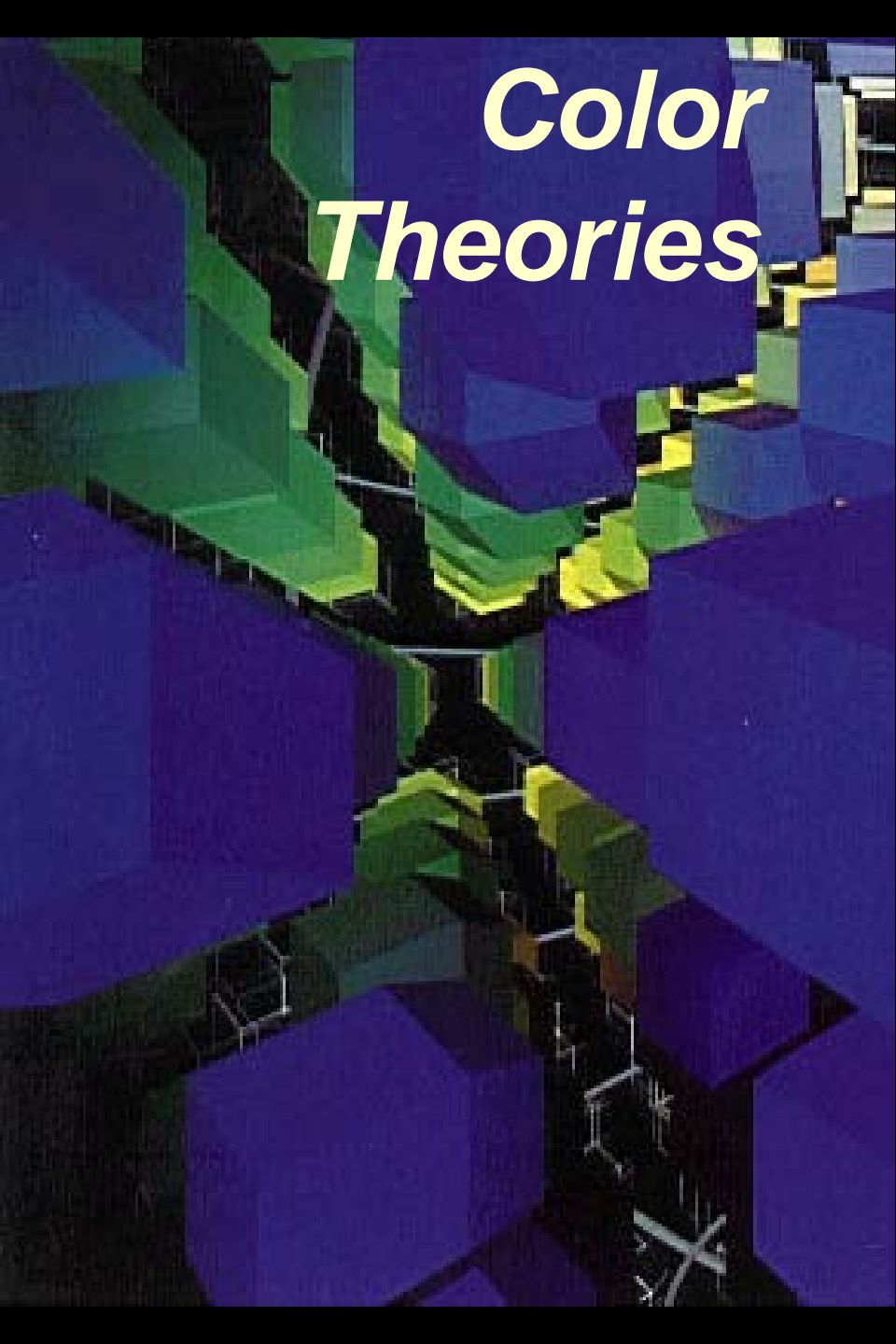


Color Theorists
1800+

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

Theorists 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

—What 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?

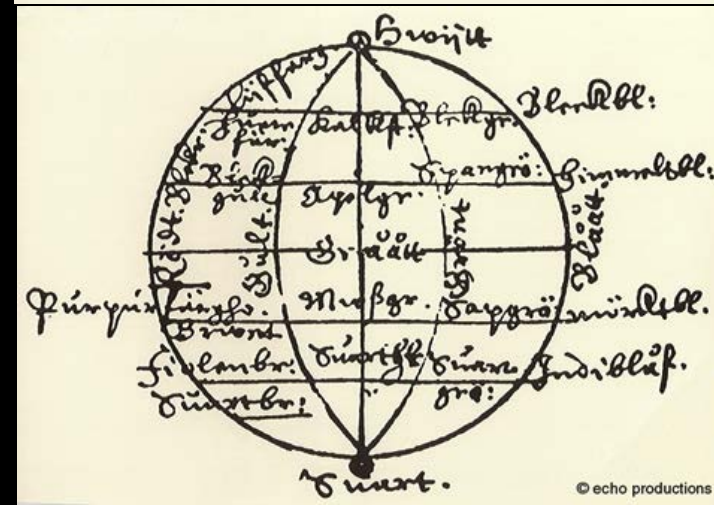
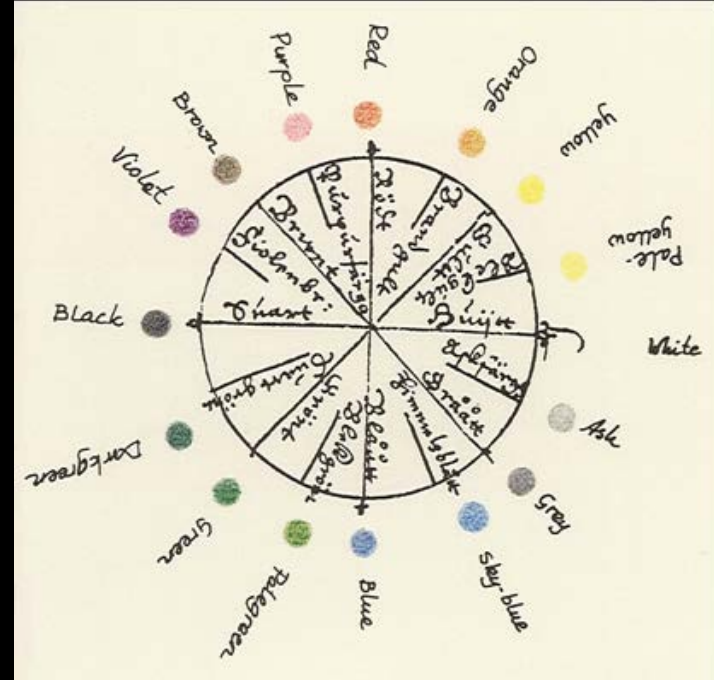
Who are the major contributors?

What did they contribute?

Who benefited...who was influenced?

Aron Sigfrid Forsius

- Finnish astronomer and priest
- Wrote a treatise on physics in 1611.
- Contained the first color wheel, drawn inside a sphere.
- This would be **the first color wheel** – but Forsius' text was effectively lost in the Royal Library in Stockholm and was **only discovered in 1969**, so his color wheel had **little influence** on color theorists and artists.



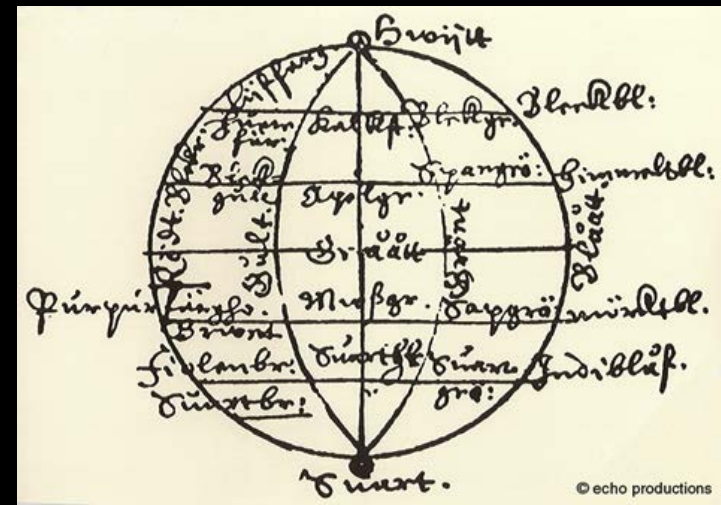
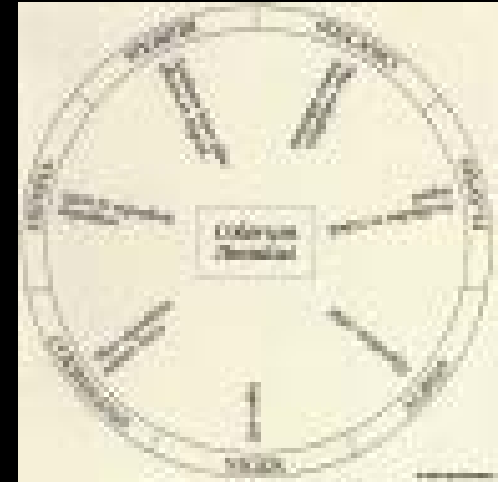
Aron Sigfrid Forsius

Forsius was the author of the color wheel before Newton.

“Forsius’ colour sphere was just one of the widespread attempts made in the 17th century to create comprehensive colour scales, partly undertaken to enable very exact differentiation between the various styles of painters. ...

“A technical problem which initially remained unsolved — also in Forsius’ case — concerned a coordinated relationship between the two parameters colour hue and colour value (or brightness).”

(colorsystems.com)

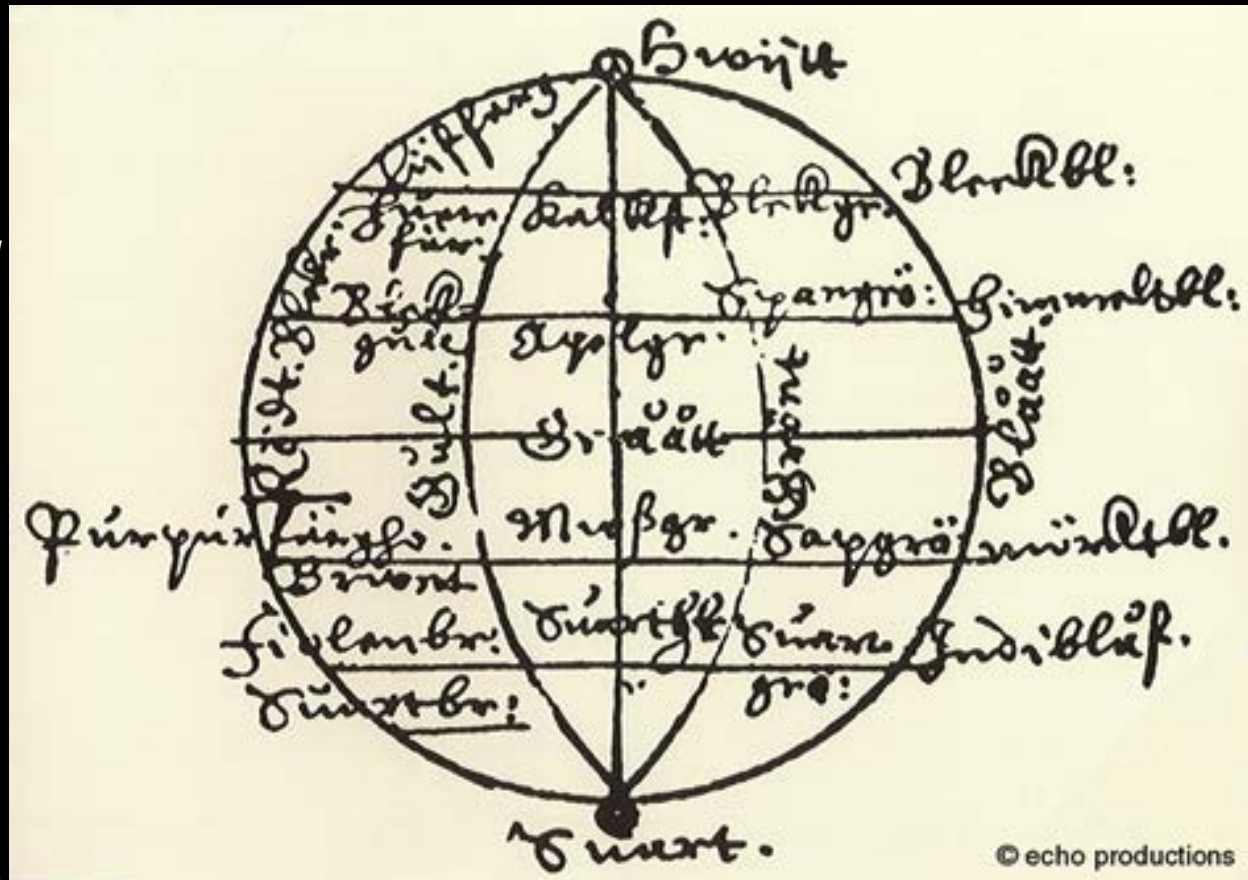


Aron Sigfrid Forsius

- “If... the origin and the relationship of the colours are to be correctly observed, then one must *begin with the five basic median colours, which are red, blue, green and yellow, with grey from white and black, ...*

...one must heed their grading, and whether they move nearer to the white because of their paleness or nearer to the black because of their darkness.”

