

*Color Theorists*  
1900+



# ***For each Color Theory***

***What is it trying to do?***

***Who are the major contributors?***

***What did they contribute?***

***Who benefited...who was influenced?***



# ***Last Time***

## ***Newton***

*7 spectral hues  
color wheel  
white light components*

## ***Le Blon***

*Early 4-color process printing*

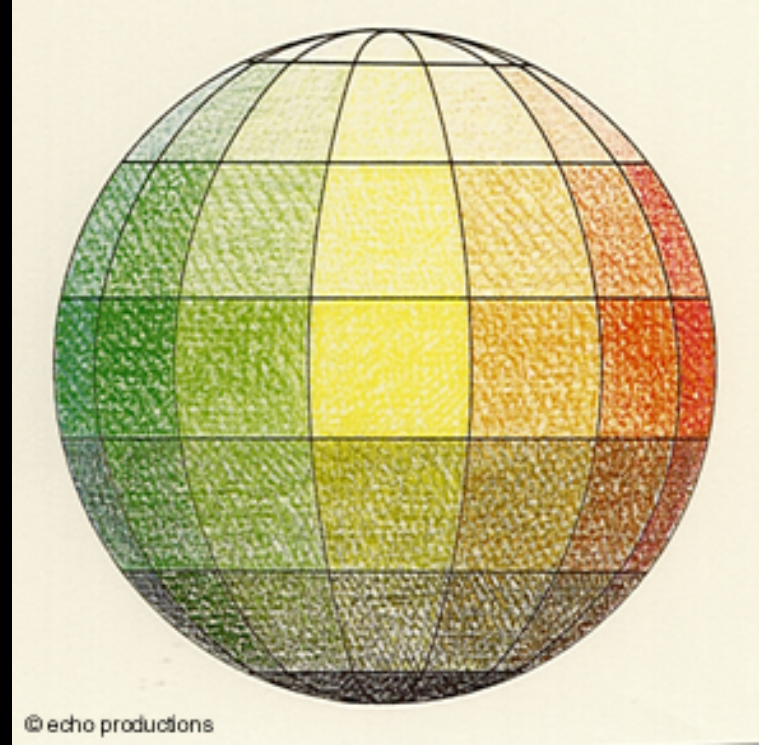
## ***Goethe***

*Farbenlehre*

*Colored shadows — Impressionism Infl.*

*(Simultaneous Contrast & Successive Contrast)*

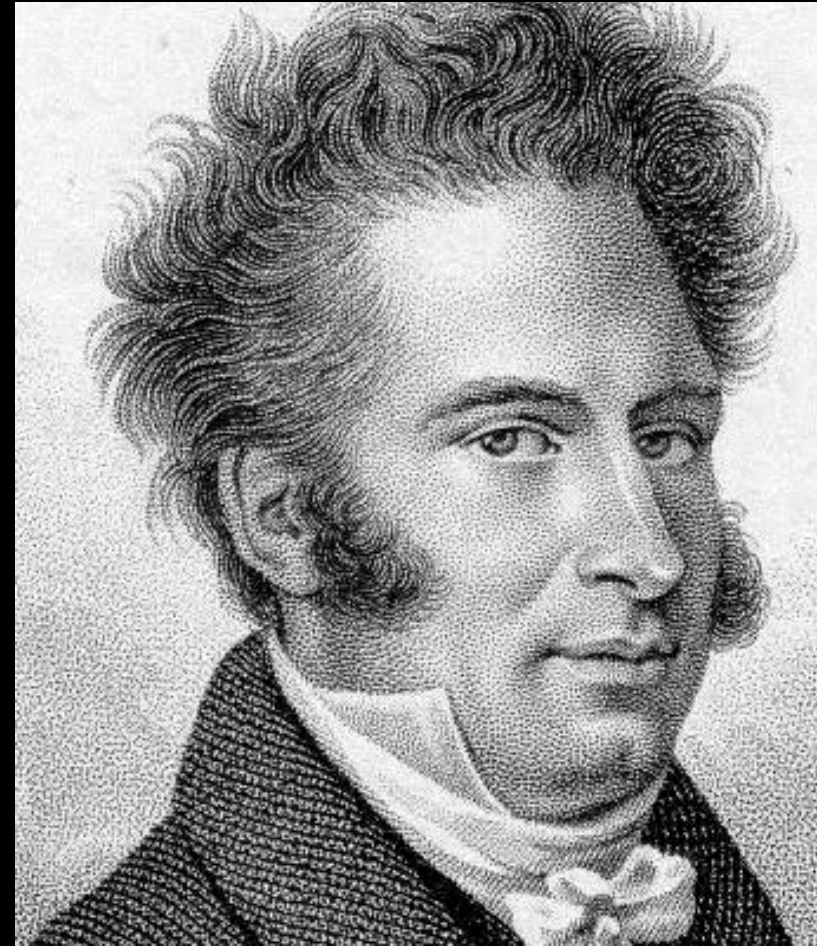
# Philip Otto Runge



- + **First true 3D color model—a sphere (1810)** (though Forsius' s 1611 circle was represented in a sphere)
- + Model (sphere) took into account **all three dimensions of color – hue, value, and saturation.**
- 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

# *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.**







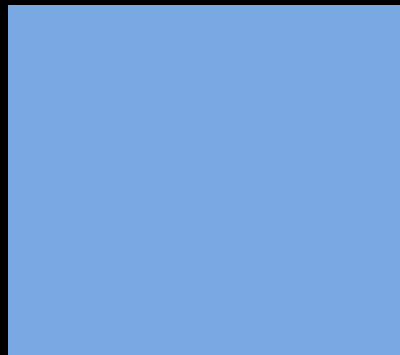
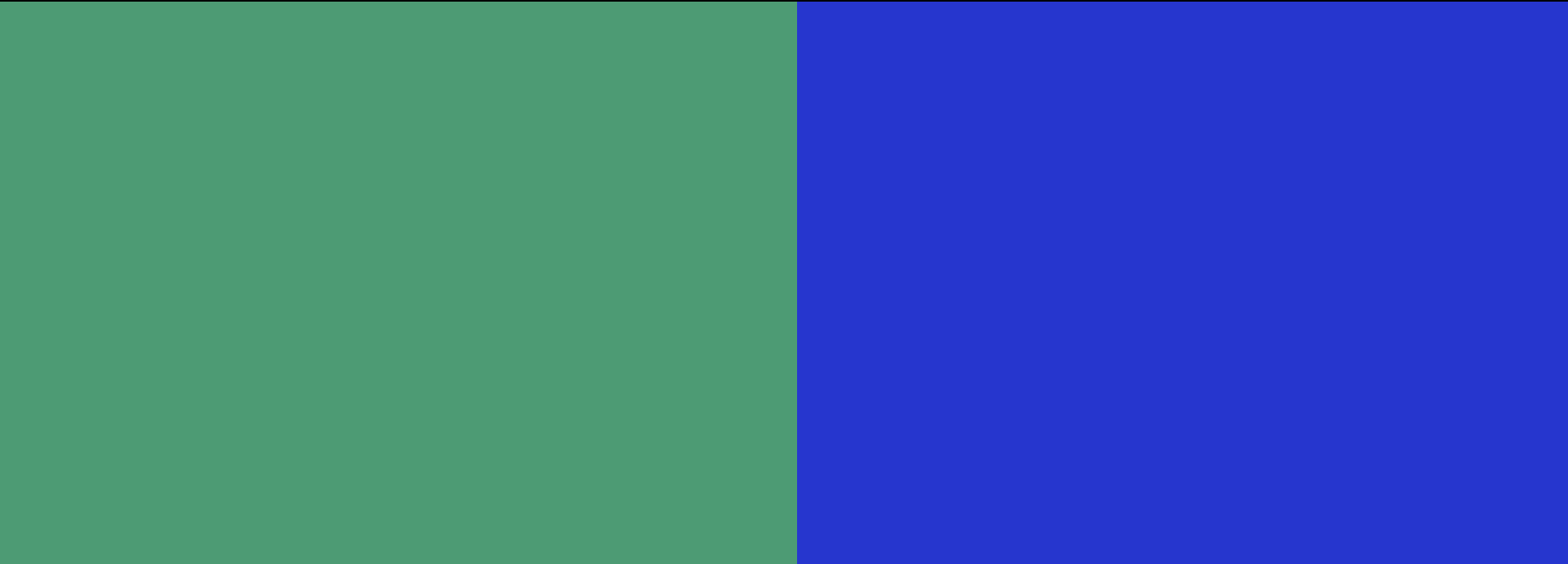
## ***Chevreul's general rule of simultaneous contrast***

### ***The Principles of Harmony and Contrast of Colors (1839)***

- *"Two adjacent colours, when seen by the eye, will appear as dissimilar as possible"*
- ***Question: can you anticipate how color perceptions will shift, according to surrounding colors?***

