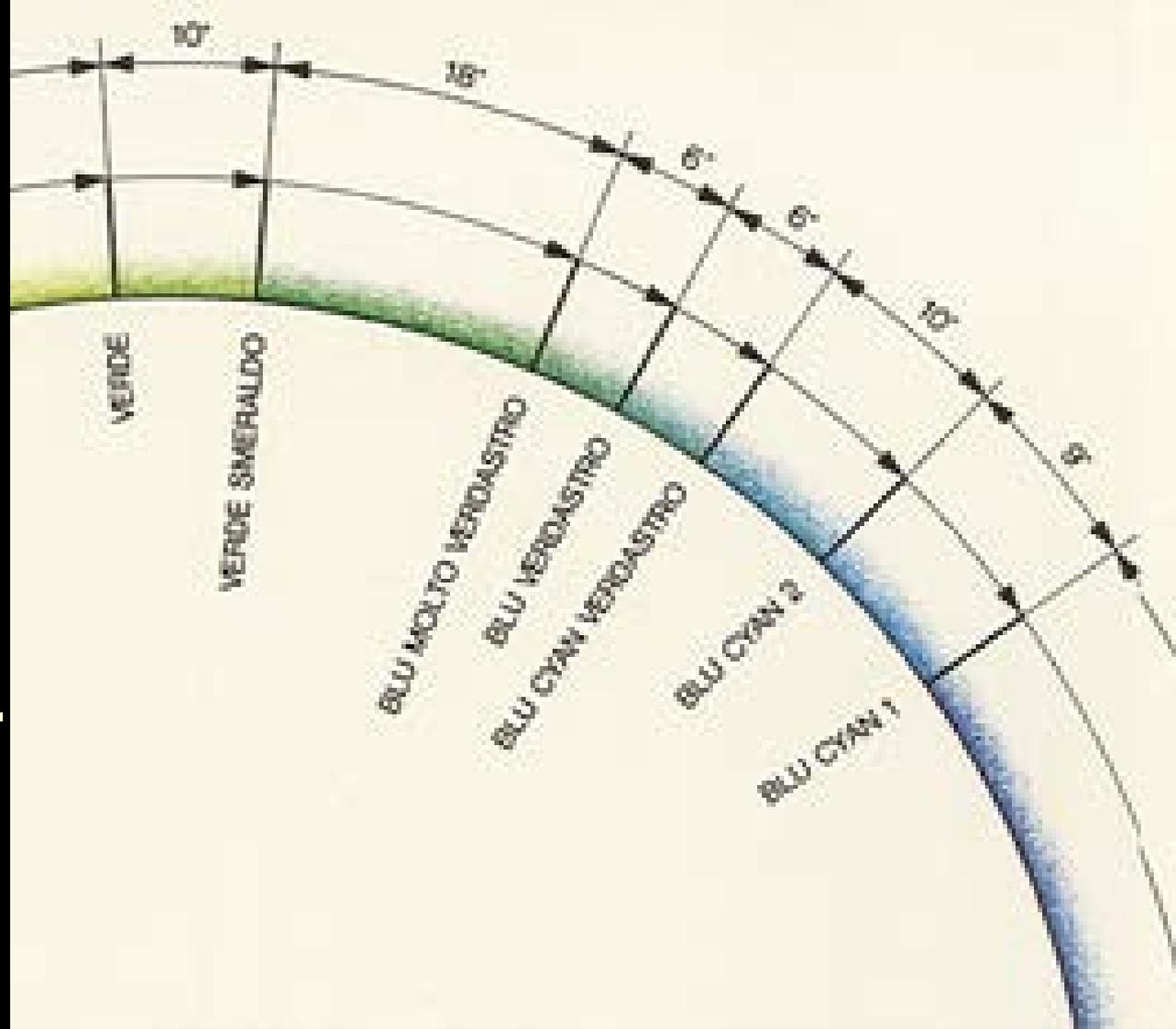
Ogden Rood

- **Circle of complementaries.**



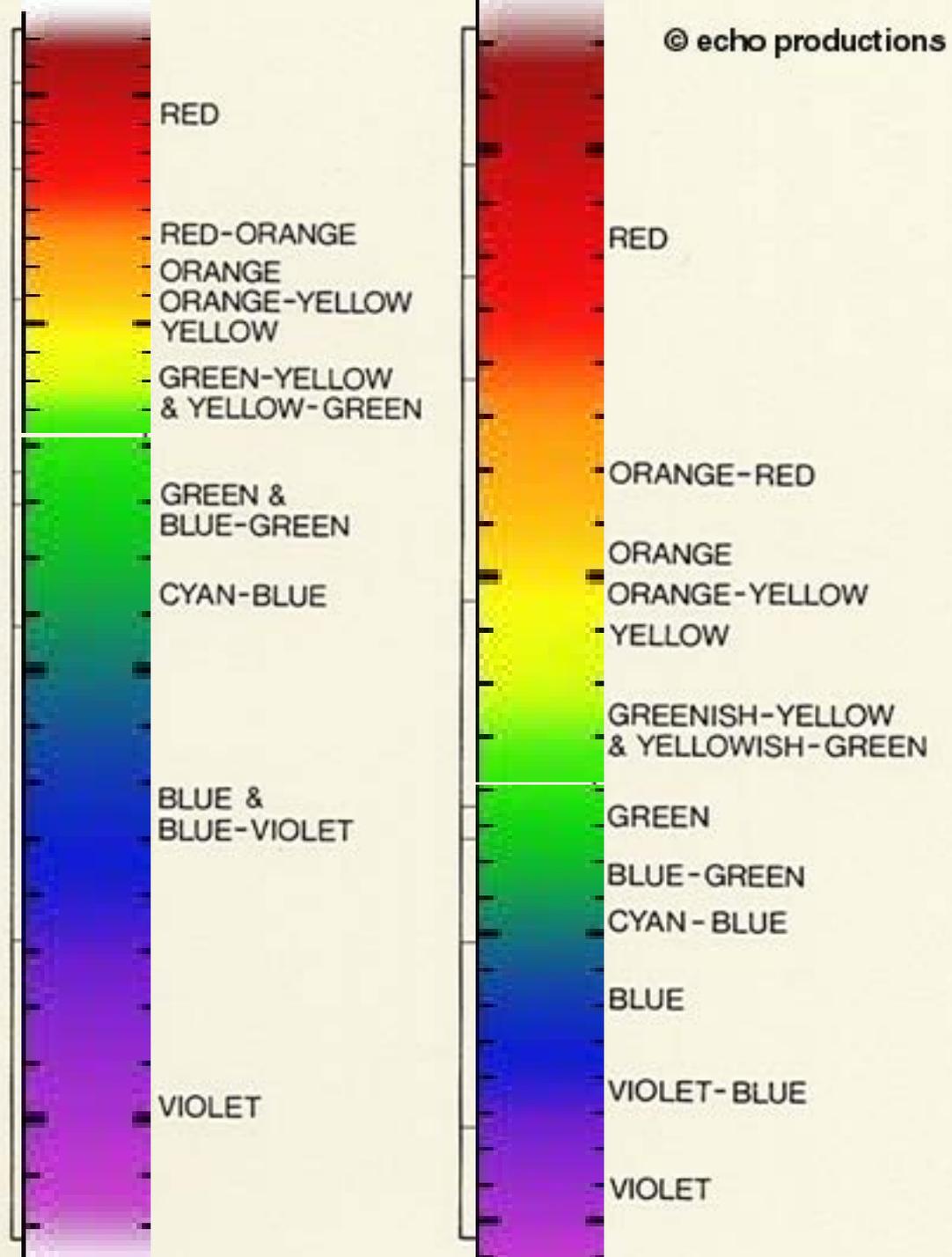
Ogden Rood

- Refined definitions of reliable, optical complementary colors – Circle of complementaries.
- Used familiar painter's pigments/paints.
-



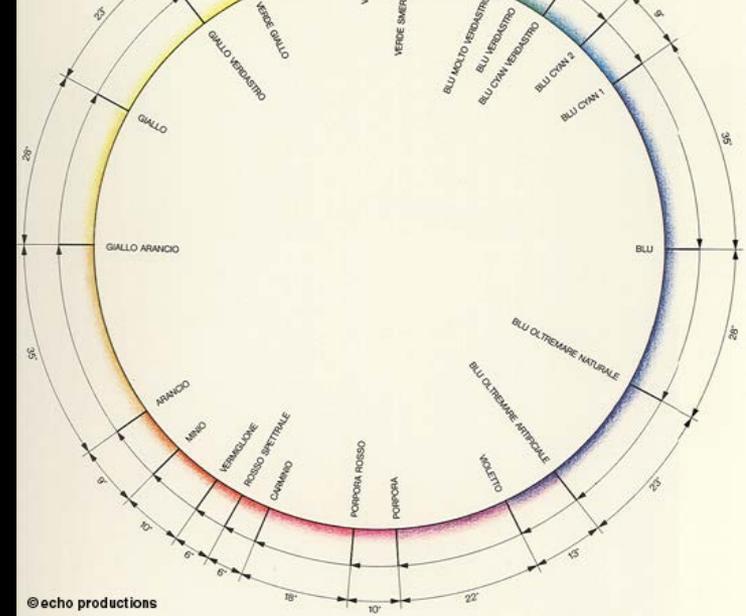
Ogden Rood

- Explored Physical vs. Optical prominence of hues.
- Red light fills only a small portion of the visible spectrum (EM wavelengths, *left*)...
... but we discern a broad range of red hues. (*right*)



Ogden Rood

- 1895 Modern Chromatics
- American
- Declared color to be “a sensation existing merely in ourselves” rather than being an absolute physical fact.
- Identified the three dimensions of color: *hue, value, and chroma*.
- Create a color wheel based on optical complementary relationships.



NEXT TIME

Albert Munsell

1905- Color Notation

Sought an objective standard for precise pigment specifications.

Widely used notation system used for pigments.

Highly influential – color theories and specification systems are still in use.

- **Color notation system standard in U.S., Britain, Germany & Japan.**