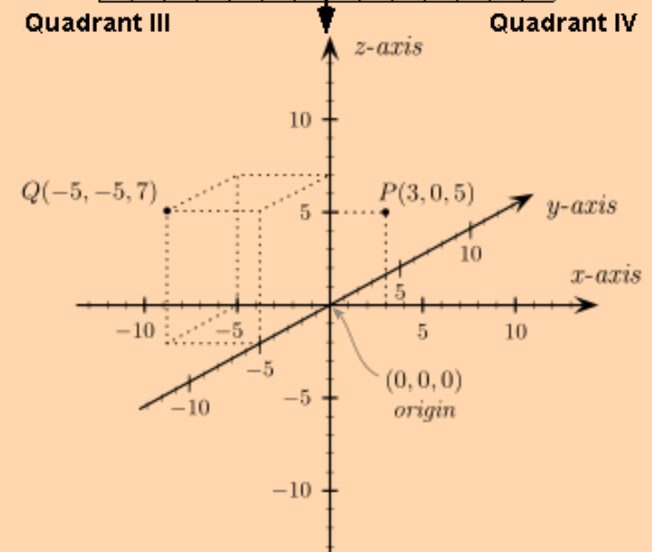
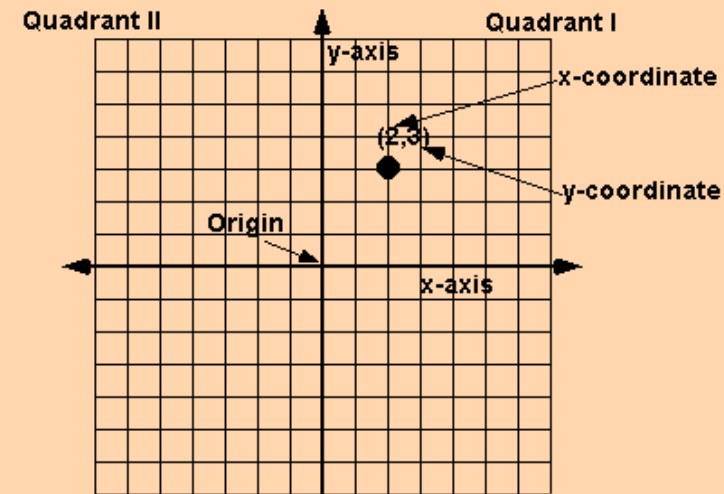
- — Forsius



Rene Descarte



- René Descartes (1596 –1650), also known as **Cartesius**.
- He is equally notable for both his groundbreaking work in *philosophy and mathematics*. He is the *inventor of the Cartesian coordinate system*, he formulated the basis of modern geometry (analytic geometry), which in turn influenced the development of modern calculus.
- Descartes, sometimes called *the founder of modern philosophy* and the *Father of Modern Mathematics*, ranks as one of the most important and influential thinkers in modern western history.





- He inspired both his contemporaries and later generations of philosophers, leading them to form what we know today as *continental rationalism*, a philosophical position in 17th and 18th century Europe.
- Thus, Descartes was a key figure in the *Enlightenment*.

Rene Descarte

- *Cogito ergo sum = “I think, therefore I am”*
- *He trusted no authority, but chose to build ideas only on what he was sure of ... “I am thinking this thought, therefore I must, without a doubt exist. Let’s start with that.”*

Portrait by Frans Hals



Rene Descartes

- *He pondered and explored the nature of color...*
- *He held that color is NOT a property of the colored object, but merely a perception — a phenomena separate from the colored object.*

*“It is clear then that when we say we perceive colors in objects, it is really just the same as saying that we perceived in objects something as to whose nature we are ignorant but which produces in us a very clear and vivid sensation, what we call **the sensation of color.** “*



***Rene
Descartes***

- ***This notion differed from prevailing common sense — most people believe(d) that a colored object “has color”.***
- ***As such, Descartes was one of the philosophers that helped us find color in light... not in the object.***



Rene Descartes

- ***Described color as being made up of particles of light.***
- ***Light would be the bearer of color experiences — the means of creating the phenomena or experience of “colored-ness”.***
- ***This fits our current understanding of light particles (photons)***



**Rene
Descarte**

Portrait by Frans

- **But Red vs Blue vs Green?**
- **A rationale for hues:**

As the speed and motion of these light particles change, so the color changes.

- ***That is, a fast light particle might produce red, while a slow light particle might produce blue.***

This idea is incorrect, but is similar to varying wavelengths/energies of light that we, today, understand to produce varied hue.

Einstein (~1905) would assert that light does not, in fact, change speed — every color of light goes at the same speed. However, instead, each hue of light varies in wavelength or frequency.

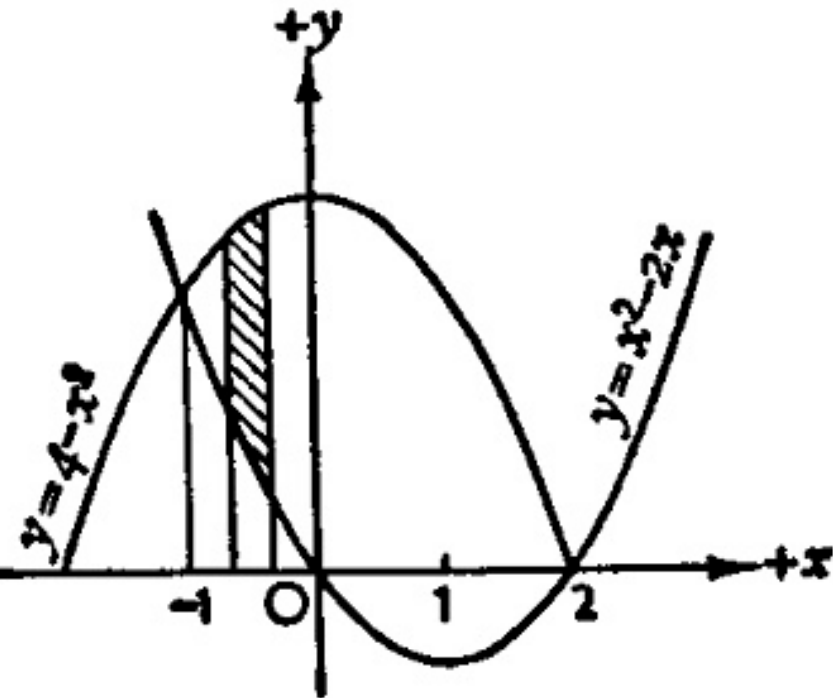
- ***Came close to a correct explanation of rainbows***



Sir Isaac Newton

1642-1727

- **British physicist and mathematician.**
- **He wrote “*Principia*”** — or *Philosophiæ Naturalis Principia Mathematica* (“Mathematical Principles of Natural Philosophy”). First published in 1687, it laid the foundations for most of classical mechanics.
- **Co-inventor of *The Calculus***



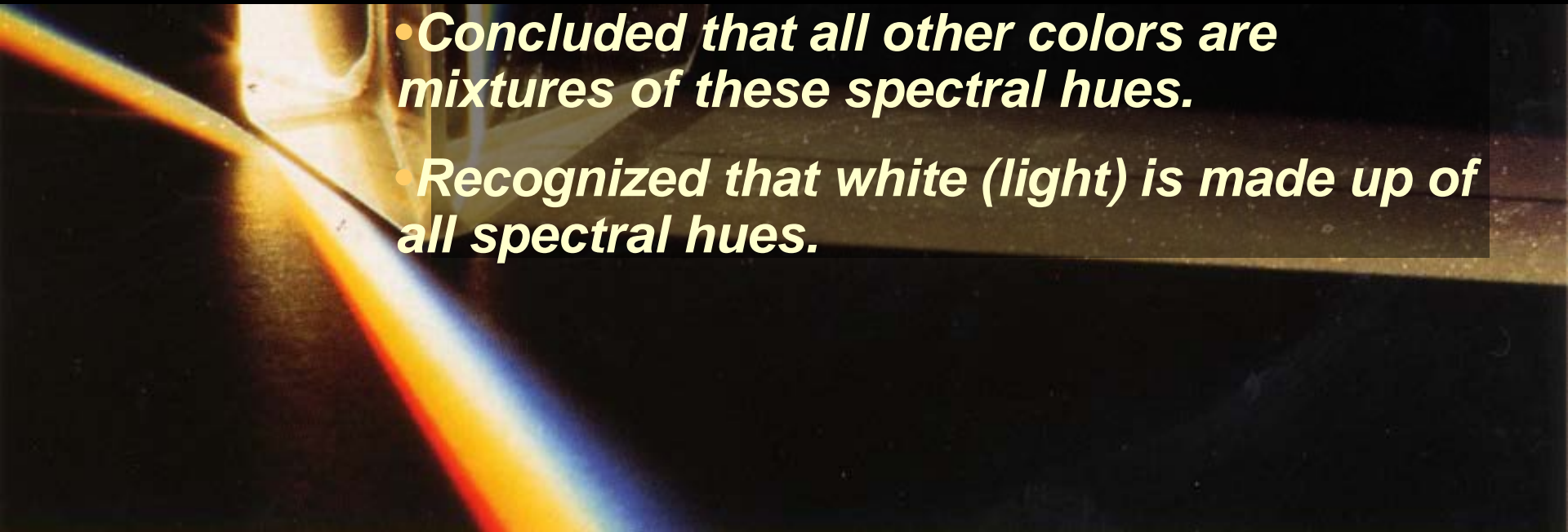
$$\int_a^b f(x) dx = F(b) - F(a)$$



Sir Isaac Newton

1642-1727

- *Major founder of current theories of color and light.*
- *Identified seven spectral hues – red, orange, yellow, green, blue, indigo, & violet*
- *Concluded that all other colors are mixtures of these spectral hues.*
- *Recognized that white (light) is made up of all spectral hues.*



Sir Isaac Newton — 1642-1727



Studied light and color through laboratory physics

As an Enlightenment scientist, he had faith that empirical observations could lead to worthwhile understanding.

As a Christian, he believed that God had created an ordered universe — that nature is built on consistent, reliable laws and principles.



Sir Isaac Newton

1642-1727

- “credited with the first model of perceptual color space, essentially a color wheel with white in the center...”
- “In the late 1660s, he starts experimenting with his ‘celebrated phenomenon of colors.’ At the time, people thought that color was a mixture of light and darkness, and that prisms colored light.”

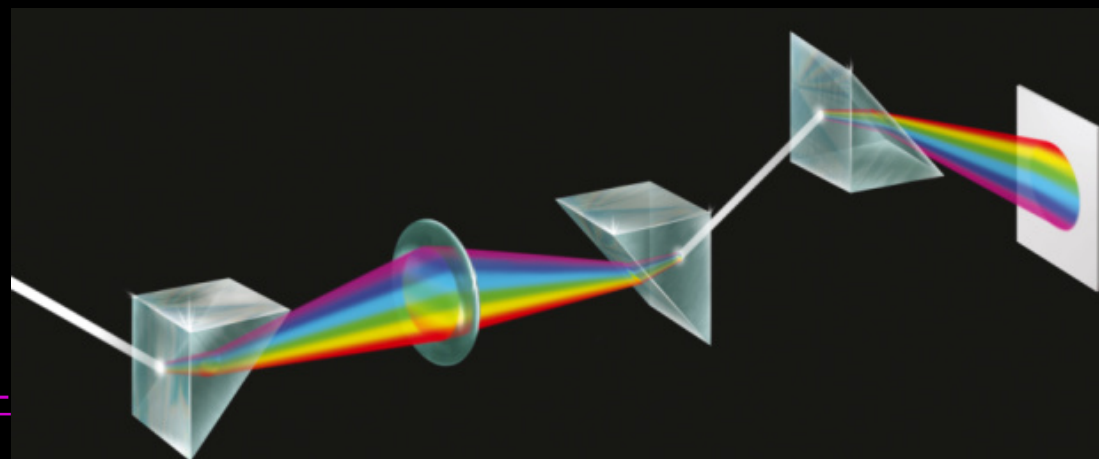
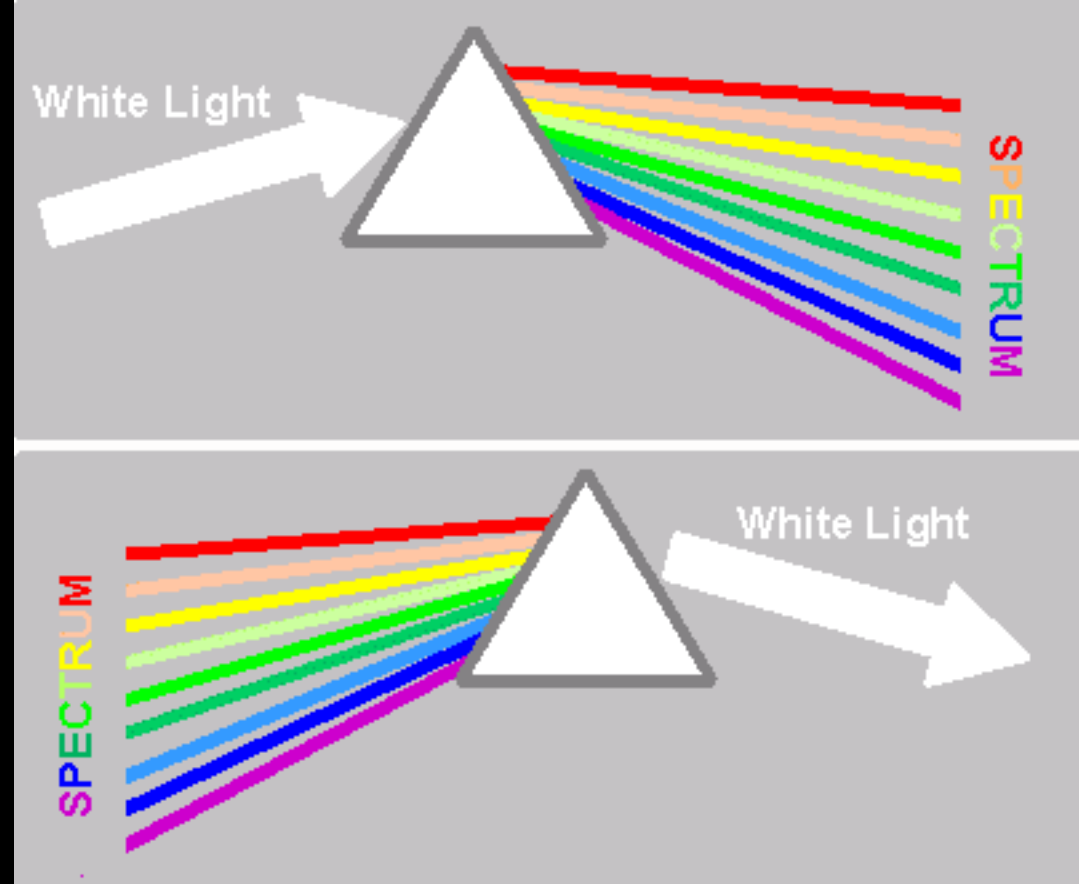
<http://guity-novin.blogspot.com/2014/07/chapter-70-history-of-color-color-wheel.html>



“Newton realizes this theory was false. Light enters the prism... and is refracted by the glass.