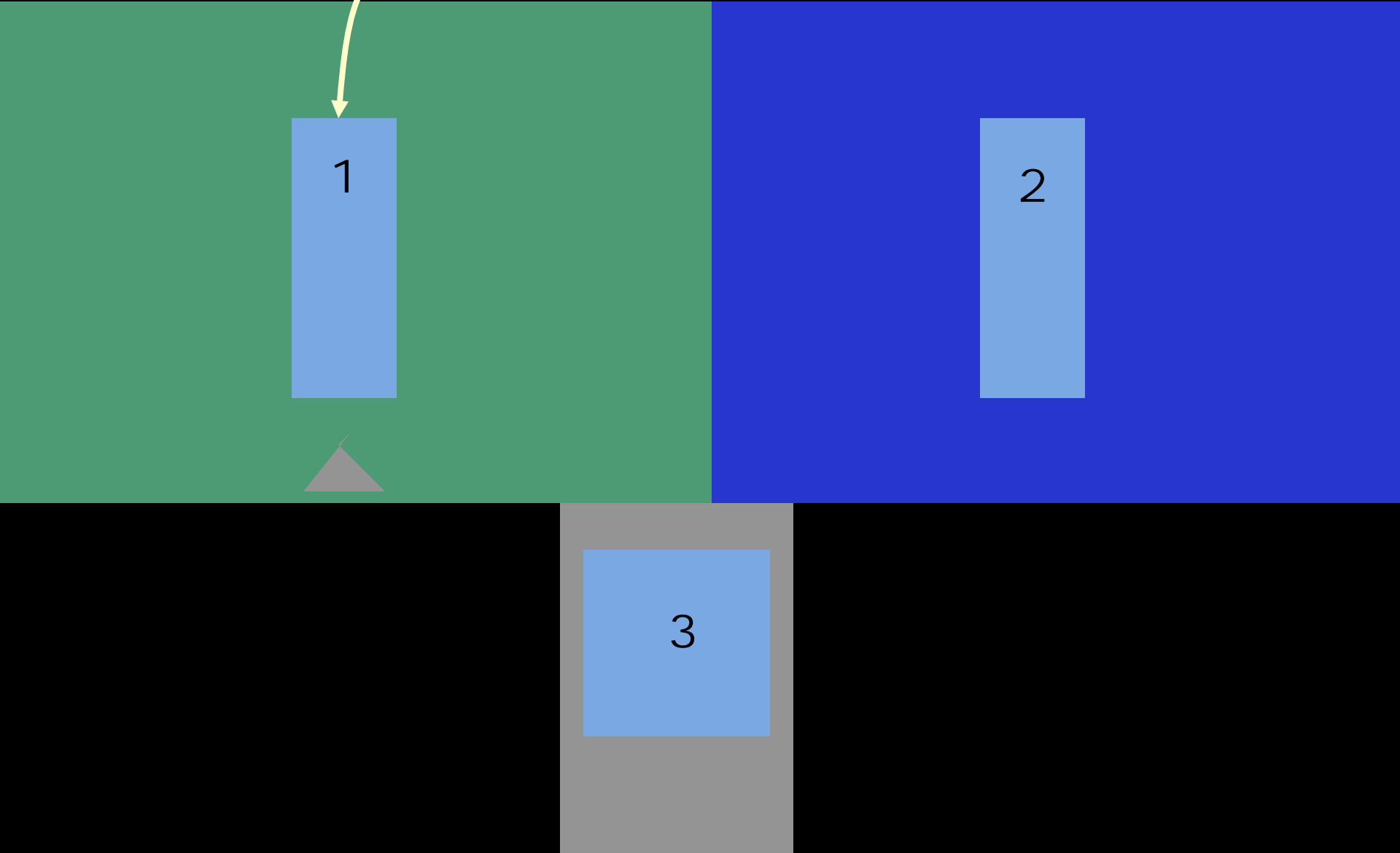
According to Chevreul's laws...

- What would the color swatch (light blue) look like against these backgrounds?



According to Chevreul's laws...

- Compared to color swatch #2, *color swatch #1 should appear...*





According to Chevreul's laws...

- Compared to color swatch #2, *color swatch #1 should appear...*



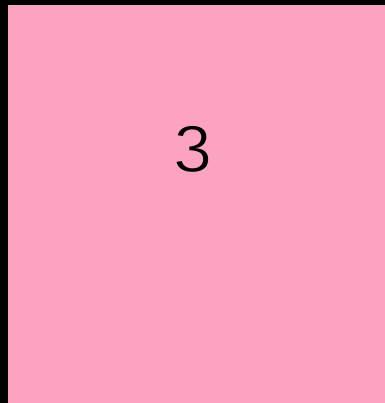
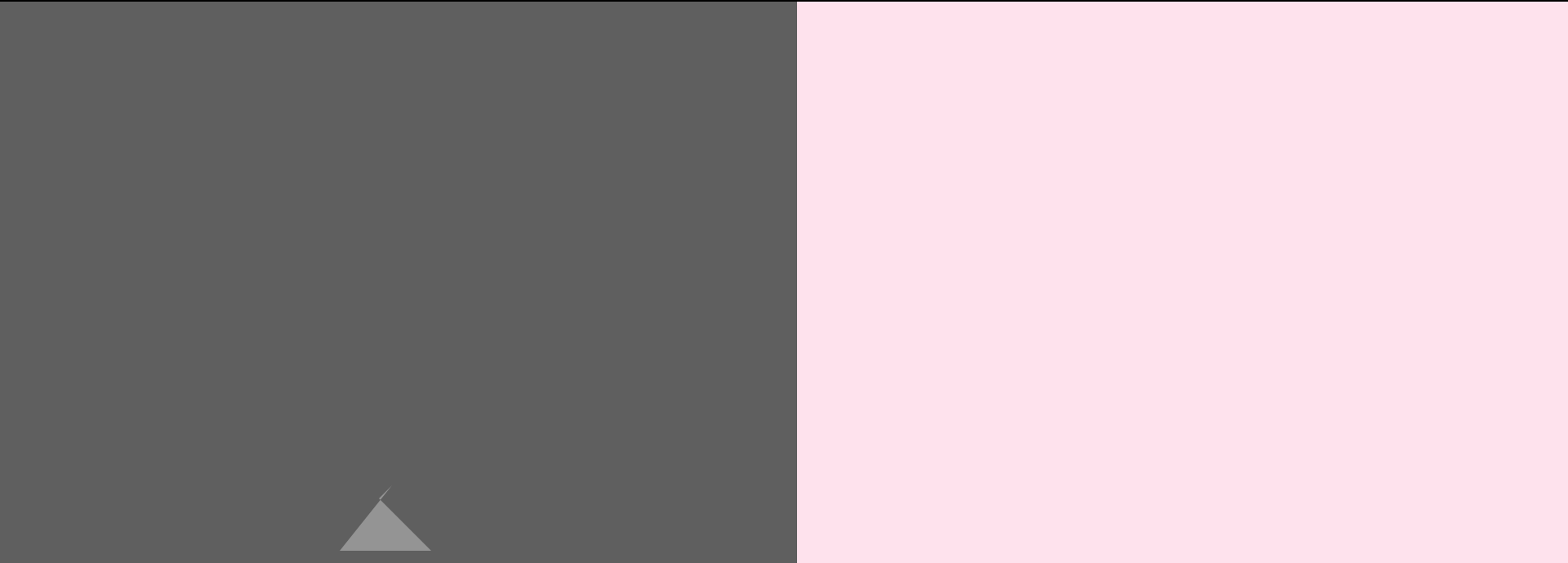
- A) ...more violet in hue, and higher in chroma (than swatch 2).
- B) ... more green in hue, and higher in chroma (than swatch 2).



- C) ... more violet in hue, and lower in chroma (than swatch 2).
- D) ... more green in hue, and lower in chroma (than swatch 2).
- E) ...darker in value, and more green in hue (than swatch 2).

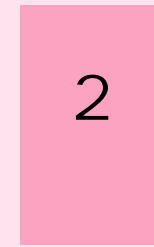
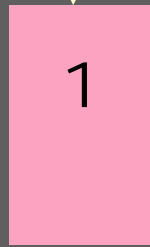
According to Chevreul's laws...

- How might this pink appear against these backgrounds?



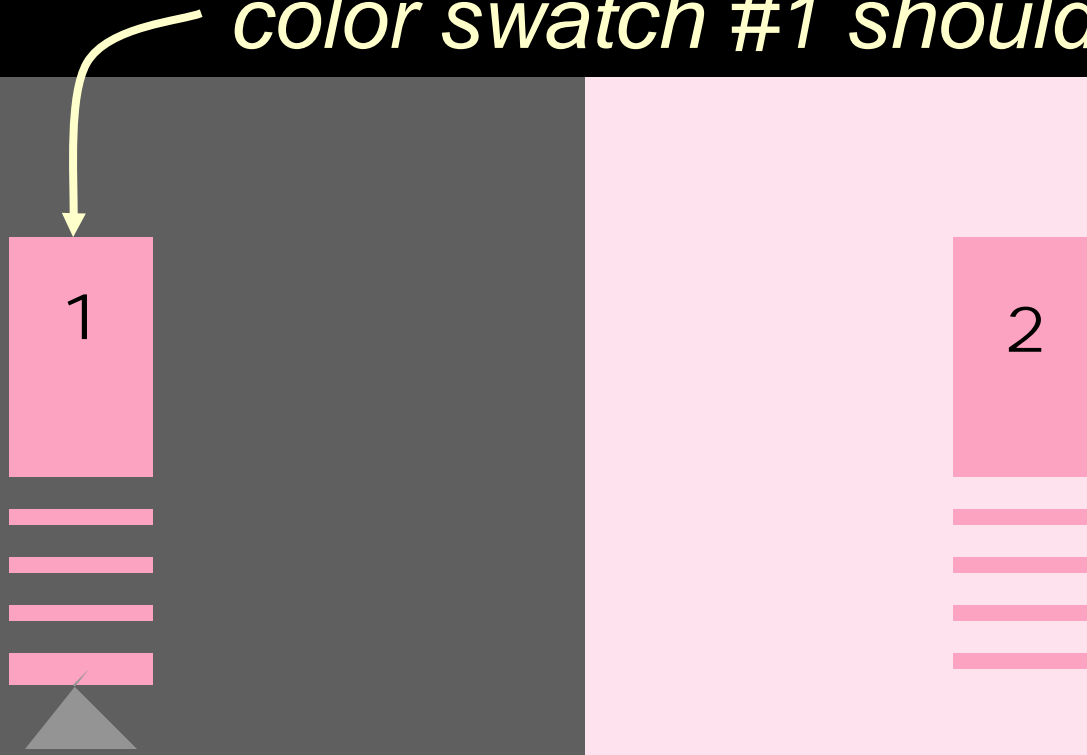
According to Chevreul's laws...

- Compared to color swatch #2, *color swatch #1 should appear...*



According to Chevreul's laws...