The violet is bent more than the yellow and red, so the colors separate. Newton set up a prism near his window, and projected a beautiful spectrum 22 feet onto the far wall.

Further, to prove that the prism was not coloring the light, he refracted the light back together....



• <http://guity-novin.blogspot.com/2014/07/chapter-70-history-of-color-color-wheel.html>



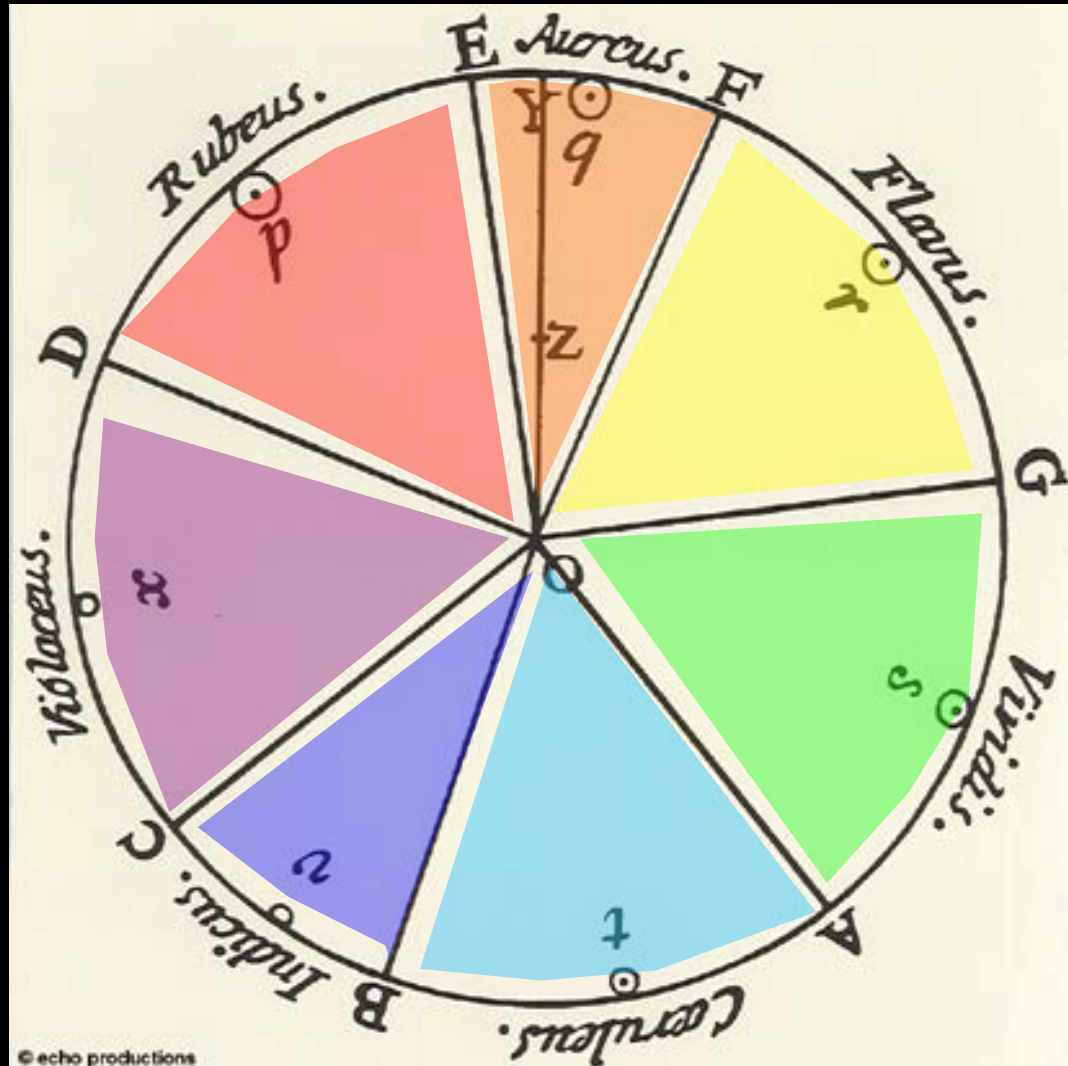
- *Devised the first widely known color wheel. He observed that both ends of the visible spectrum are similar, and “looped” the spectrum into a circle.*
- *Unlike Forsius’, Newton’s color model has been very influential — the color spectrum is wrapped around into a circle, creating a simple model of hue relationships.*

Newton’s Color Wheel



- Each color was originally given the same space as on the spectral band (as in a rainbow).

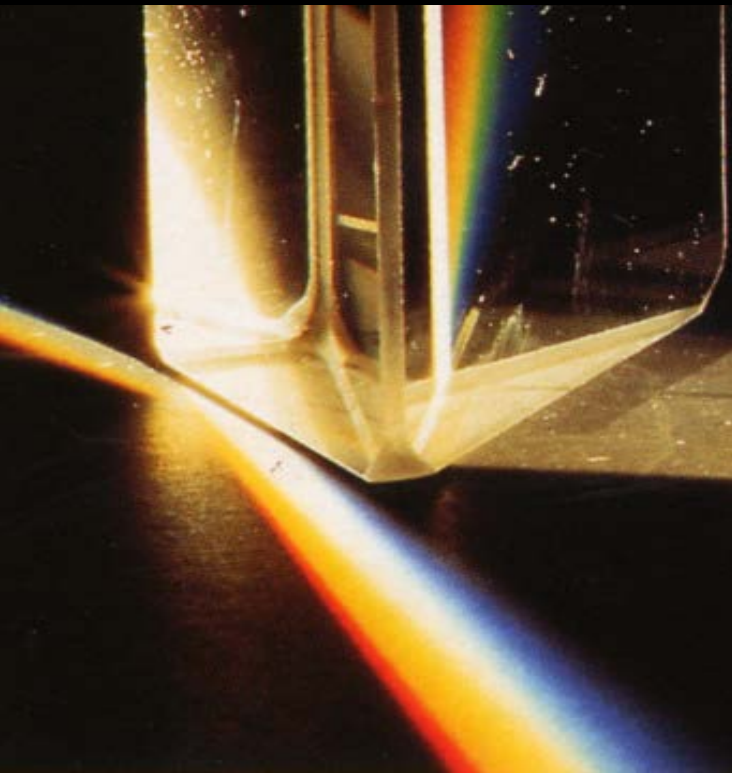
Newton's Color Wheel



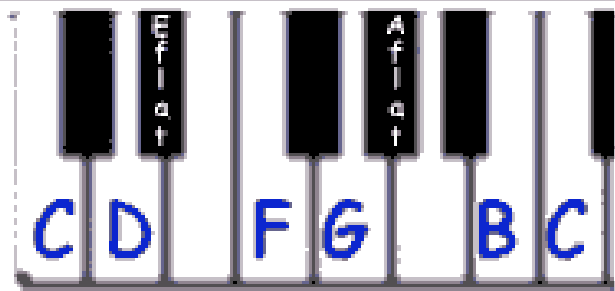


Newton's “primaries”

- *proposed the seven distinguishable colors of the spectrum (RoyGBiv) as “primaries”*
- *Red*
- *Orange*
- *Yellow*
- *Green*
- *Blue*
- *Indigo*
- *Violet*

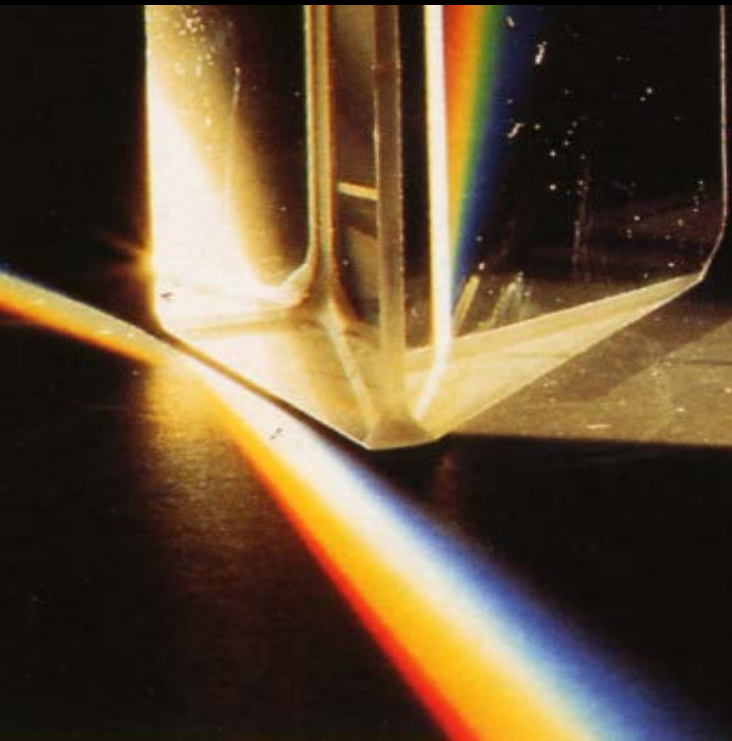


The scale of C harmonic minor

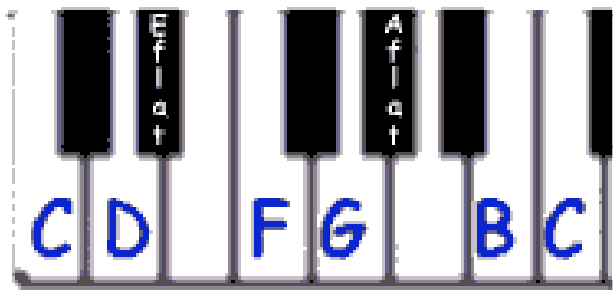


Why seven hues?

- “..it remains the case that his division of the prismatic spectrum into seven chromatic areas, announced so casually in a letter to the Royal Society of 1675, reflects his interest in the eternally fruitless, eternally stimulating search for objective principles of visual colour-harmony that goes back to Classical Antiquity.”
- Newton was a man of faith who believed that God’s creation is orderly—that the natural world reflects the order of God’s mind.
- John Gage, *Color and Meaning: Art, Science and Symbolism*, p.15

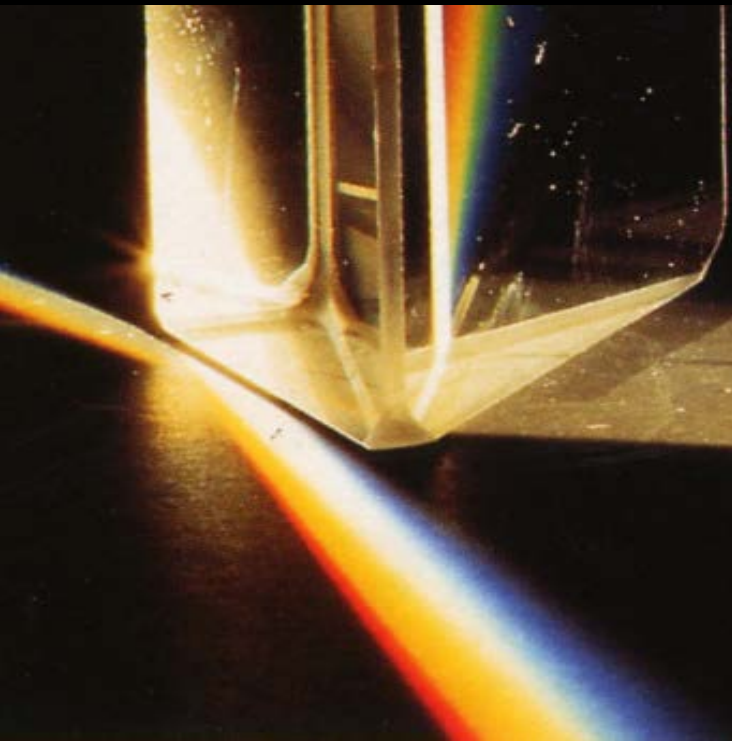


The scale of C harmonic minor



Why seven?

- *Thus he expected that accepted principles of musical harmony would be parallel to as-yet-undiscovered principles of color harmony.*
- *He divided the colors of the spectrum in to seven hues because the traditional division of a Western musical octave is divided into seven notes — A, B, C, D, E, F, & G.*
- *Thus the selection of seven hues reflects a hope that color harmony could be systematized as musical harmony seemed to have been.*





Sir Isaac Newton

- *Demonstrated that all spectral hues are within white light.*
(as seen in prisms and rainbows)

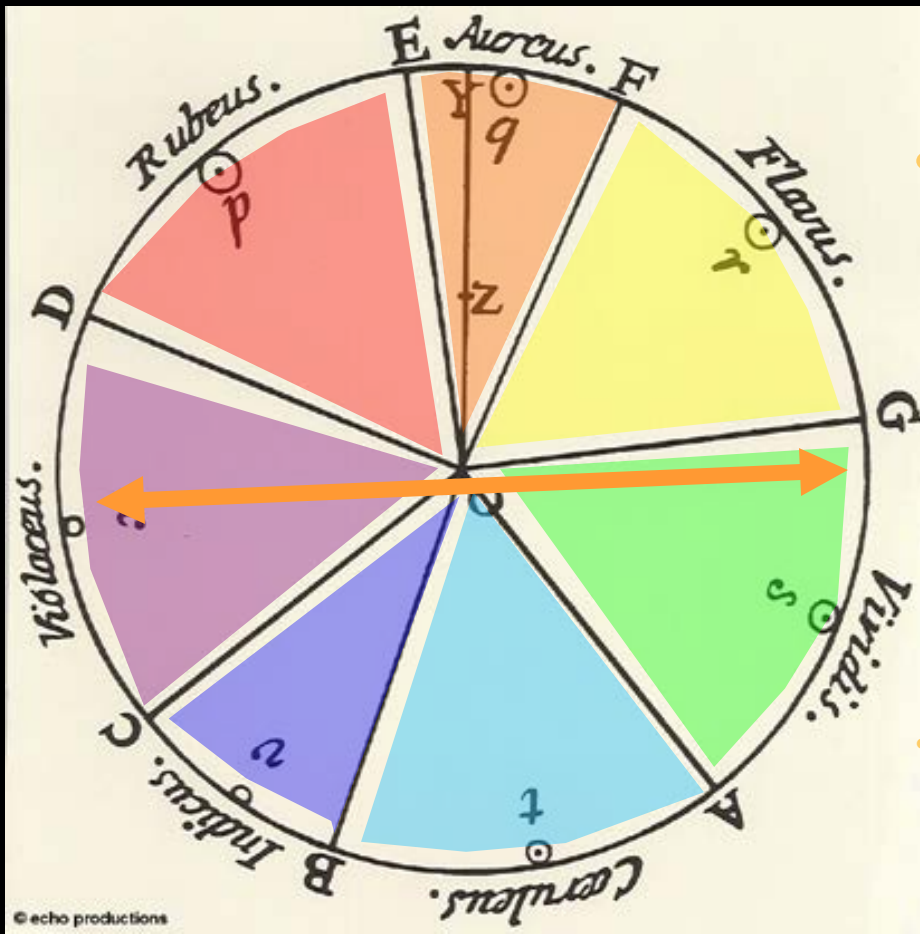


Proposed the concept of three LIGHT primary colors, but was unable to prove the concept.



Stimulating complementarity

- His color wheel graphically infers the concept of complementarity — or oppositeness of hue.



“...[his work] formed the starting-point for the investigation of complementarity in the latter part of the eighteenth century, and thus of the contrast theory of harmony which was to prevail for most of the nineteenth century, mainly through the influence of Chevreul.”

John Gage, *Color and Meaning: Art, Science and Symbolism*, p.15



Color Since Newton

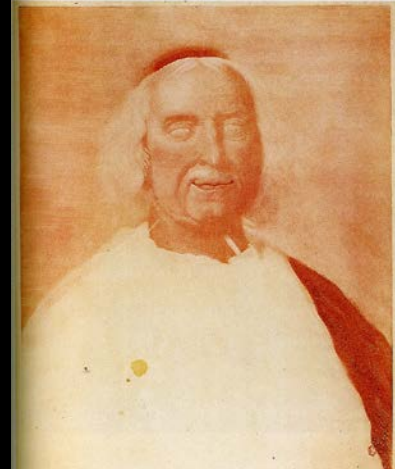
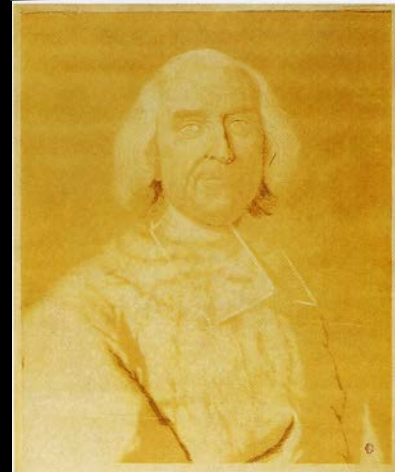
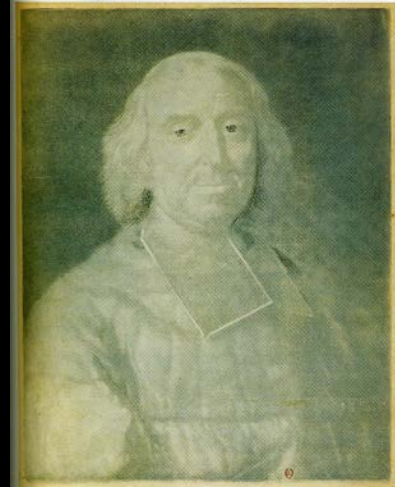
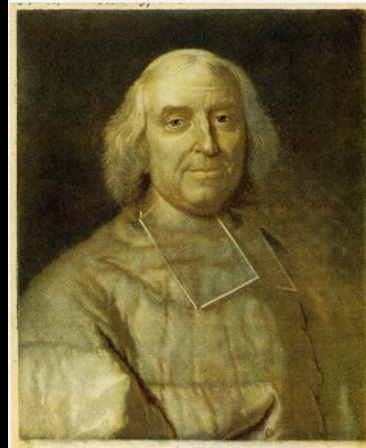
- *“After Newton, the aspects of colour-theory most interesting to artists have been, in addition to theories of harmony, the devising of colour-systems, and the exploration of how colours relate to the mechanisms of perception, and affect the feelings of the spectator.*
- *“Many of these concerns had long since developed in artists’ studios themselves, but now they were investigated and codified systematically.”*
- John Gage, *Color and Meaning: Art, Science and Symbolism*, p.46

Jacques Christophe le Blon

- *German-born artist and printer/engraver lived and worked in France and England (1667-1742)*
- *Three Primaries: Discovered that THREE hues (red, yellow and blue) along with black, could mix a broad variety of colors.*
- *Created an early form of four-color process printing.*
- *“...was the first to make use of several metal plates (each for an individual colour) for making prints with continuous gradations of colour. His colour theory formed the foundation for modern colour printing.” (Britanica)*

Jacques le Blon:

3-color plates = full color

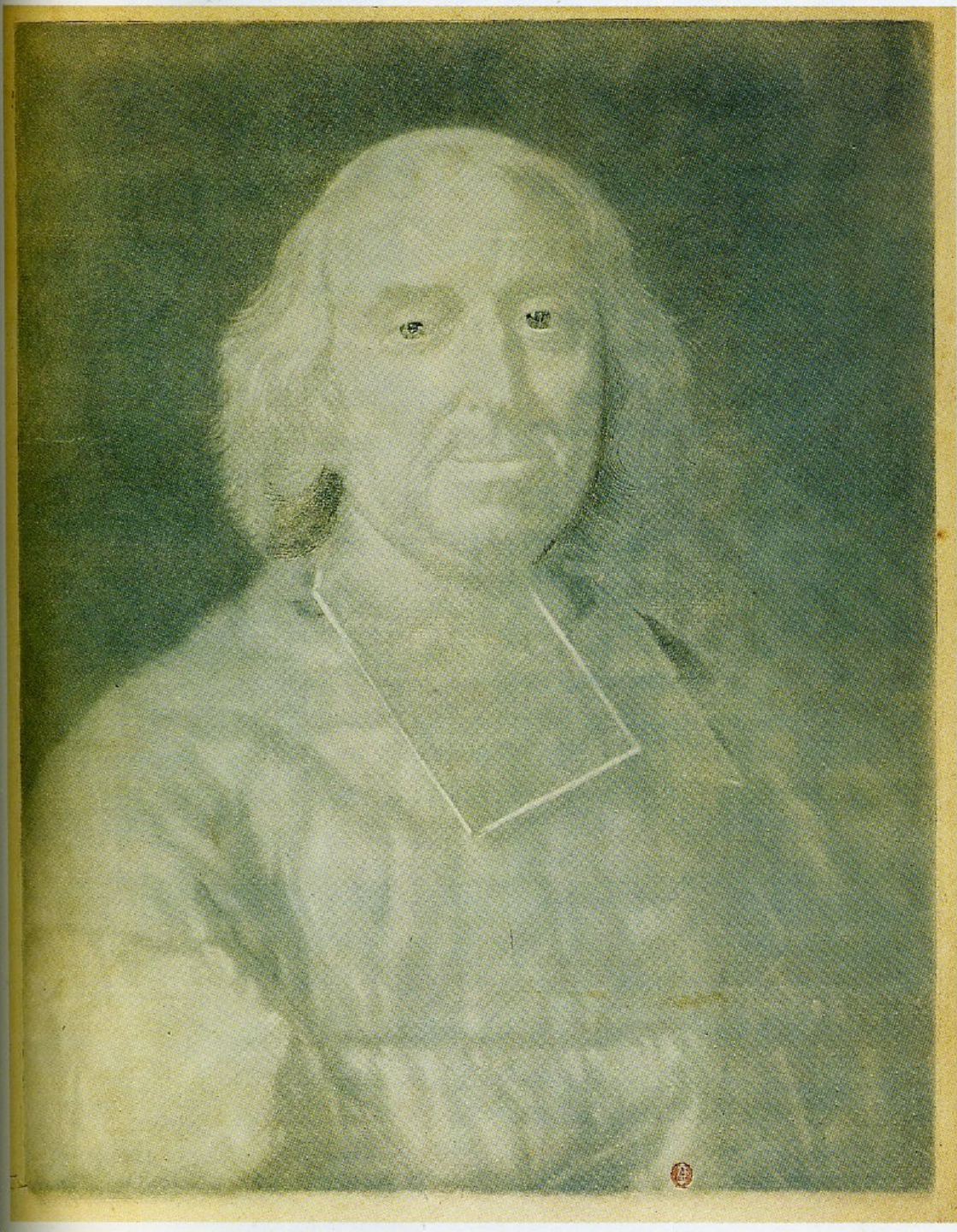
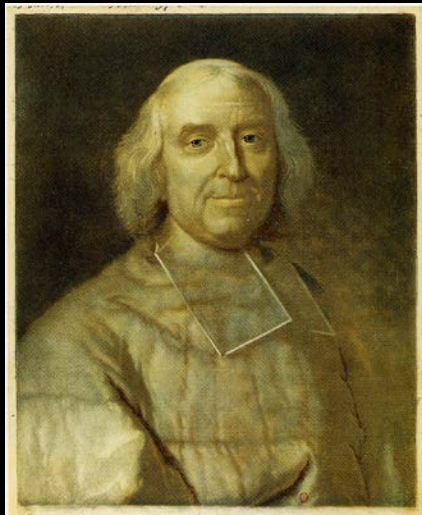


- “Le Blon began to experiment with color-printed pictures. His system used three different plates, each inked with a different color and applied in sequence to a single sheet of paper. Le Blon's studies continued even after a move to London, about 1715. In 1719, King George I granted him a patent for a technique to print pictures in color and, with a business partner and students, Le Blon set out to exploit his invention.”

- http://www.gutenberg-e.org/lowengard/C_Chap14.html

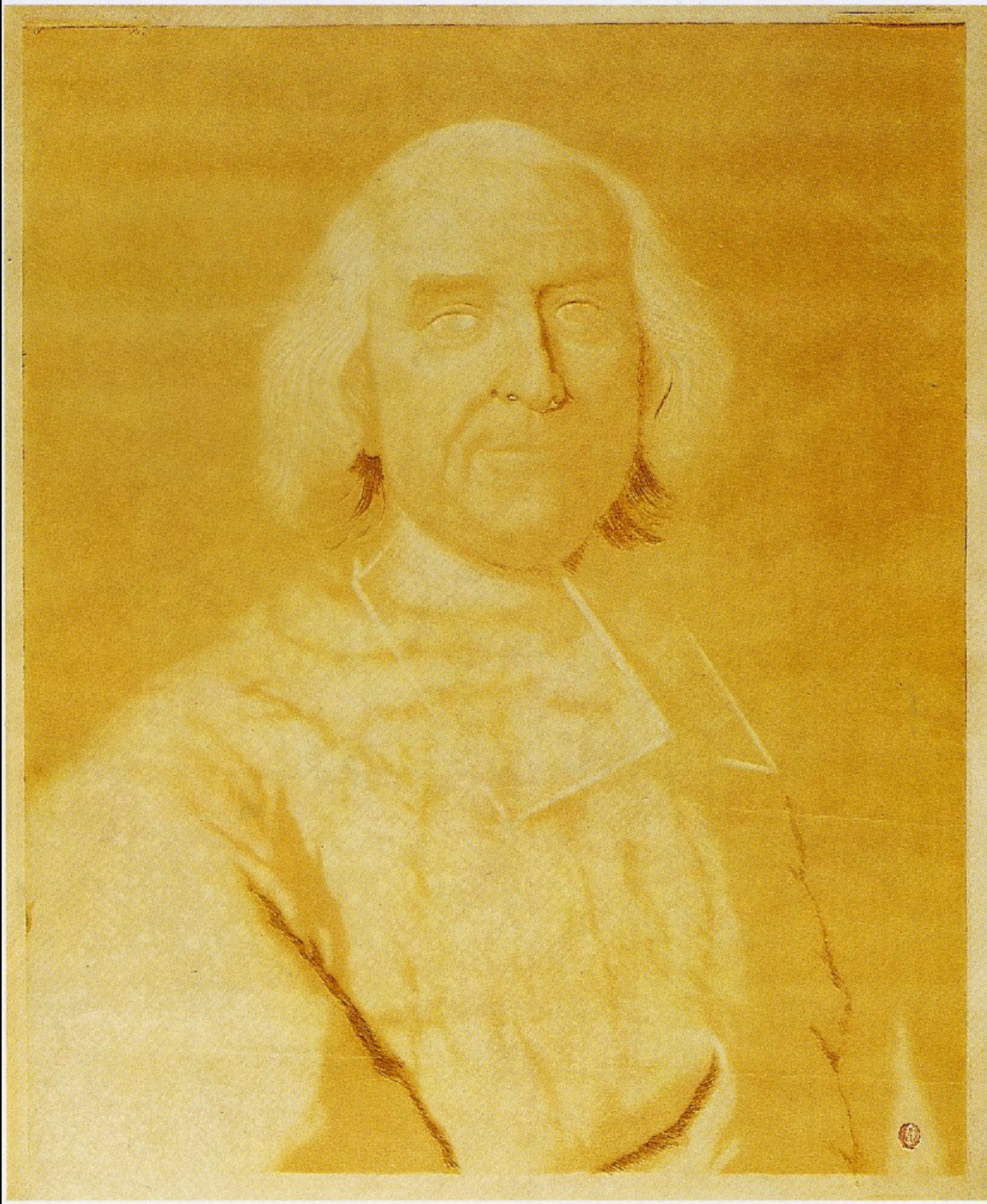
Pre-4-color process

- Mass production of colored images has always, and still does, depend on efficiency of plates and process — we want to produce prints that have the most vivid and accurate color, consistently across dozens, hundreds or thousands of print. Thus, we want it as simple as possible.