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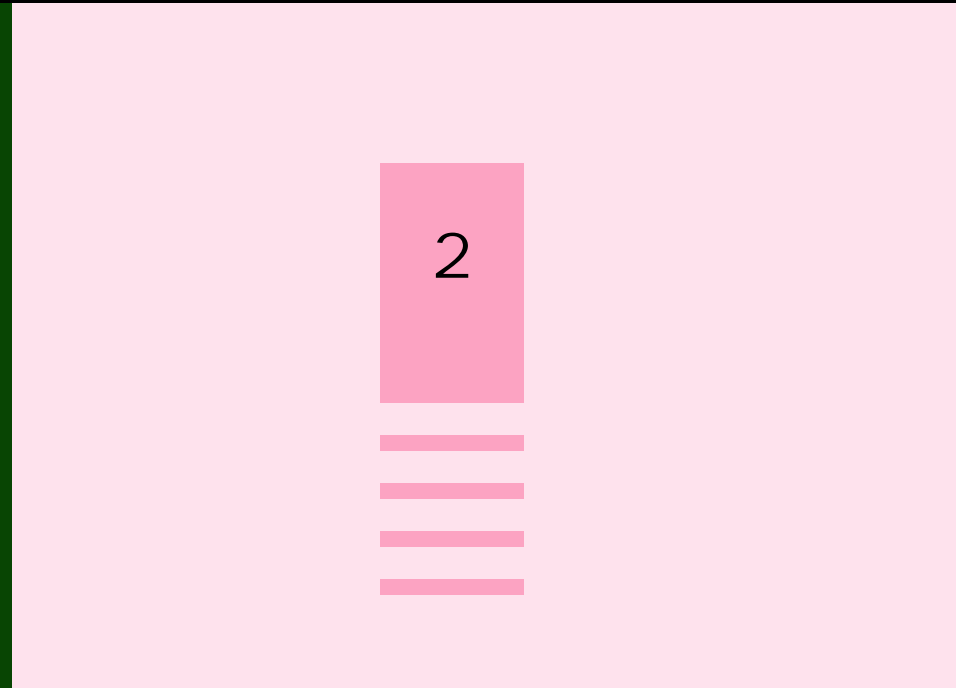
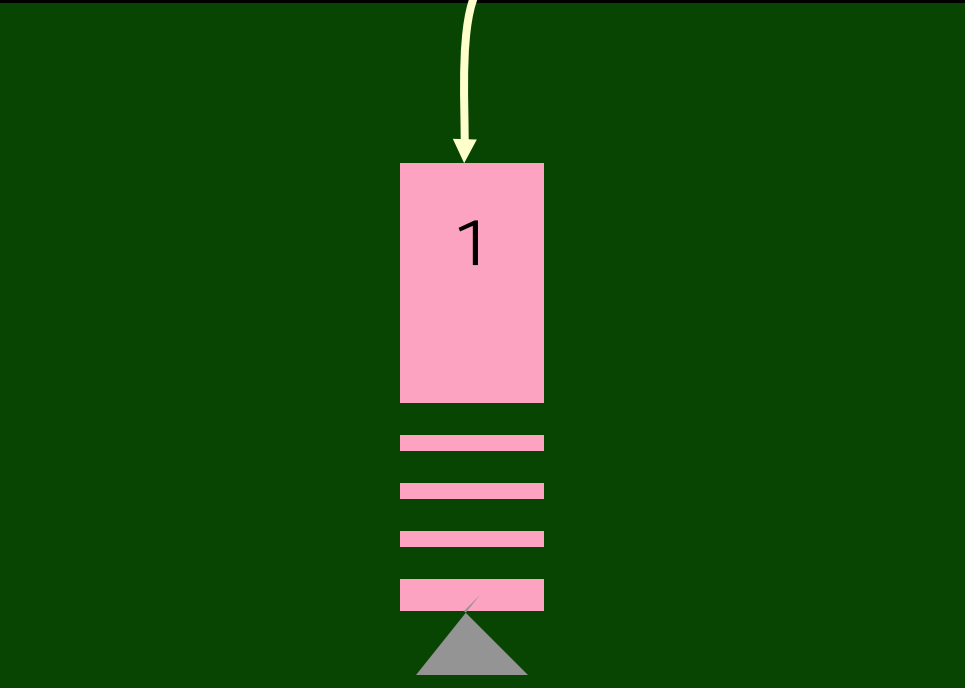
- A) ...darker in value, and lower in chroma.
- B) ...lighter in value, and lower in chroma.



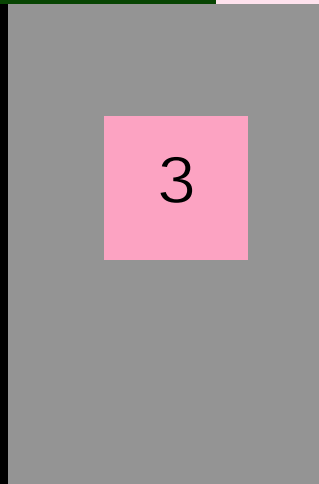
- C) ...darker in value, and higher in chroma.
- D) ...lighter in value, and higher in chroma.
- E) ...cooler in hue, lighter in value

According to Chevreul's laws...

- Compared to color swatch #2, *color swatch #1 should appear...*



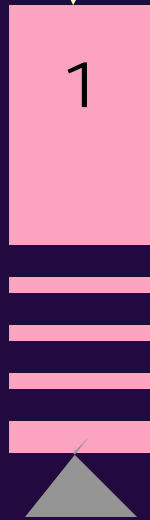
- A) ...darker in value, and lower in chroma.
- B) ...lighter in value, and lower in chroma.



- C) ...darker in value, and higher in chroma.
- D) ...lighter in value, and higher in chroma.
- E) ...cooler in hue, lighter in value

According to Chevreul's laws...

- Compared to color swatch #2, *color swatch #1 should appear...*

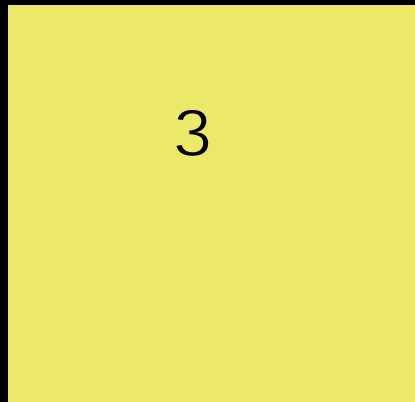
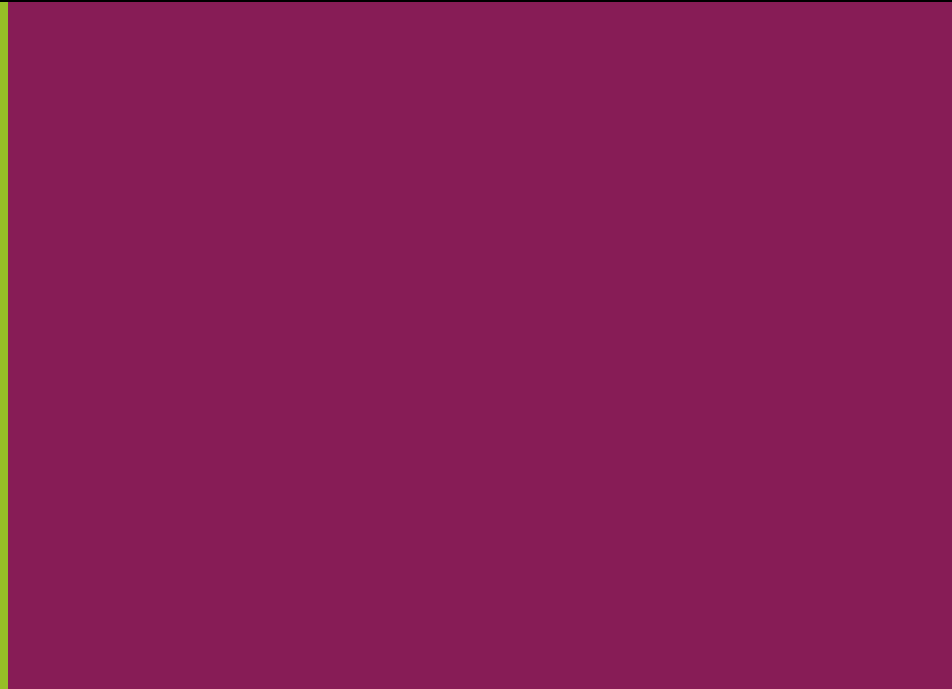


- A) ...darker in value, and more blueish in hue.
- B) ...lighter in value, and more reddish in hue.

- C) ...darker in value, and higher in chroma.
- D) ...lighter in value, and higher in chroma.
- E) ...cooler in hue, lighter in value

According to Chevreul's laws...

- How will this pale yellow green appear?