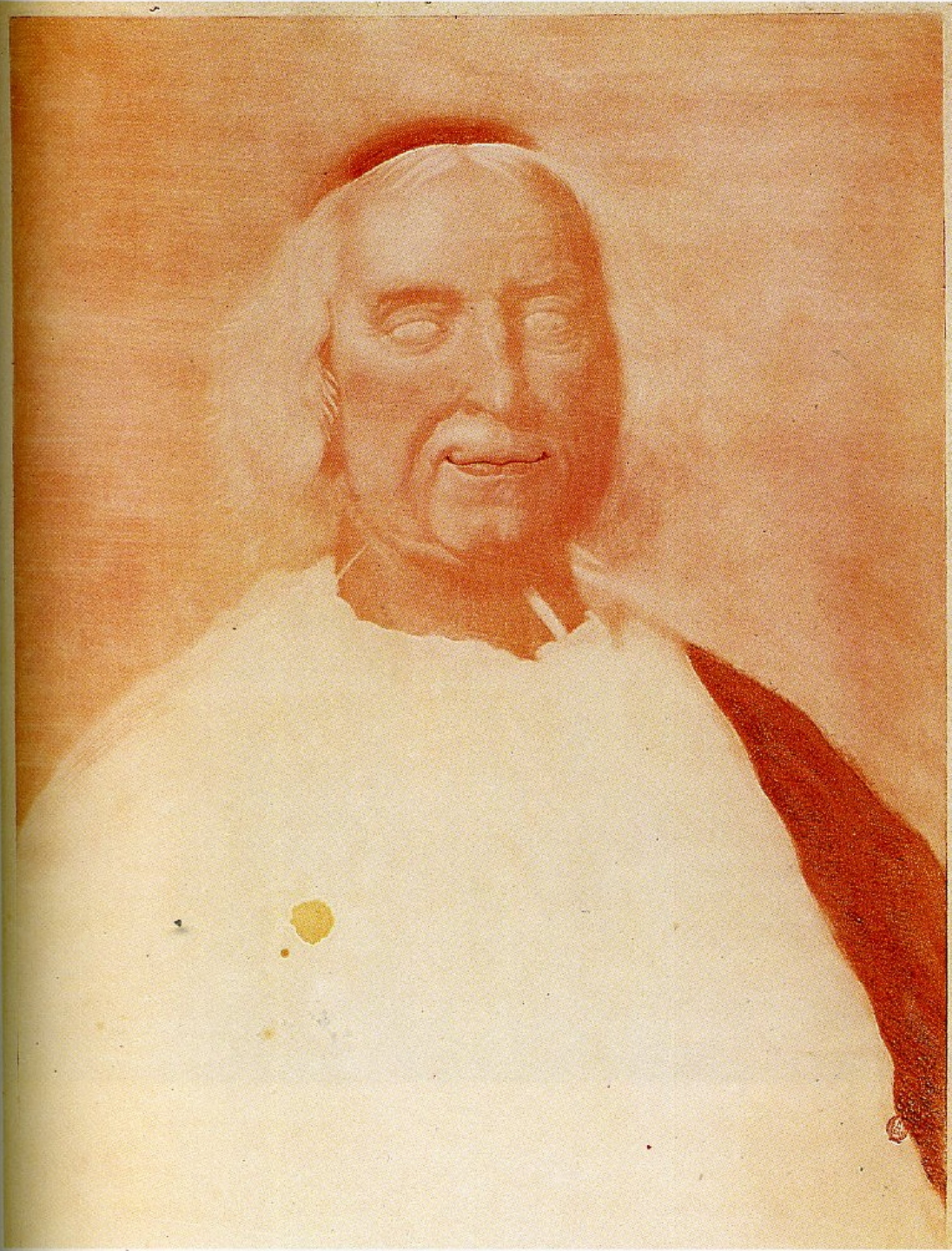
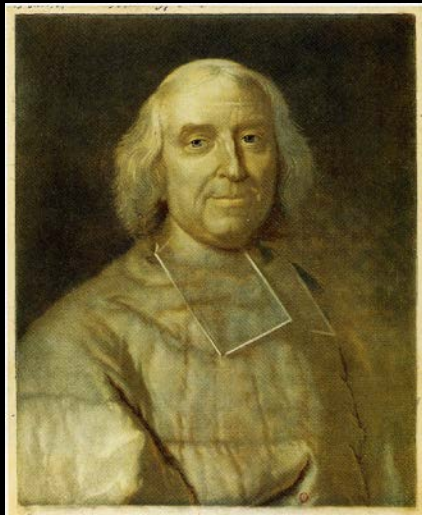
Pre-4-color process

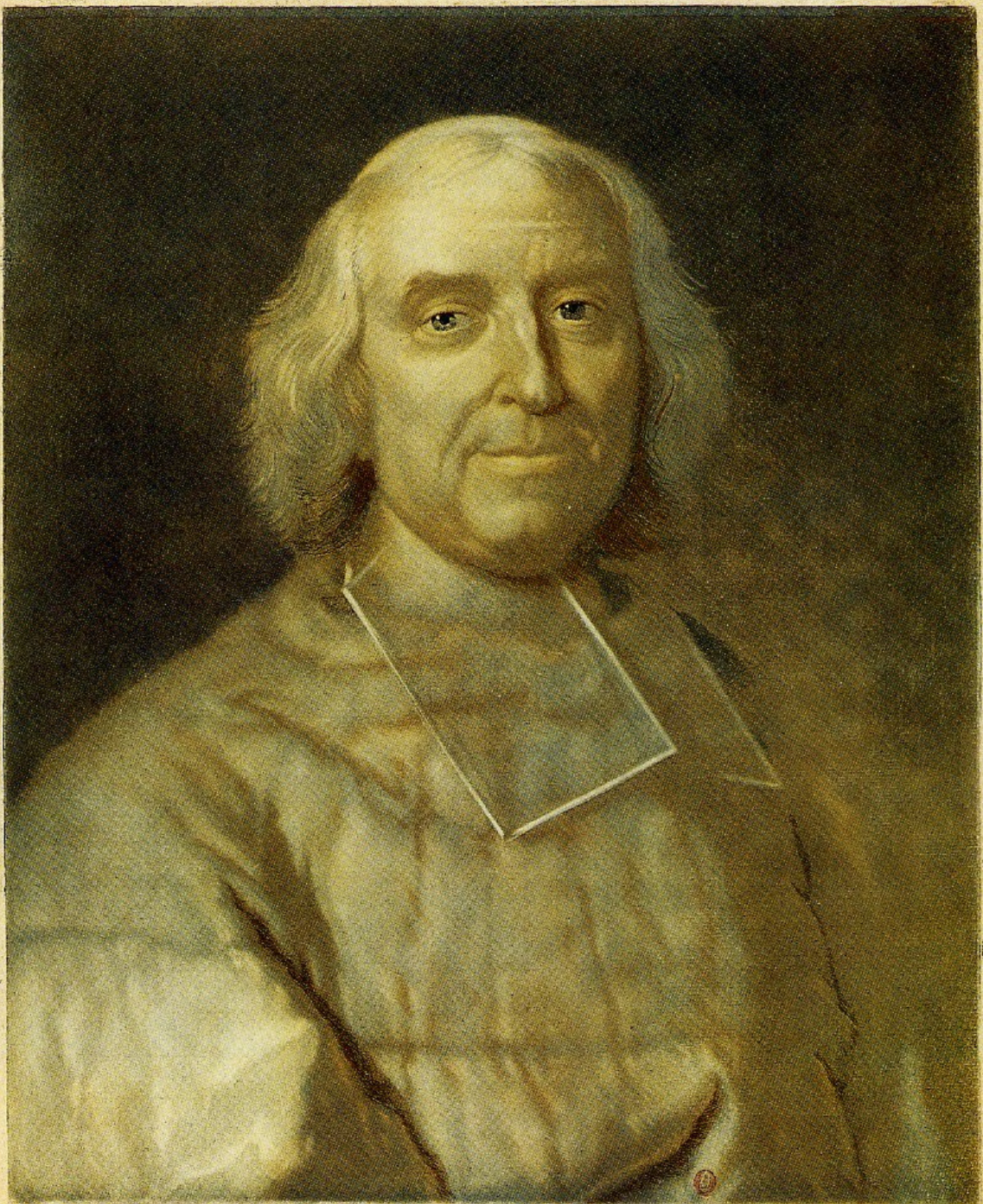
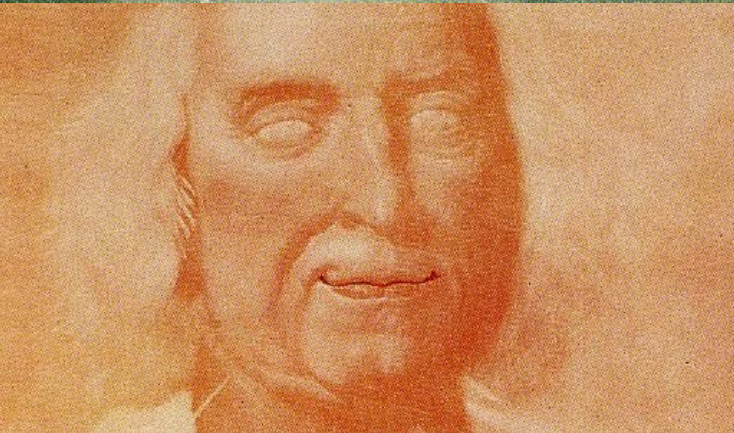
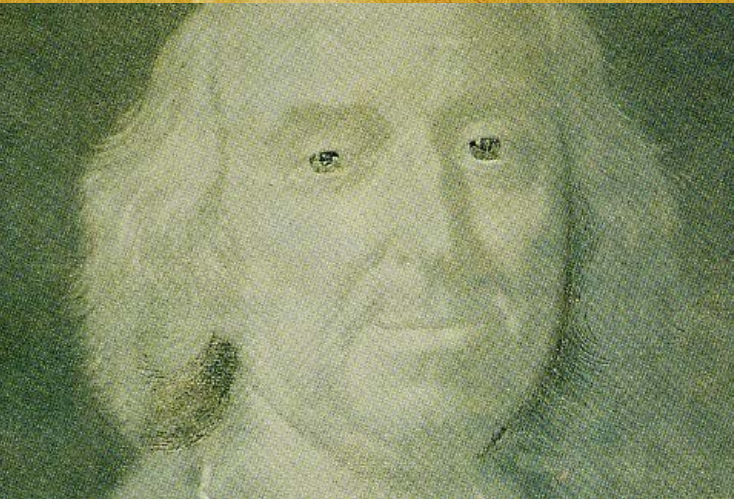
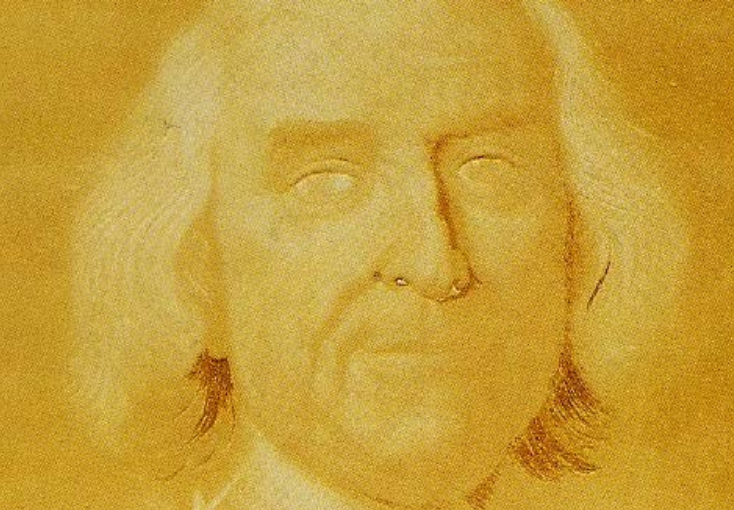
- Today standard color printing uses 4-colors of ink (CMYK) and 4 lithographic plates.



Pre-4-color process

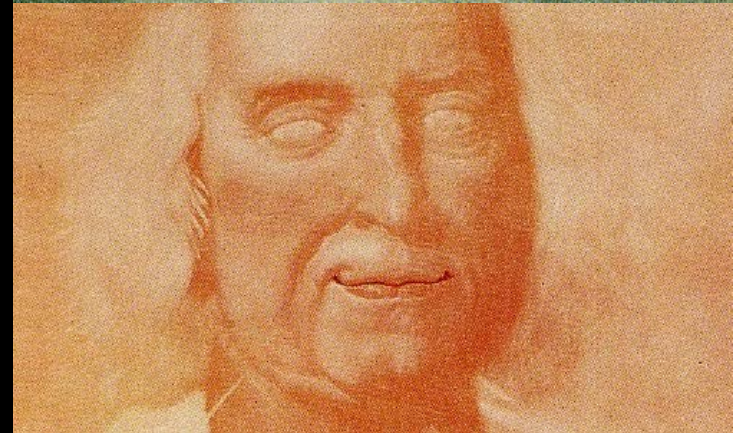
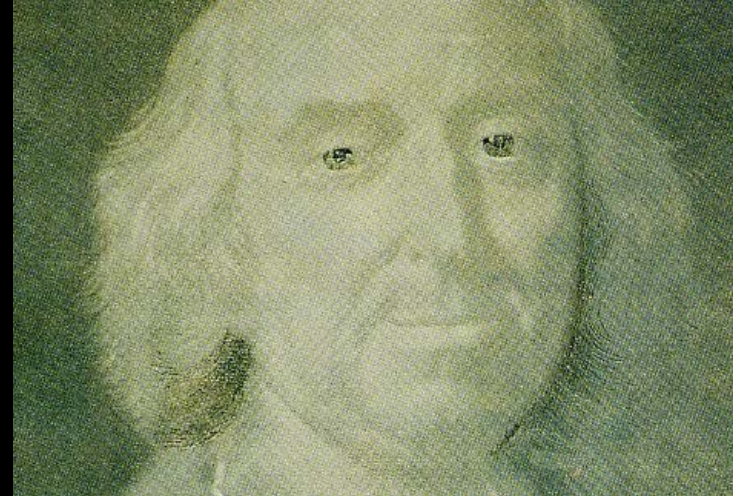
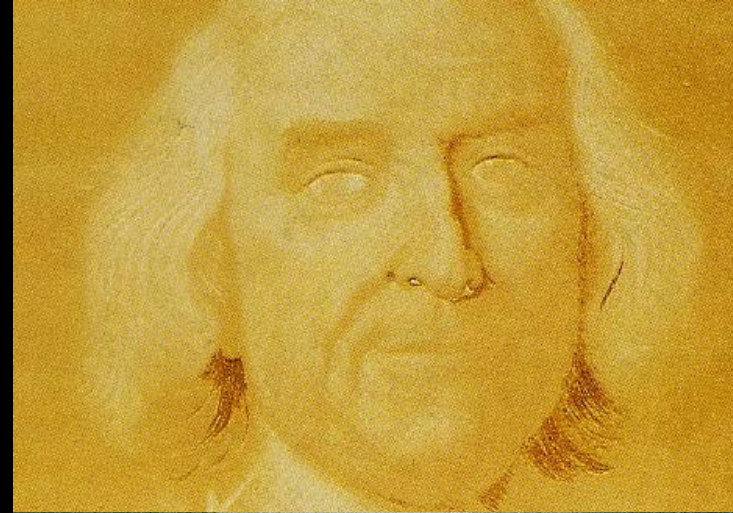
- Le Blon tried the still more limited 3-colors and three plates in his earliest color mezzotints.