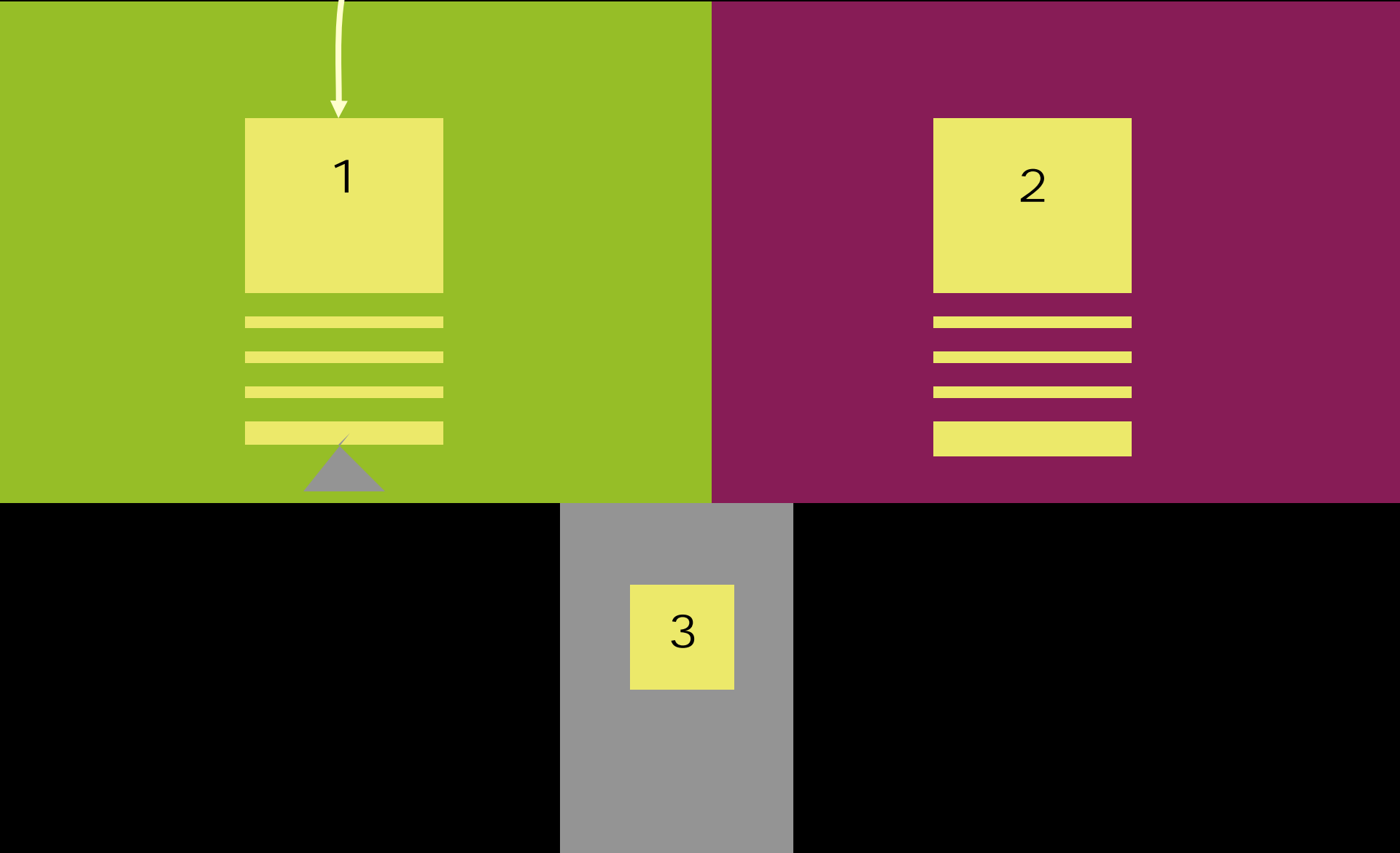




According to Chevreul's laws...

- Compared to color swatch #2,

*swatch #1 should appear...*



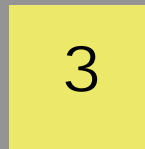
According to Chevreul's laws...

- Compared to color swatch #2,

*swatch #1 should appear...*



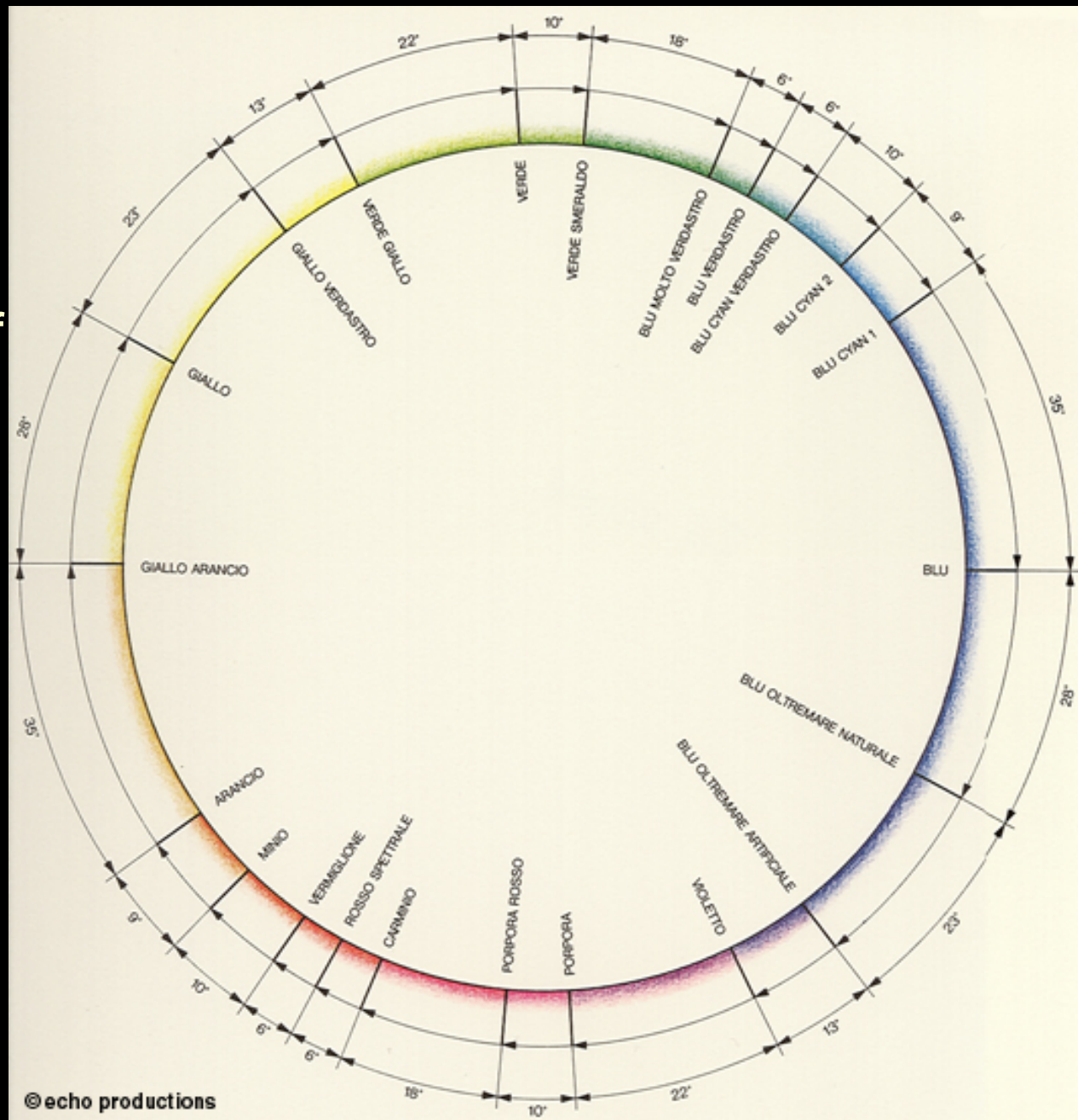
- A) ...more green in hue, and higher in chroma (than swatch 2).
- B) ... more yellow in hue, and higher in chroma (than swatch 2).



- C) ... more yellow in hue, and lower in chroma.
- D) ... more green in hue, and lower in chroma (than swatch 2).
- E) ...darker in value, and more green in hue (than swatch 2).

# Ogden Rood

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

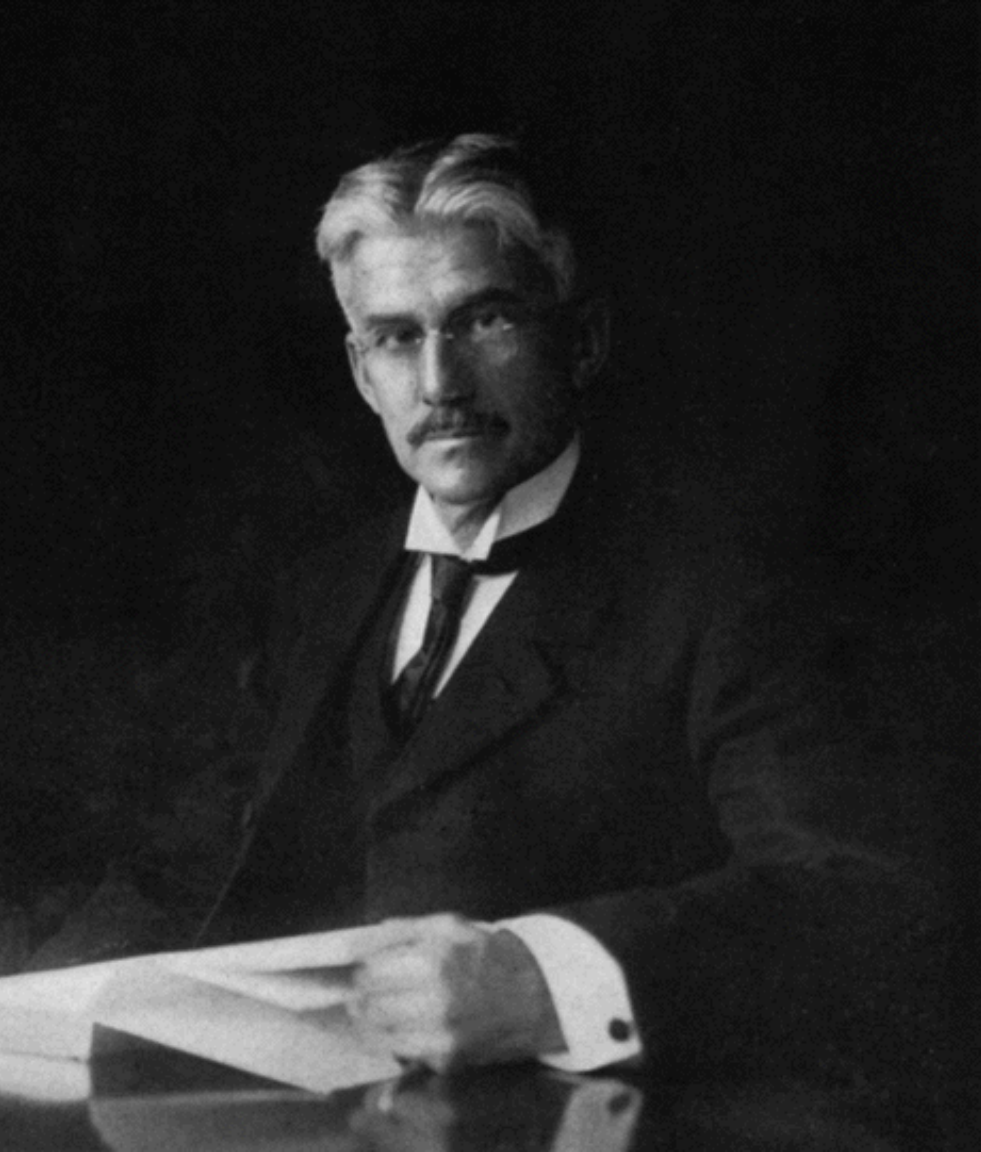


# Ewald Hering

- **German physiologist and psychologist (1834-1918)**
- **Interested in color perception**
- **Established psychological or medial primary hues.**
- **Circle presents four primary hues in equal proportions.**
- **His circle is the basis for the Natural Color System (NCS)**

# Herbert E. Ives

- **American physicist (1882-1953)**
- **+ Developed the hues used as primary printing process colors (cyan/syan, magenta/anchlor, & yellow/zanth).**
- **His goal was to find the hues that, when mixed, would create the best secondary and tertiary hues.**



# ***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.**



# Albert Munsell

- Attempted to advise on color harmony:
- *“the use of strongest colors only fatigues the eyes; beginners should avoid strong color; ... and quiet color is the mark of good taste.”*
- (he was, after all, raised in the Victorian era)





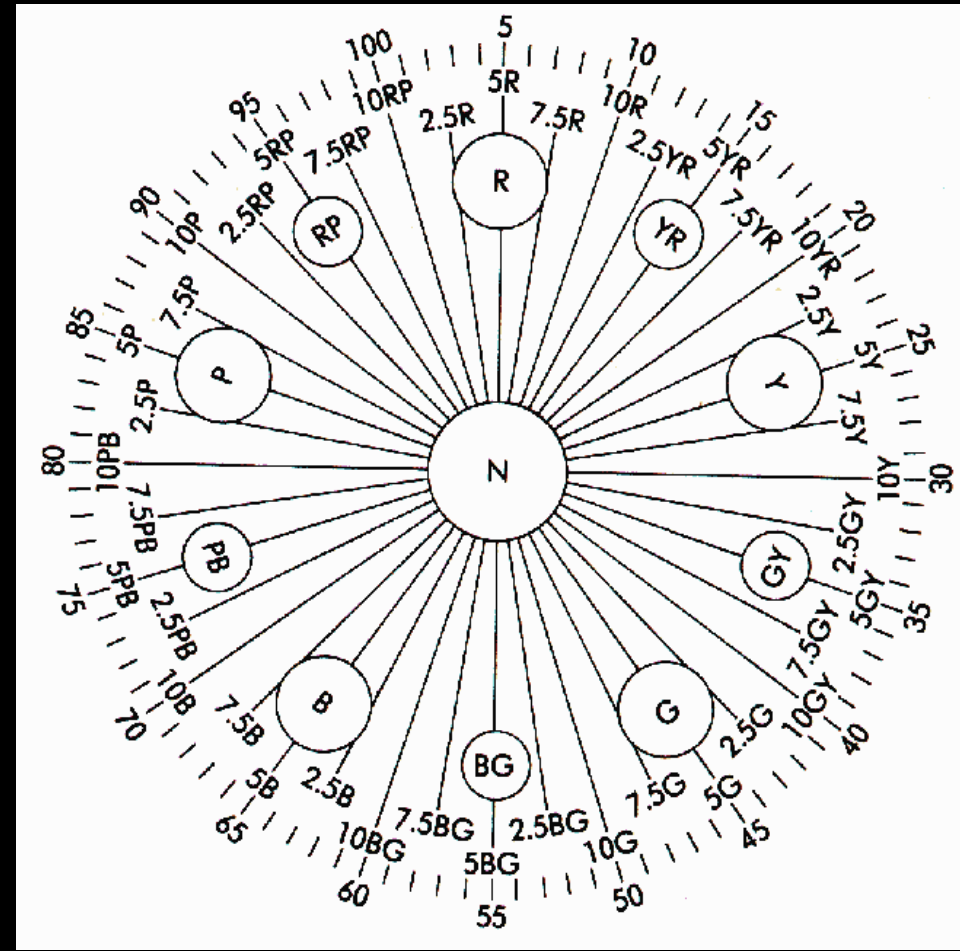
# Albert Munsell

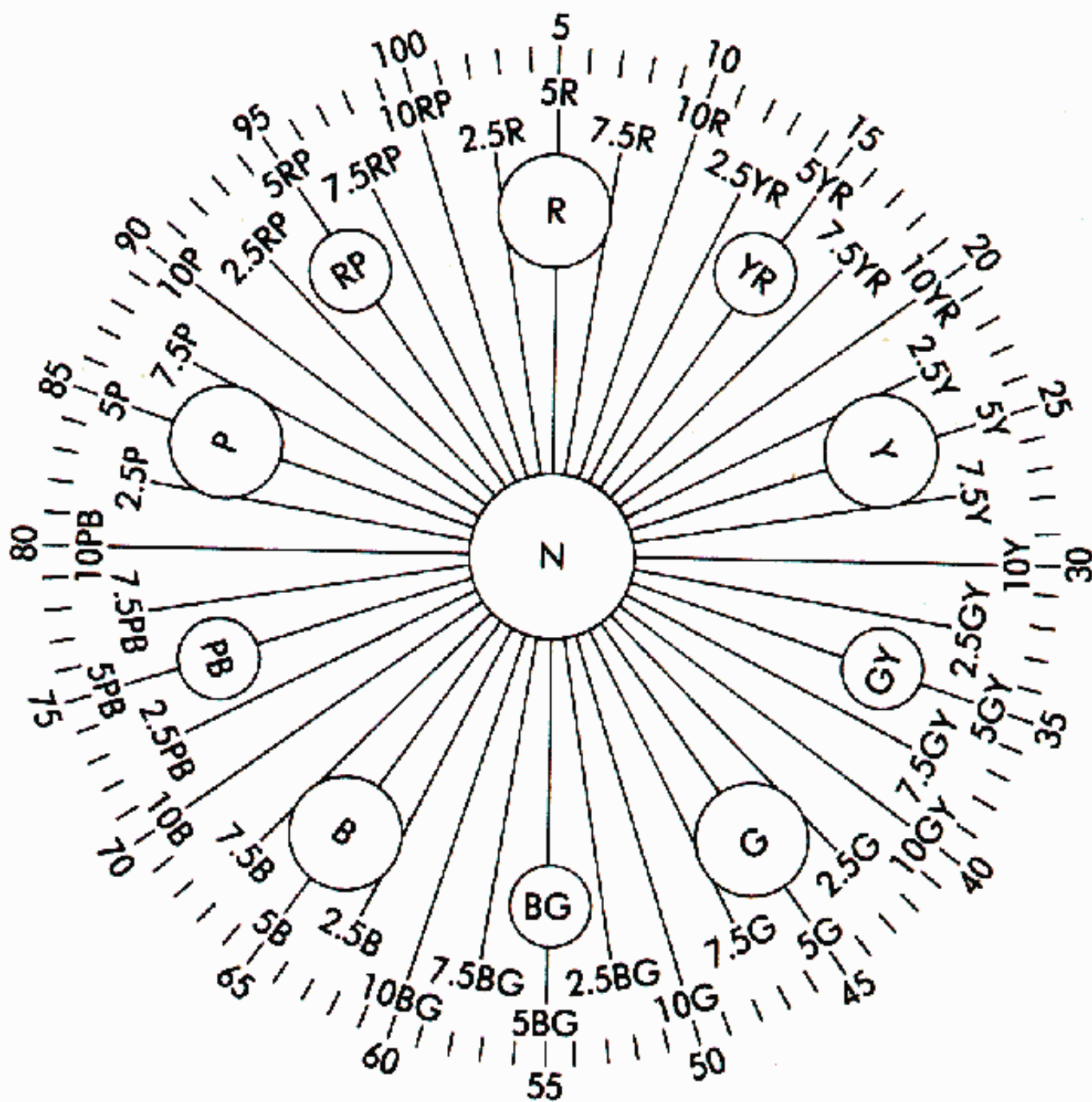
- Believed that *BALANCE* was the key to harmonious color. (if a chroma 3 Red is present, a chroma 3 BG may balance it. If the Red is chroma 6, then the BG at chroma 3 needs to be twice the size/area.)
- Preferred medium value and medium chroma as dominants.
- He would balance value and chroma above and below the dominant. (if value 5 dominant, then V3 and V7 might be used for contrast)
- Complements should be used at equal value (subdue strong hue contrast with limited value contrast)



# Albert Munsell

- 10 hue color wheel
- 5 primary/principle hues: red, yellow, blue, green, & purple





# *Munsell color wheel*

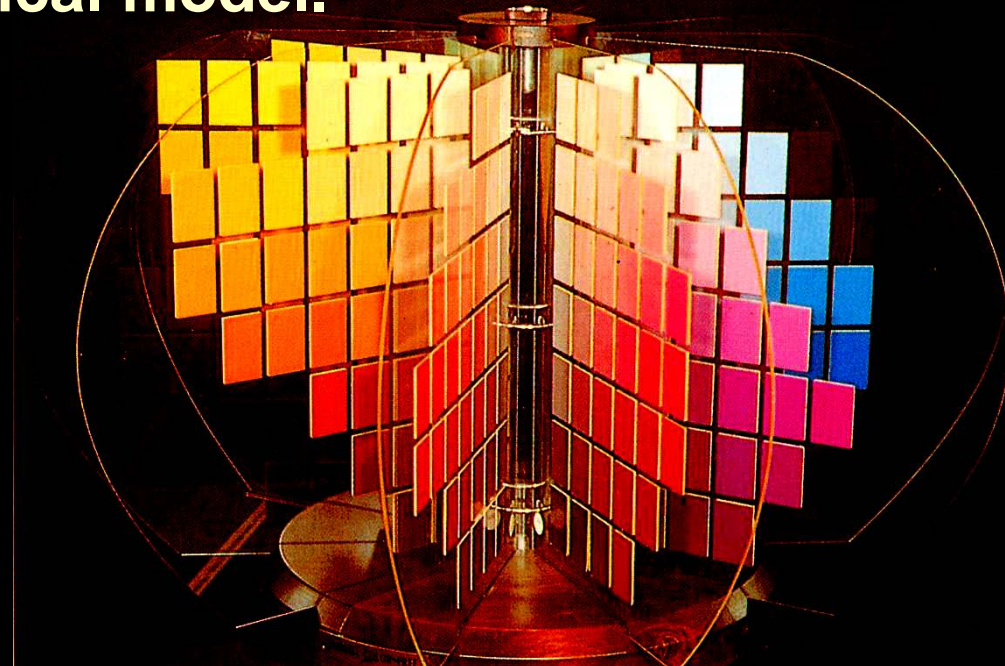
Based on 10  
major  
hues.

Note 1 & 2  
letter hue  
abbrevs.