Jacques le Blon

- “Le Blon's system rested on the separation of a composition into its red, yellow, and blue components and on the creation of an engraved plate for each.
- The three plates were applied sequentially to a sheet of paper.
- The result, when the inks were good and the plates aligned accurately, was an imitation oil painting as well as a new kind of art. It was in colors, like the original. More than one copy could be made from the set of plates, and each copy would be nearly identical to every other one.”
- http://www.gutenberg-e.org/lowengard/C_Chap14.html

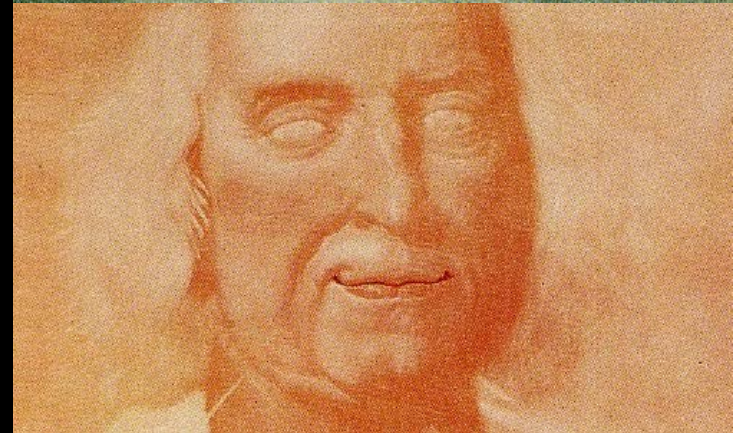
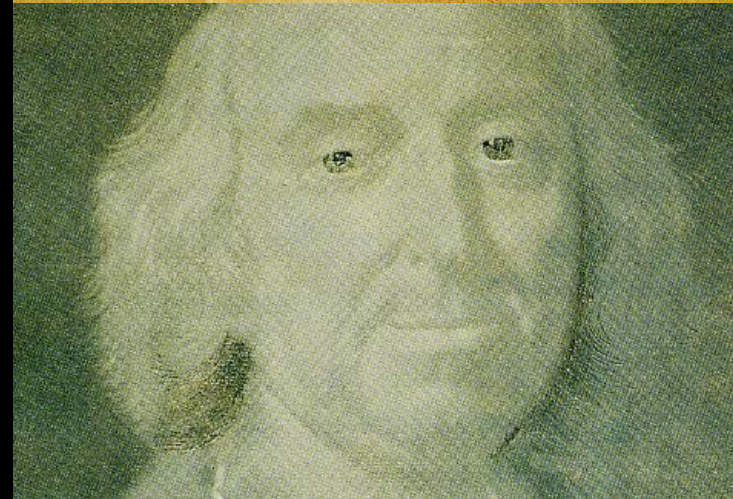
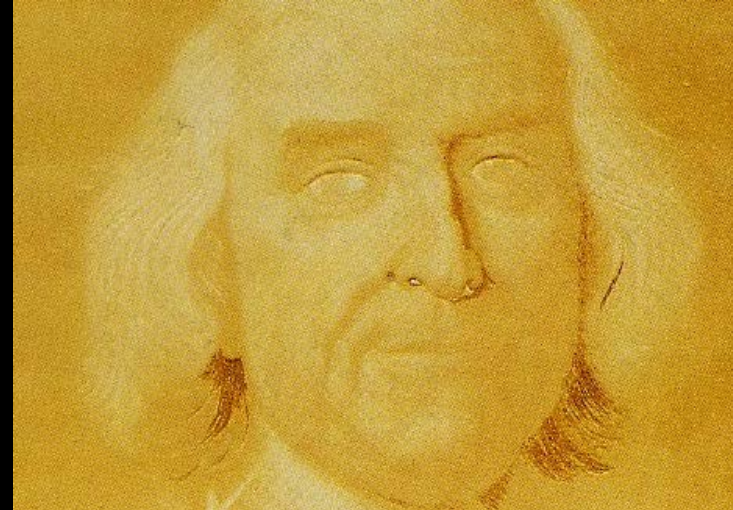


Jacques le Blon: colors/pigments critical — no color standards existed to keep prints consistent.

- “... The choice of coloring materials was as critical ... Le Blon recommended the use of a red lake made from cochineal or brazilwood, Prussian blue reference, and yellow berries (stil de grain), but the quality of the coloring materials was as important as their sources.

Black was made by combining the three colors and the paper support provided white.”

- http://www.gutenberg-e.org/lowengard/C_Chap14.html



Jacques Christophe le Blon



- “*The Picture Office*, as his company was called, offered the public copies of pictures of famous people and portraits by famous painters. Yet despite the appeal of bringing home the notorious or revered, Le Blon's color-printed pictures never attracted clientele in the numbers he and his supporters expected, and *The Picture Office* failed before the patent expired.

Le Blon's printing invention was moderately successful in France but still not profitable or, apparently, well managed. “

- http://www.gutenberg-e.org/lowengard/C_Chap14.html

Jacques Christophe le Blon

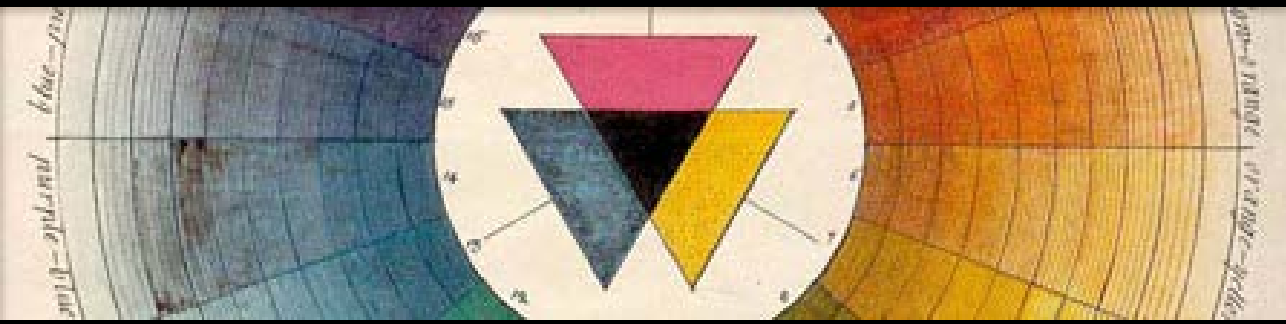


- “Le Blon used a sequence of pictures to demonstrate his skill at color printing, and to establish its links to Newtonian principles. (three primaries) This monochrome image was only the beginning of the representation-vision relationship, Le Blon claimed.”
- Source: From *Coloritto, or the Harmony of Coloring in Painting . . .* (London, n.d. [1725]), plate 1, after page 27
- http://www.gutenberg-e.org/lowengard/C_Chap14.html

Jacques Christophe le Blon



- “According to Le Blon, three-color printing could reproduce ‘all the degrees of lights and shades’ found in the flesh tones. Lifelike modeling of skin tones was considered the most difficult aspect of reproduction.”
- Source: From *Coloritto, or the Harmony of Coloring in Painting . . .* (London, n.d. [1725]), plate 3, after page 27
- http://www.gutenberg-e.org/lowengard/C_Chap14.html



Moses Harris

- *English engraver (1731-1785)*
- *Wrote The Natural System of Colors (1766)*
- *Presented a detailed **color circle based on subtractive primaries (red, yellow, blue)**, placed equidistant from each other, Shades shown toward center, Tints toward outer edge of circle*
- *Demonstrated subtractive mixing principles — the mixture of all primaries resulting in black.*
- *Referred to primaries as “prismatics” or “primitives”*
- *Referred to secondaries as “mediate” or “compound” colors.*
- *Included 12 tertiary hues*



Moses Harris

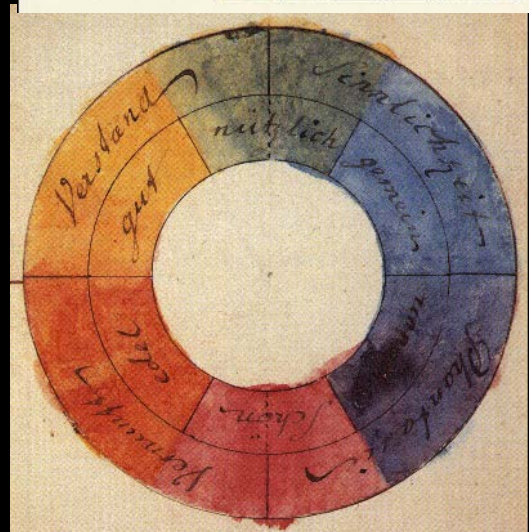
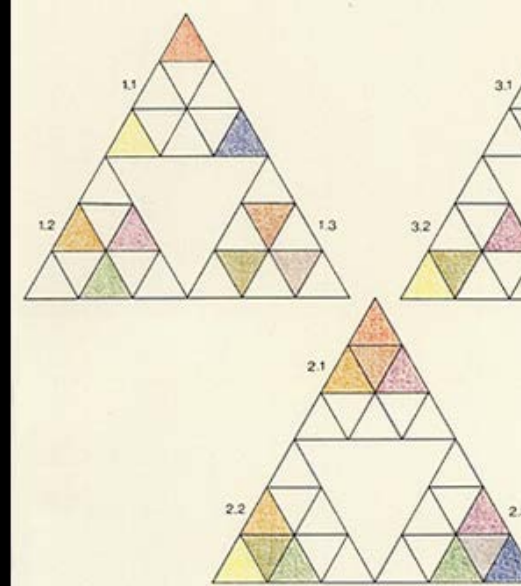
- “In the *Natural System of Colours* (1766) he examined the work of Isaac Newton and tried to reveal the multitude of colours which can be created from three basic ones.
- As a naturalist, Harris wished to understand the relationships between the colours, and how they are coded, and his book attempted to explain the principles, "materially, or by the painters art", by which further colours can be produced from red, yellow and blue.
- Harris showed what is now known as the subtractive mixing of colours, with his most important observation showing that black will be formed through the superimposition of the three basic colours.

• — Wikipedia



Johann Wolfgang von Goethe

- **German poet (1749-1832)**
- **Published *The Theory of Colors* (1810)**
- **Dealt with the phenomena of color shadows**
- **Devised a color circle based on the laws of subtraction.**
- **Intended to oppose and discredit Newton**
- **Called warm hues “warm, lively and exciting”**
- **..cool hues “weak, unsettled and yearning”**
- **Believed color is created by an interaction of light and shadow.**



Goethe

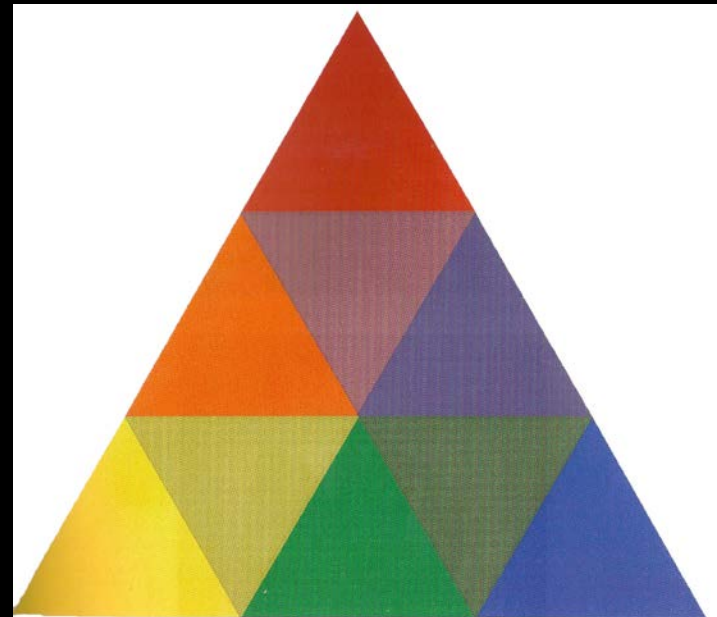


- **Poet, dramatist, novelist, and scientist.**
- **Born in Frankfurt-on-Main, Germany**
- (28 August 1749 – 22 March 1832)
- His most enduring work, one of the peaks of world literature, is the two-part dramatic poem *Faust*.
Faust, or Faustus, is a reinvention of a popular German legend in which a mediæval scholar makes a pact with the Devil.

Goethe



- As a boy, showed a persistent fondness for drawing and learned with surprising ease.
- His early taste for the graphic arts continued to the end of his days, resulting in a vast collection of treasures.



Goethe



- *In 1810 he published Theory of Colors*

Goethe approached the subject primarily to gain some knowledge of colours from the point of view of art. ...Goethe explained that by embarking on his *History of the Theory of Colours* he had also hoped to create a *History of the Human Spirit in Miniature*.