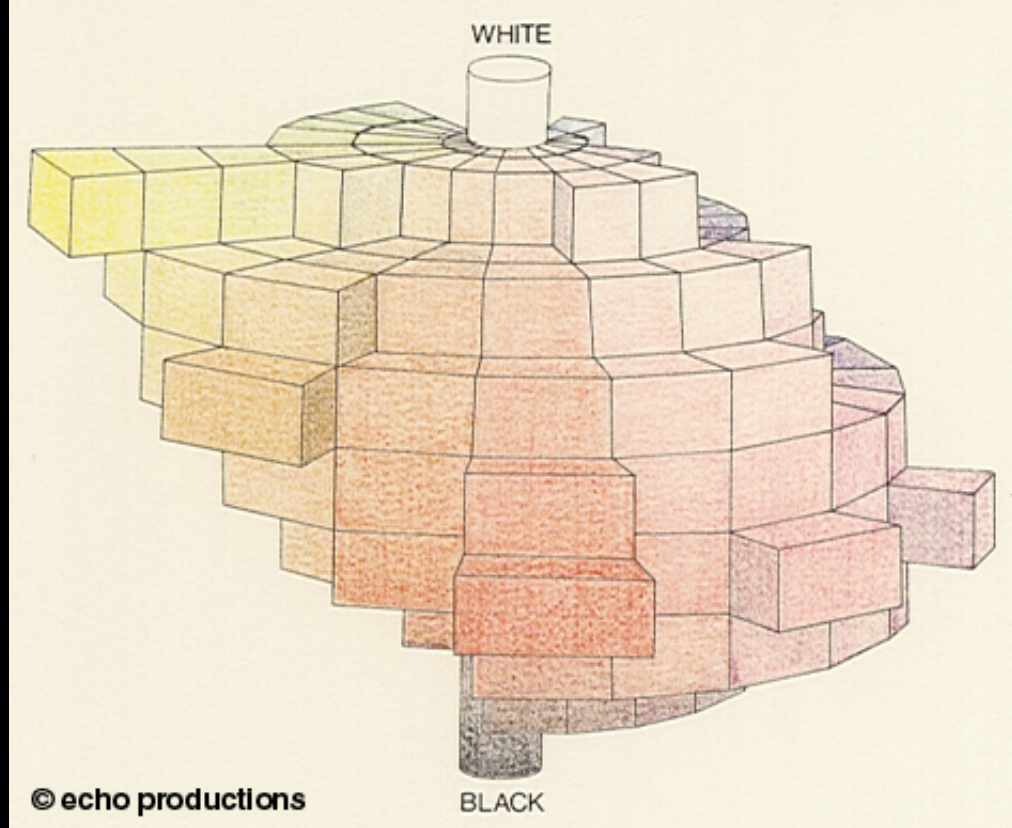
# Albert Munsell

- Hue, Value, Chroma system replaced elaborate and ambiguous color names.
- His system was further developed into the “color tree” – a 3D asymmetrical model.



# Albert Munsell

- 3D model is an irregular “tree” - branches extend as far as chroma for each hue allows.
- colors are reduced in chroma using complementaries.
- *5 primary hues-red, yellow, green, blue, purple.*

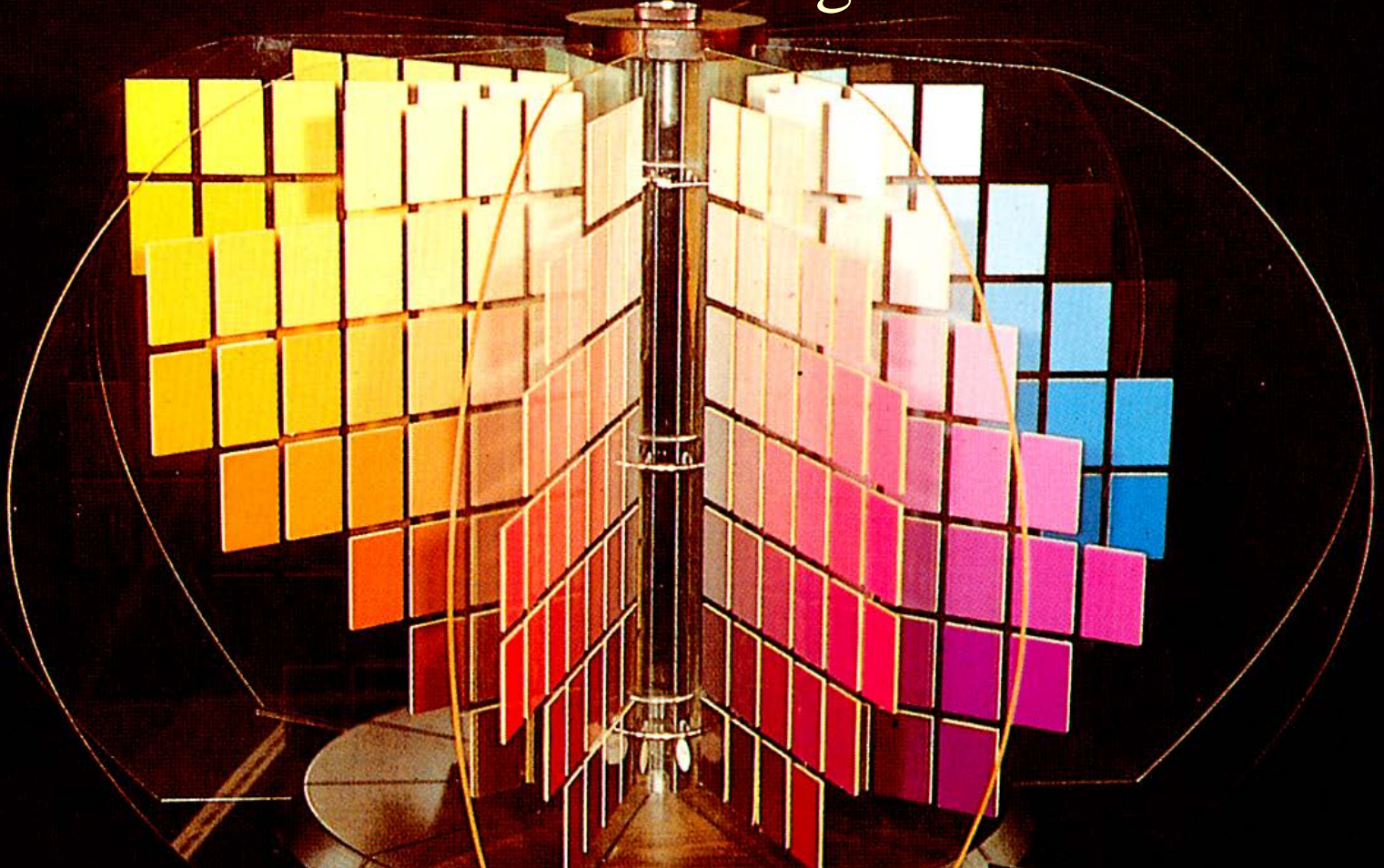


based on the principle of "perceived equidistance... Munsell attempts to account for each colour attribute in *ordered visual steps.*



# *Munsell's 3D color model*

- Each panel is a constant *hue*.
- Height = value
- Chroma - far from center = high chroma





5P9/2



5P9/4



5P8/2



5P8/4



5P8/6



5P8/8



5P8/10



5P7/2



5P7/4



5P7/6



5P7/8



5P7/10



5P7/12



5P7/14



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5P3/16



5P2/2



5P2/4



5P2/6



5P2/8



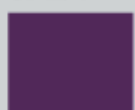
5P2/10



5P2/12



5P1/2



5P1/4



5P1/6



5P1/8





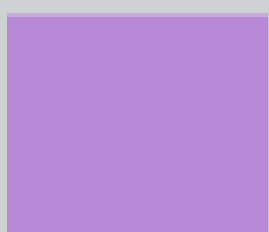
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5P6/14

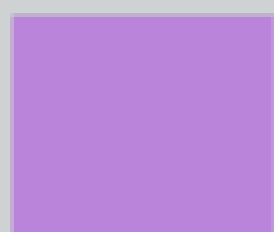
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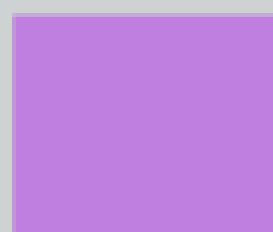
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5P5/12



5P5/14



5P5/16



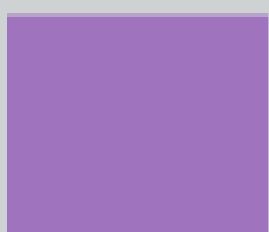
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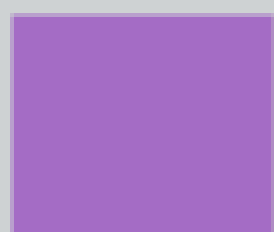
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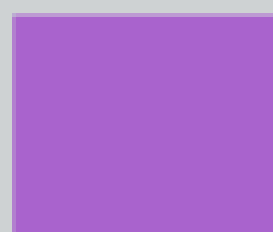
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5P4/12



5P4/14



5P4/16



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5P6/12



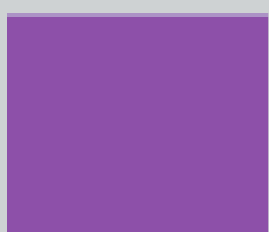
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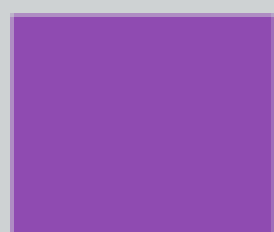
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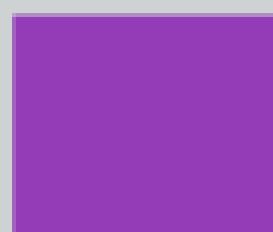
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5P3/12



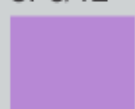
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5P3/16



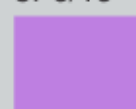
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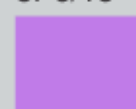
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5P5/14



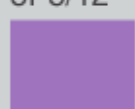
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5P5/18



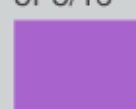
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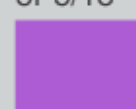
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5P4/14



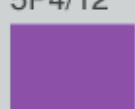
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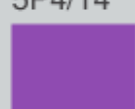
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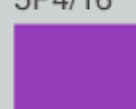
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5P3/12