• — ColorSystems.com

- Unlike Newton, Goethe aimed to explore the viewer's experience — his studies included the *emotional aspects of color*.

“Goethe's book provides a catalogue of how colour is perceived in a wide variety of circumstances, and considers Newton's observations to be special cases.



Unlike Newton, Goethe's concern was not so much with the analytic treatment of colour, as with the qualities of how phenomena are perceived.

Philosophers have come to understand the distinction between the optical spectrum, as observed by Newton, and the phenomenon of human colour perception as presented by Goethe”

Goethe



In 1810 he **published Theory of Colors**

“*Farbenlehre is still the most comprehensive study of colour from every point of view, including the historical...and is still in print in several languages, including English.”**

- John Gage, *Color and Meaning: Art, Science and Symbolism*, p.169

- * *Theory of Color*

Goethe: religion and mysticism



- “He also expressed an interest in ***mysticism***, which manifested itself in various forms besides the writing of ***Faust***.
- “During his childhood at Frankfurt he ***did symbolic drawings of the soul's aspirations to the deity***, and he later became immersed in the study of ***the Christian religion***.
- “Later his intellect was seemingly less engaged by Christianity than by ***ancient Eastern faiths***”



Goethe the Colorist

*Attacked Newton's theories —
wanted to prove him wrong.*

*Observed color phenomena
directly.*

*Emphasized color as a visual
phenomena occurring **in the eye.***

Gave detailed explanations of:

- Colored shadows
- Simultaneous contrast
- Successive contrast

Goethe



Goethe

- *“That I am the only person in this century who has the right insight into the difficult science of colors, that is what I am rather proud of, and that is what gives me the feeling that I have outstripped many.”*
- Because Goethe misinterprets some experiments, he **incorrectly thinks that these experiments show Newton to be wrong.** <http://webexhibits.org/colorart/ch.html>

Goethe

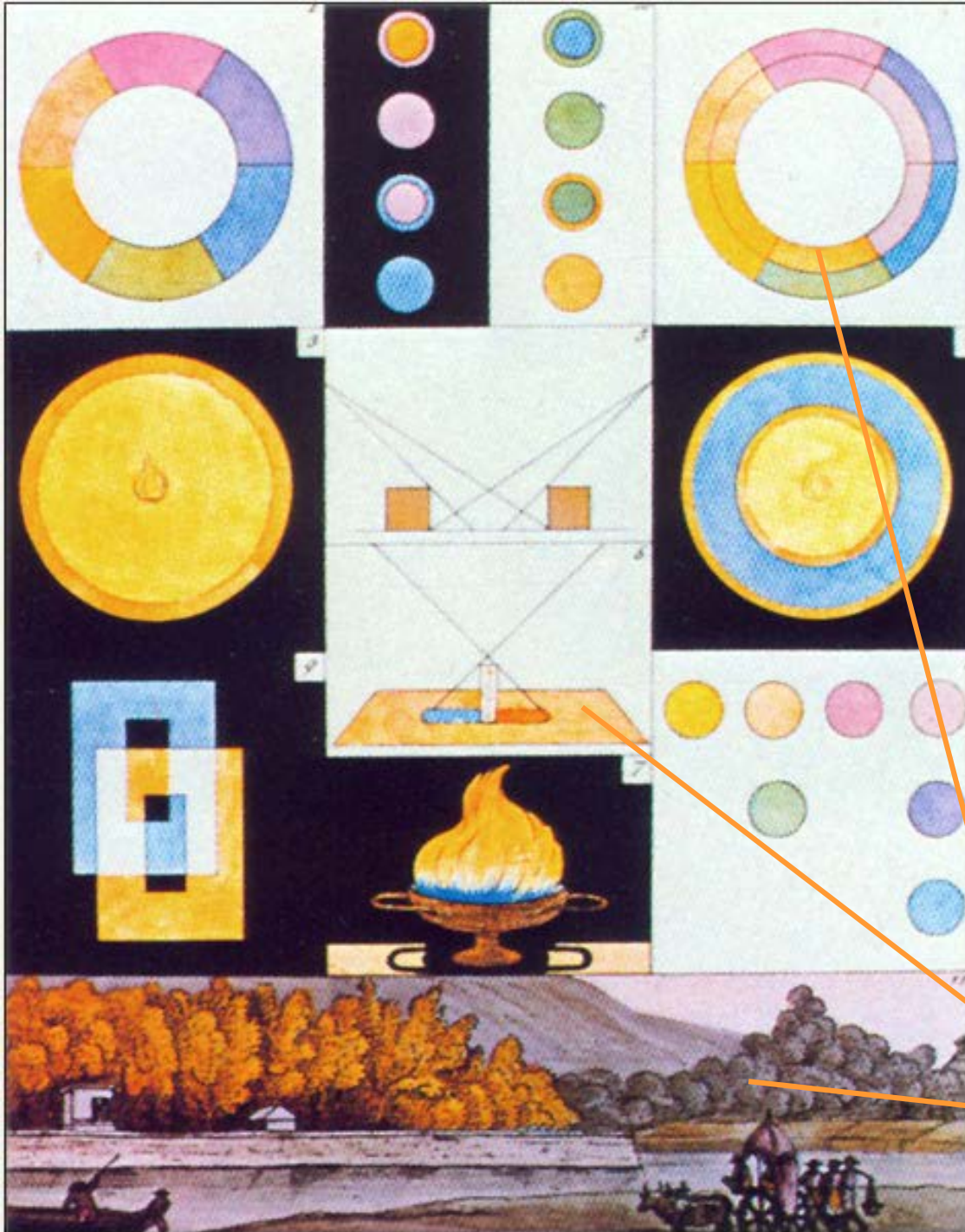
- *Developed several color models (variations on color wheels)*
- *“He anticipates Hering’s “opponent-color” theory, which is one basis of our understanding of color vision today. Above all, Goethe appreciates that the sensation of complementary colors does not originate physically from the actions of light on our eyes but perceptually from the actions of our visual system.”*

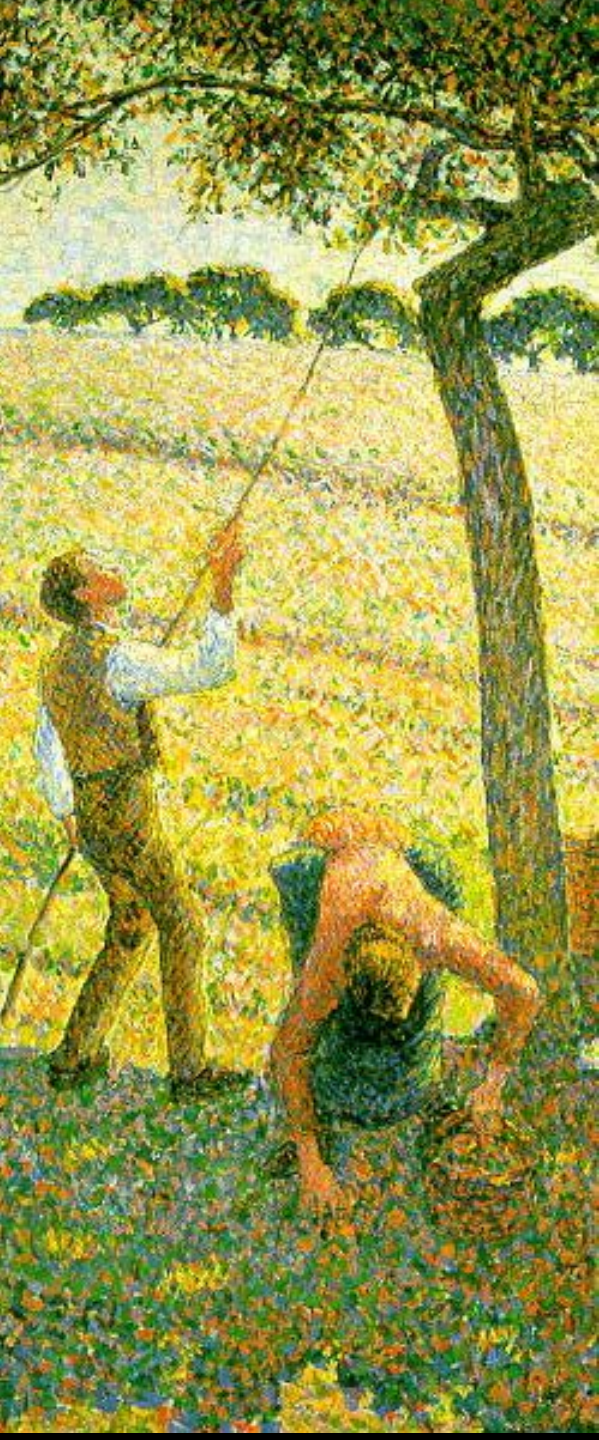
<http://webexhibits.org/colorart/ch.html>

Color Wheels

Color shadow sketch

Landscape as seen by blue-yellow colorblind person.





Goethe: Colored Shadow Observations

- **In strong midday sunlight, shadows are black, gray, or a darker value of the surface (local) color.**
- **In less direct light, shadows will be the hue complementary to the hue of the light. This effect is most pronounced when the main illumination is NOT white and when there is a secondary light source.**
- **Pale colored illumination produces richer colored shadows.**

Goethe: Influence

- *Impressionists and Postimpressionists consciously added color shadows to many works.*



Paul Signac

*The Railway at
Bois-Colombes.*

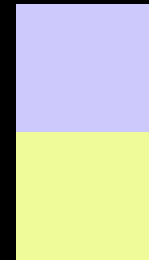
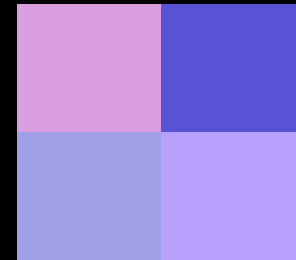
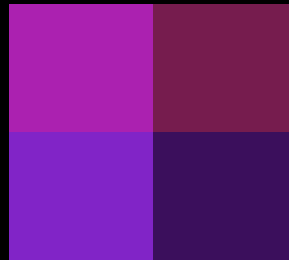
1886.

Oil on canvas.

33 x 47 cm.

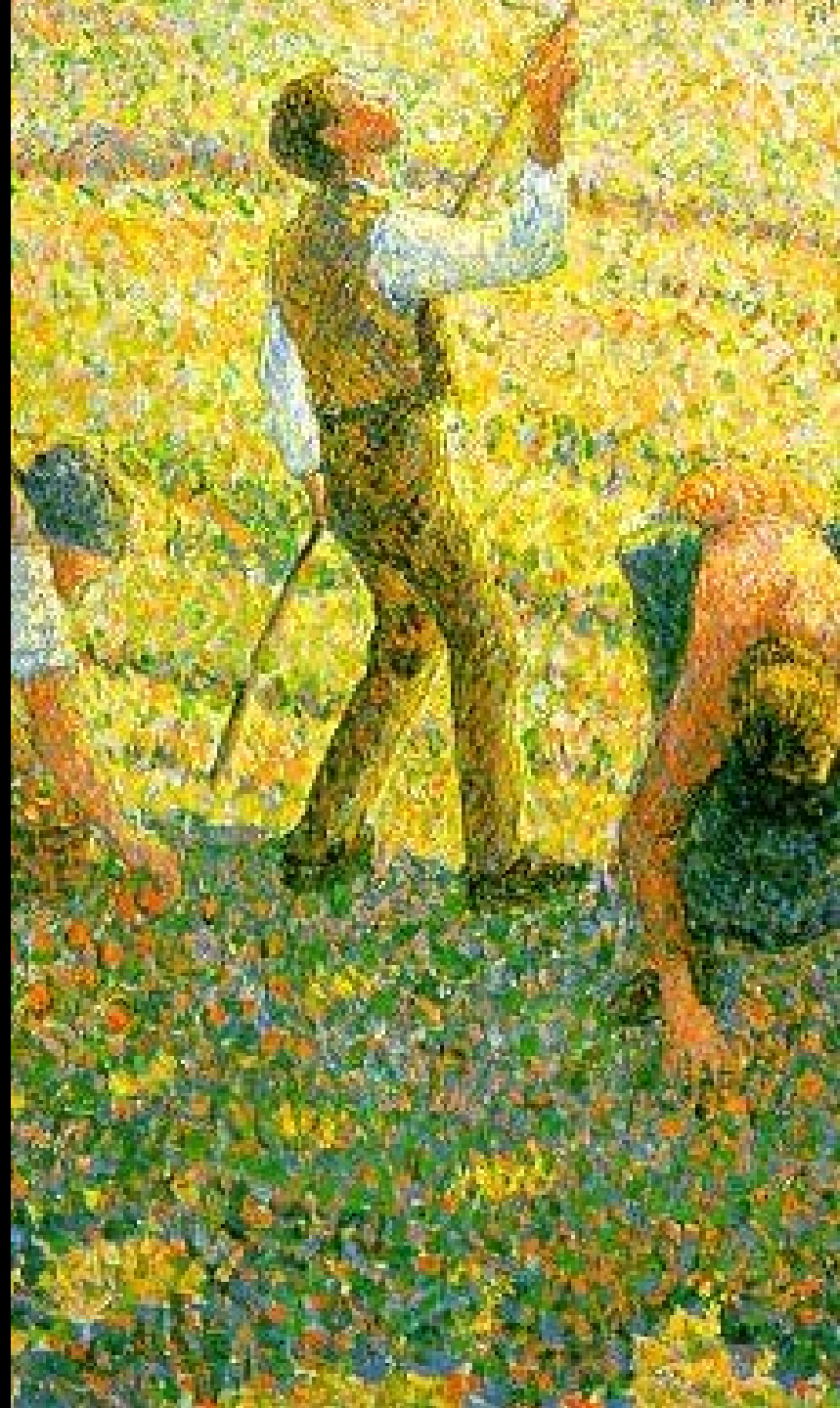


Note Signac's *bold violet along the shadow faces of the tree trunks, and... the lavender (violet tints) in the cast shadows on the grass.* Also note the *BV tint mingled in the Yellow sky.*



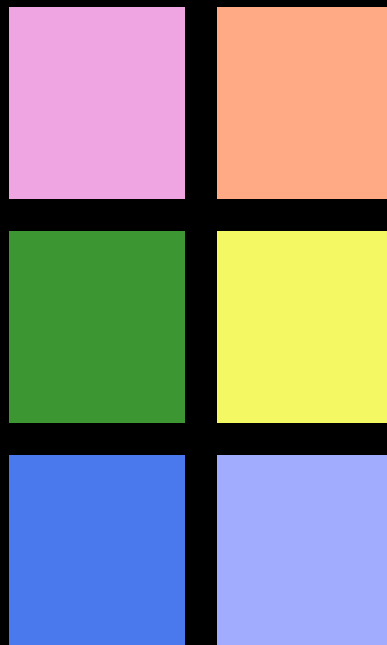
Goethe: Influence

- *Impressionists and Postimpressionists consciously added color shadows to many works.*



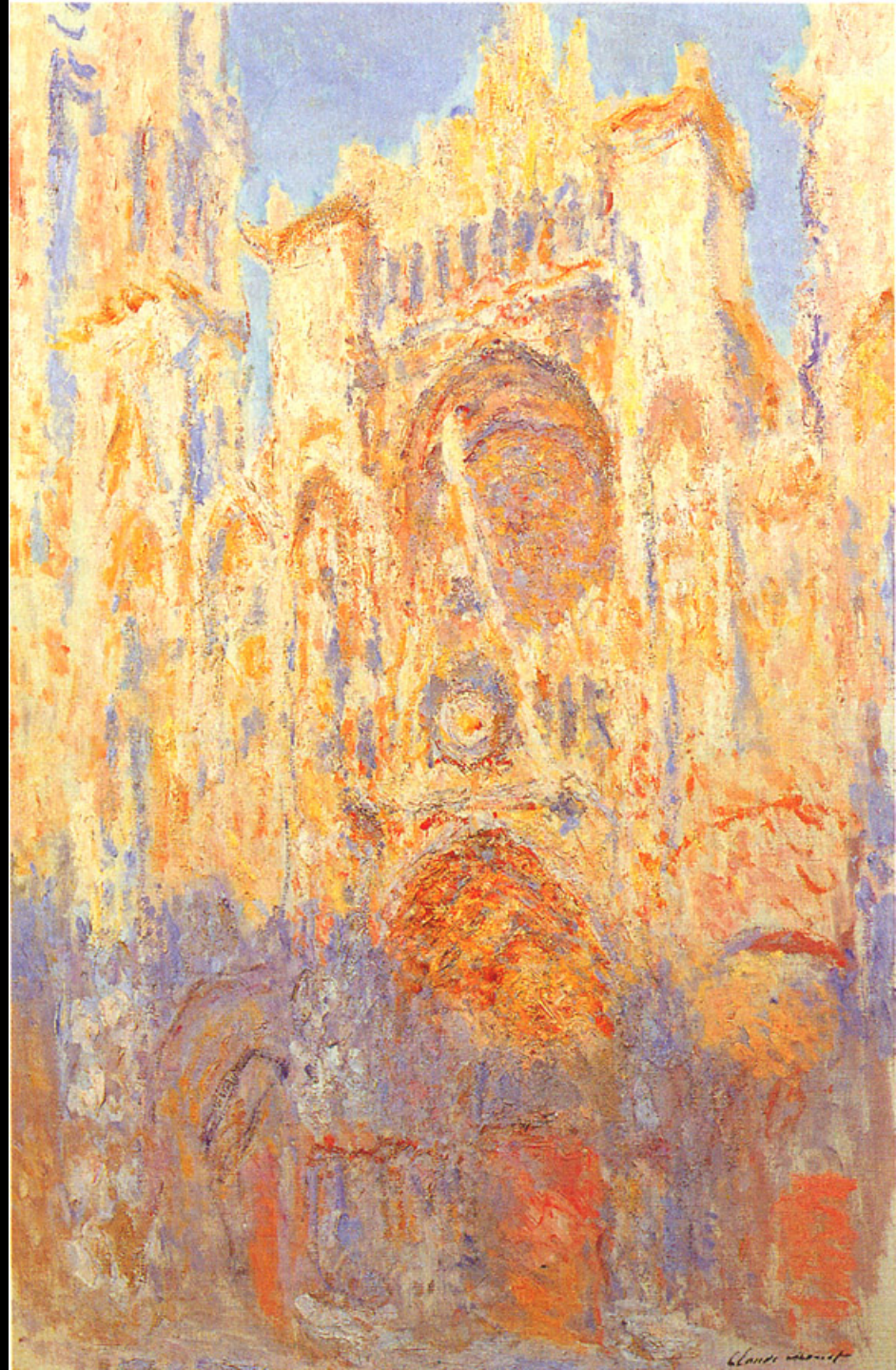
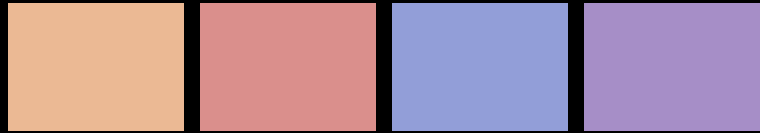
Goethe: Influence

Impressionists and Postimpressionists consciously added color shadows to many works.



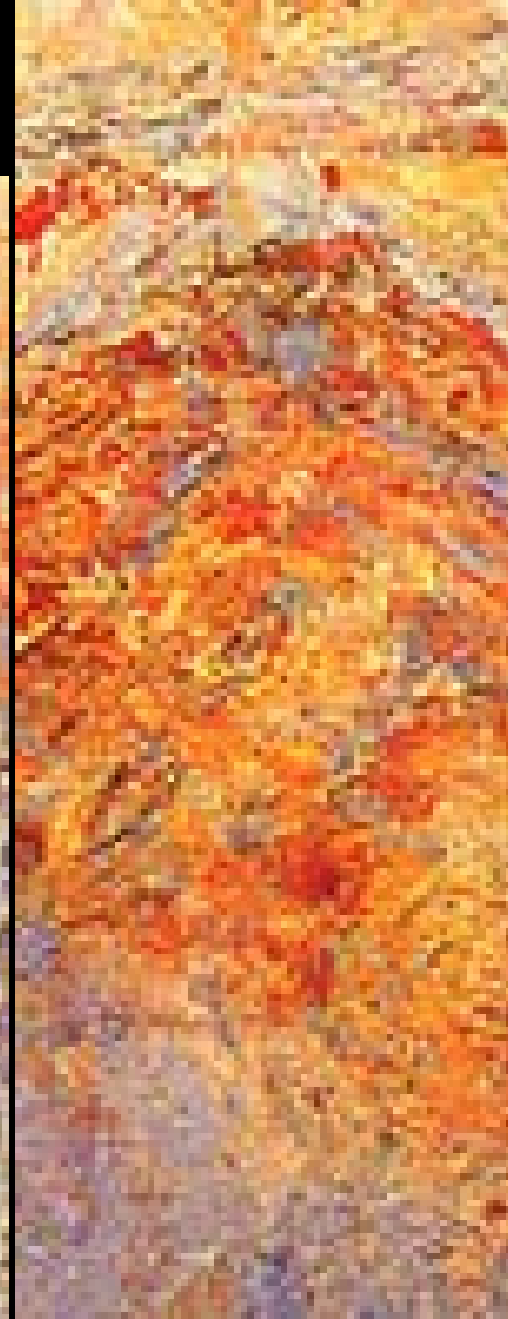
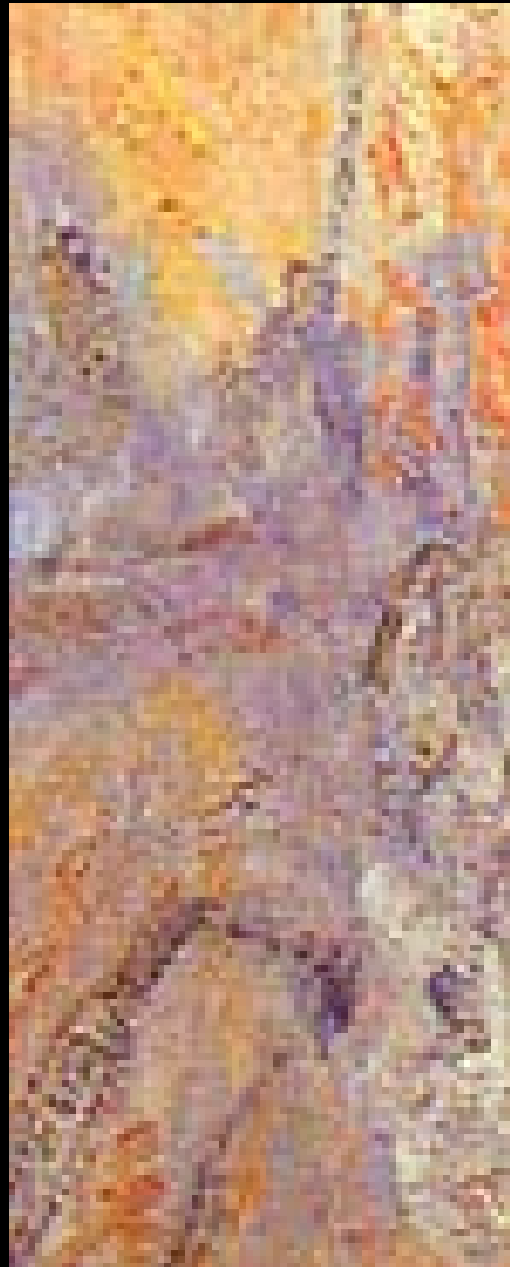
Goethe: Influence/Monet

- *Impressionists and Postimpressionists added color shadows.*



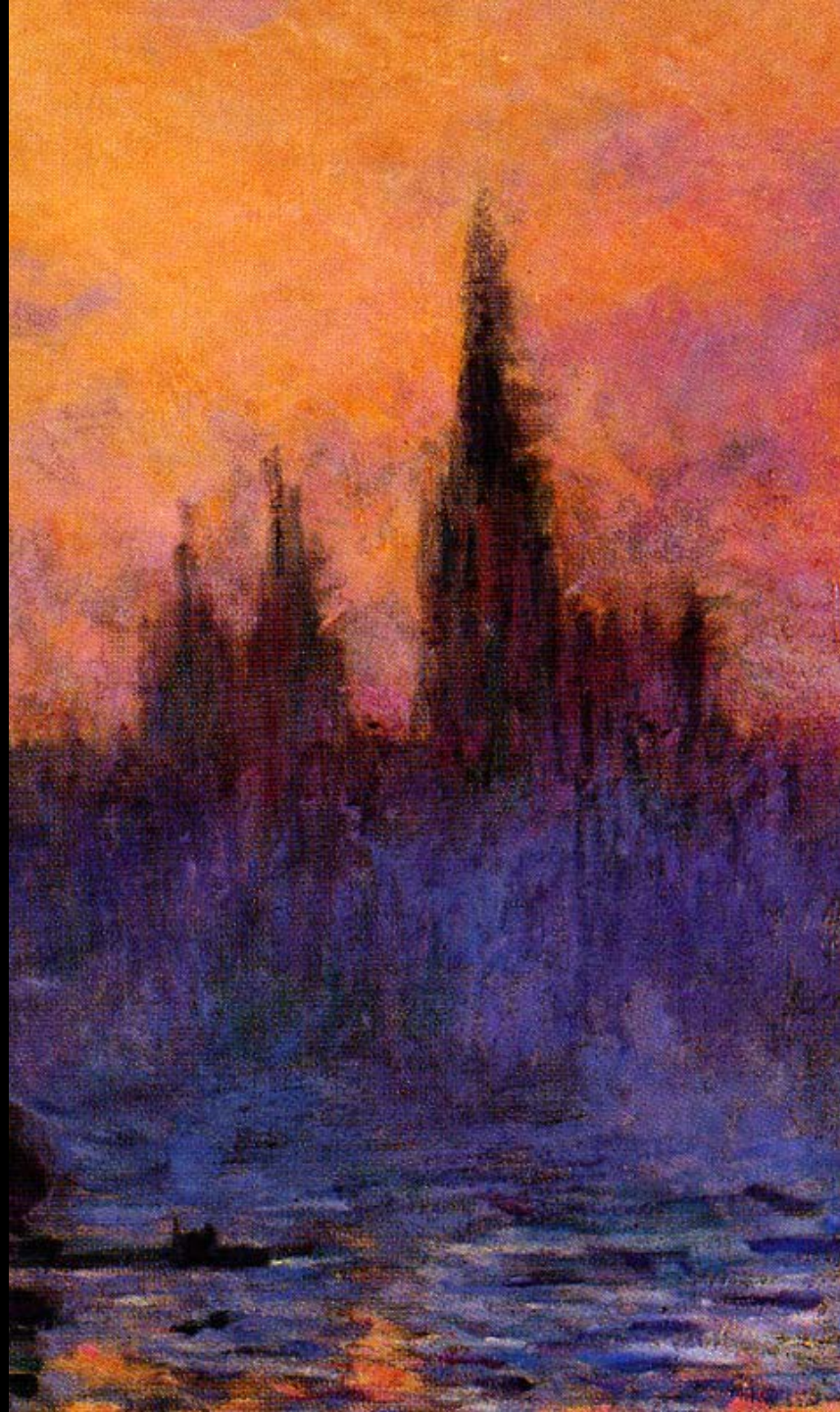
Goethe: Influence

*Impressionists and
Postimpressionists
added color
shadows.*



Goethe: Influence

- *Impressionists and Postimpressionists added color shadows.*



Goethe: Influence/Monet

- *Impressionists and Postimpressionists added color shadows—not simply darker values of local color, but often hues complementary to the surrounding colors or prevailing light..*



- ***Continue Reading
Chapter 6 on Color
Theorists***



Warhol on Goethe

"Goethe 1982,
Portfolio of 4"

Four screenprints
on Lenox Museum
Board

38 x 38 inches each

Edition of 100

Andy Warhol's
serigraphs exploit
typically brash,
high chroma color
— in shadows or in
full illumination.





Next time...the 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