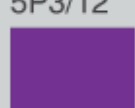
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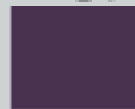
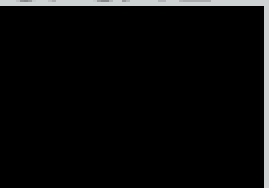
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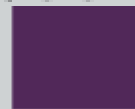
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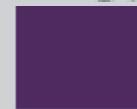
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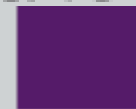
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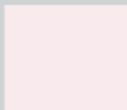
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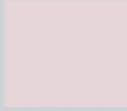
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5P1/8



10R9/2



10R8/2



10R8/4



10R7/2



10R7/4



10R7/6



10R7/8



10R7/10



10R6/2



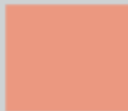
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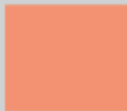
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10R6/8



10R6/10



10R6/12



10R6/14



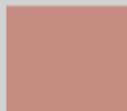
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10R5/2



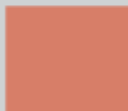
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10R5/6



10R5/8



10R5/10



10R5/12



10R5/14



10R4/2



10R4/4



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10R4/8



10R4/10



10R4/12



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10R3/8



10R3/10



10R2/2



10R2/4



10R2/6



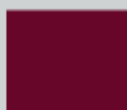
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10R1/2



10R1/4



10R1/6



10R9/2



10R8/2



10R8/4



10R7/2



10R7/4



10R7/6



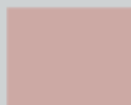
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10R7/10



10R6/2



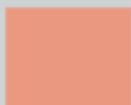
10R6/4



10R6/6



10R6/8



10R6/10



10R5/2



10R5/4



10R5/6



10R5/8



10R5/10



10R4/2



10R4/4



10R4/6



10R4/8



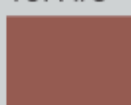
10R4/10



10R3/2



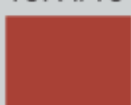
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10R3/6



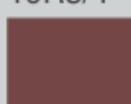
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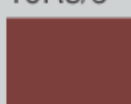
10R3/10



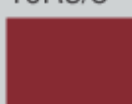
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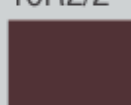
10R2/4



10R2/6



10R2/8



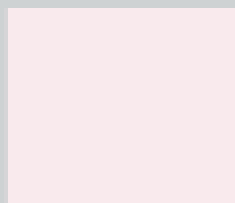
10R1/2



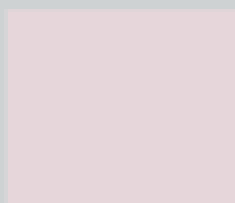
10R1/4



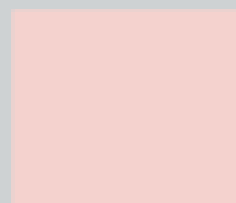
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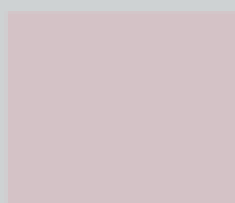
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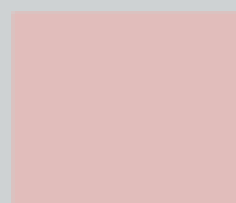
10R8/2



10R8/4



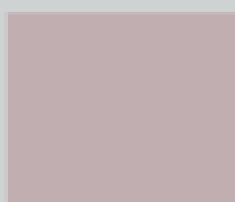
10R7/2



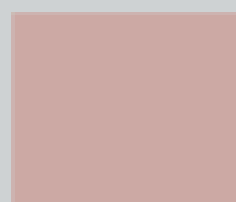
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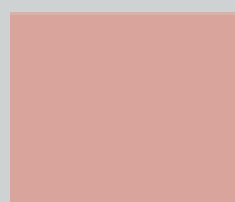
10R7/6



10R6/2



10R6/4



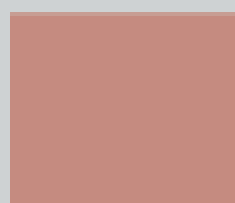
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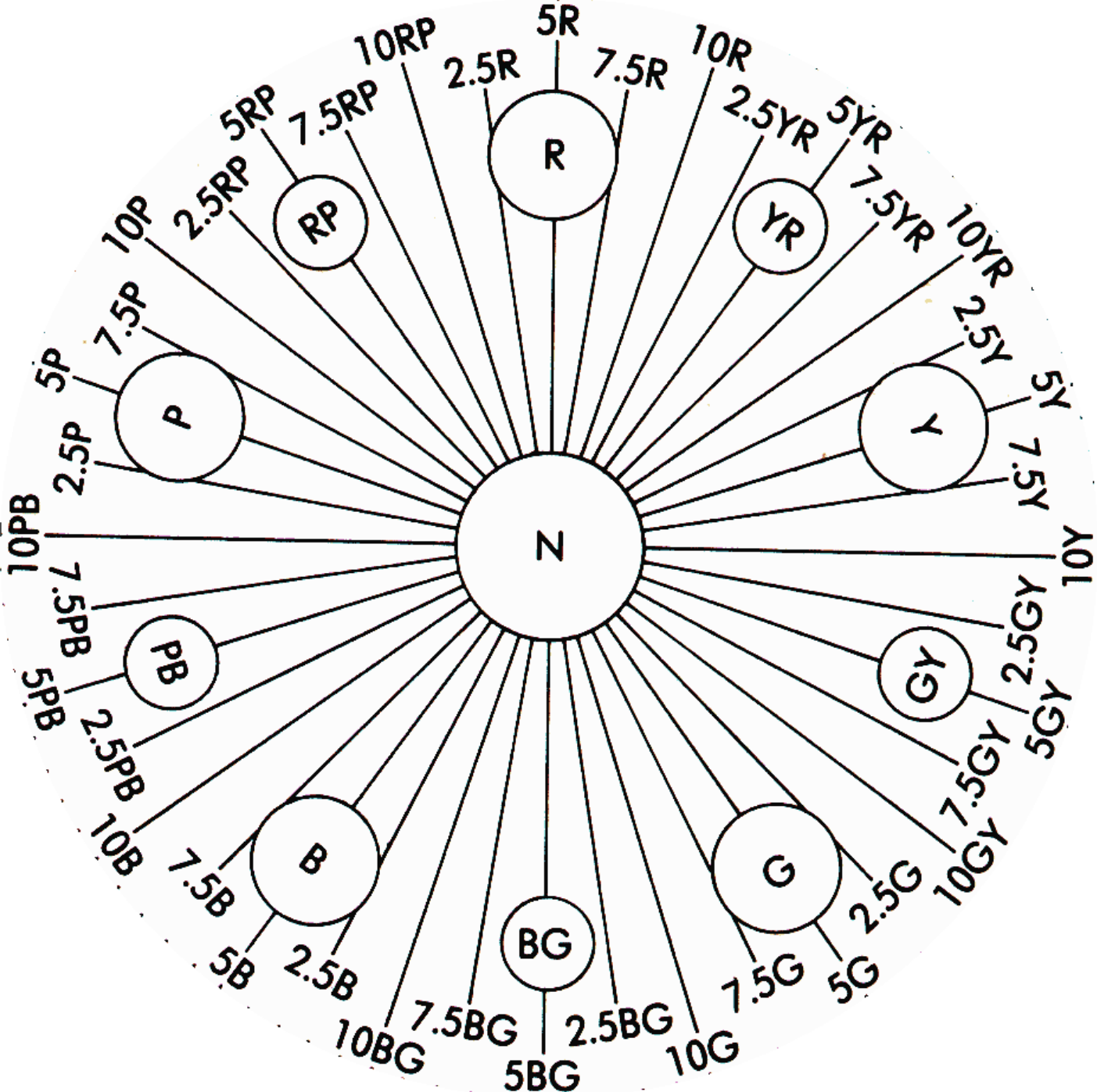
10R5/2



10R5/4

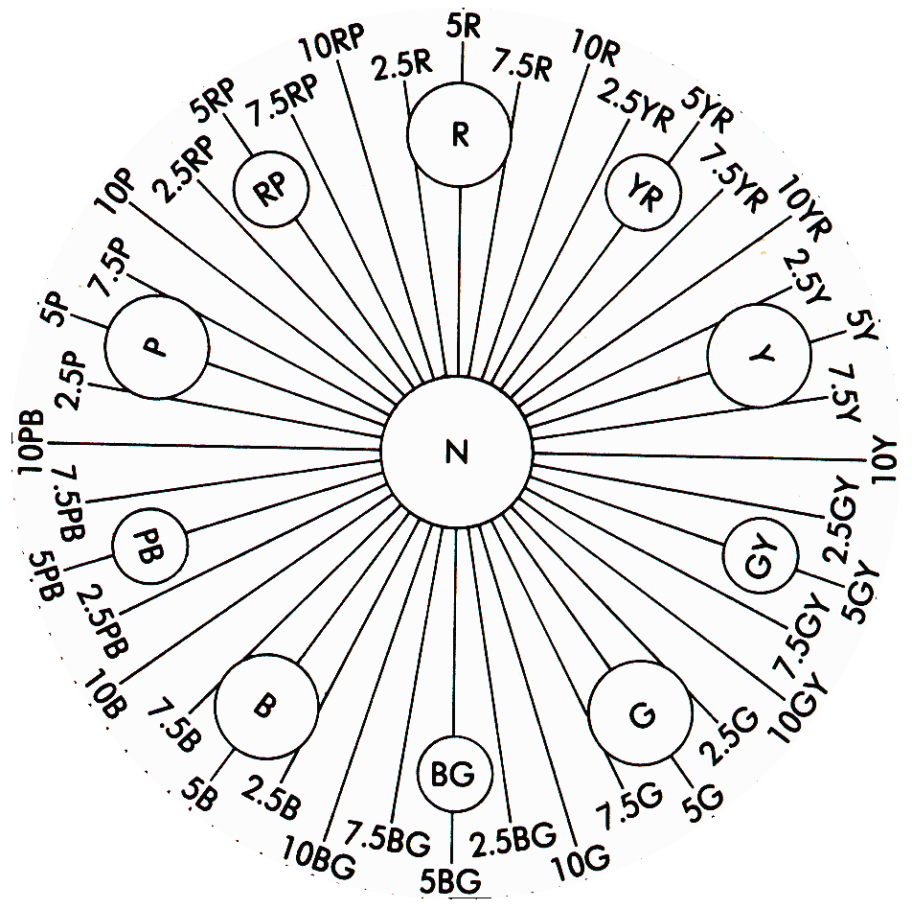


10R5/6

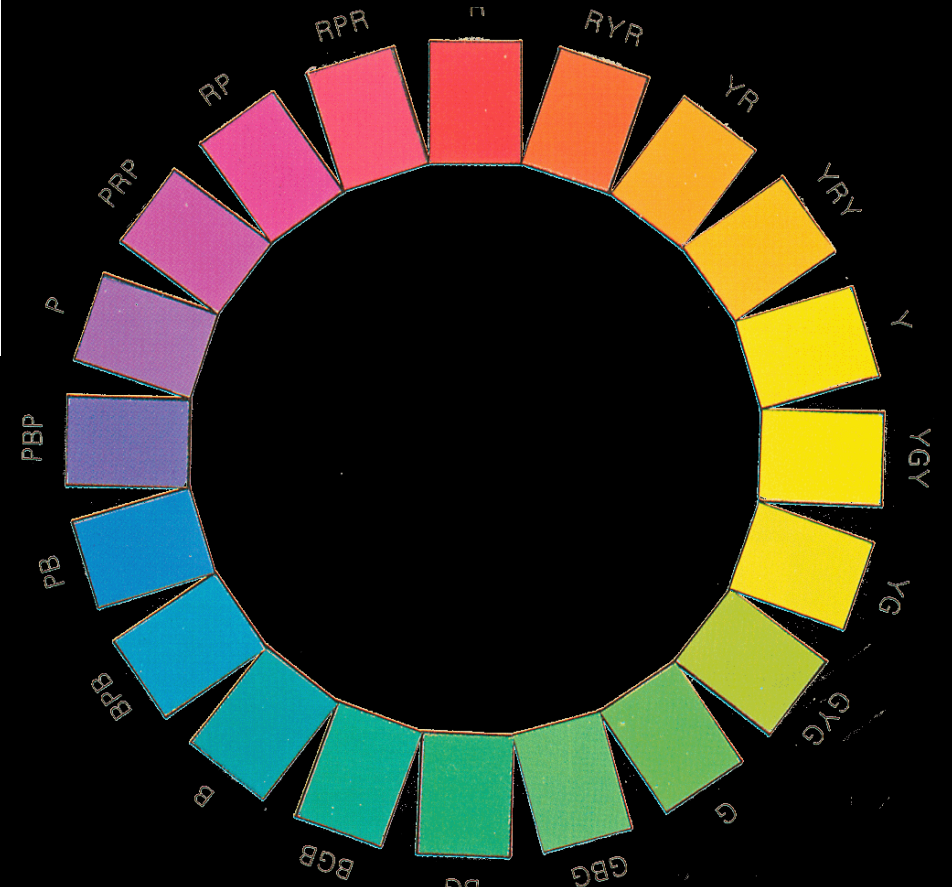


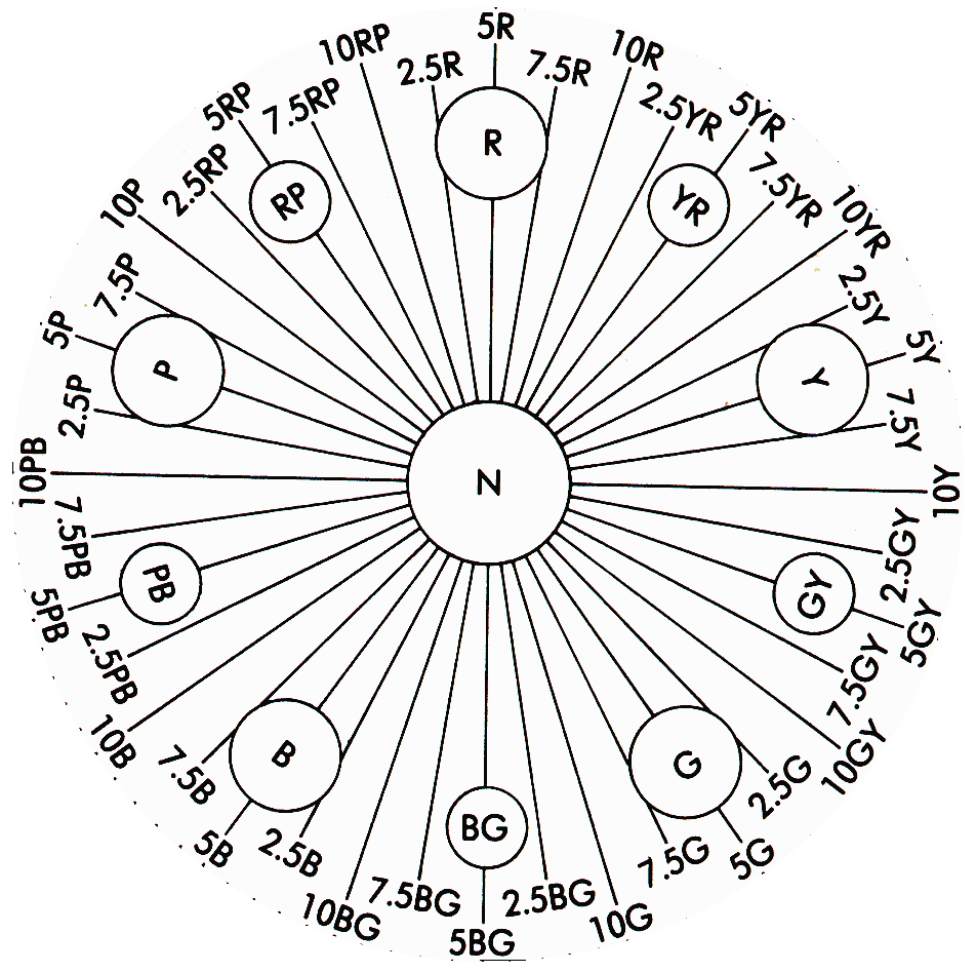
**Munsell 100-hue Circle**  
**A standard color notation system**

5R - "pure" red  
 1R - R-Red  
 Purple  
 10R - R-Red-Orange



- Munsell 100-hue Circle
- relies on 5 primaries (red, yellow, green, blue, and purple) for a broader range of practical color.





## Munsell 100-hue Circle Munsell Color Notation System

5 primaries *and* 5 secondaries make a more *practical* starting point for mixing a full range of color.

Letter-Number (hour-minute?) system describes a particular HUE.

ARTIST COLOR

**GREEN LIGHT, PERMANENT**  
**(Mixture)**

VERT PERMANENT CLAIR  
VERDE CLARO PERMANENTE

OPAQUE



WATER.

# SERIES 2

LIGHTFASTNESS:1

OPAQUE

MUNSELL HUE: 1.2G

VALUE:4.9

CHROMA:10

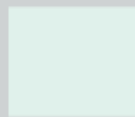
ATIVE HUE:

YG

G  
\*  
⋮

BG

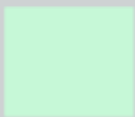




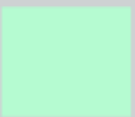
2.5G9/2



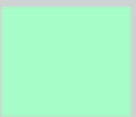
2.5G9/4



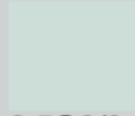
2.5G9/6



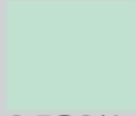
2.5G9/8



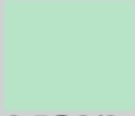
2.5G9/10



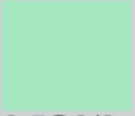
2.5G8/2



2.5G8/4



2.5G8/6



2.5G8/8



2.5G8/10



2.5G8/12



2.5G8/14



2.5G7/2



2.5G7/4



2.5G7/6



2.5G7/8



2.5G7/10



2.5G7/12



2.5G6/2



2.5G6/4



2.5G6/6



2.5G6/8



2.5G6/10



2.5G5/2



2.5G5/4



2.5G5/6



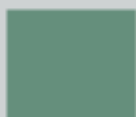
2.5G5/8



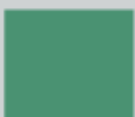
2.5G5/10



2.5G4/2



2.5G4/4



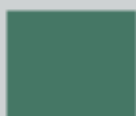
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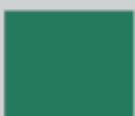
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2.5G3/2



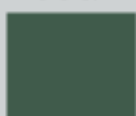
2.5G3/4



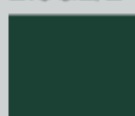
2.5G3/6



2.5G2/2



2.5G2/4



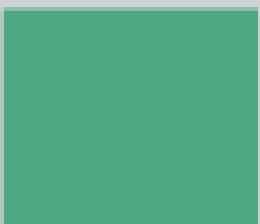
2.5G1/2

2.5G5/6



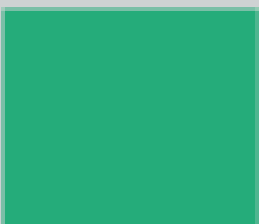
2.5G5/6

2.5G5/8

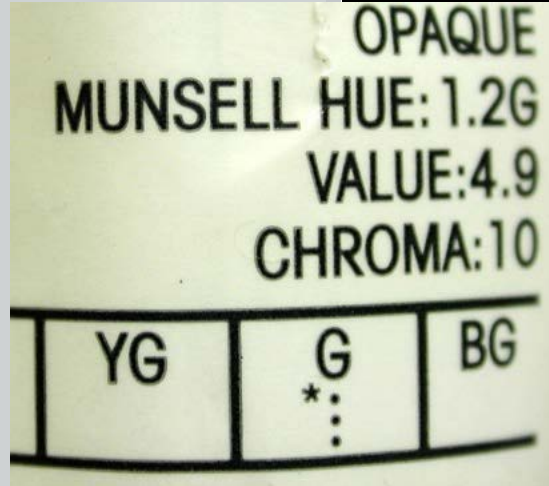


2.5G5/8

2.5G5/10

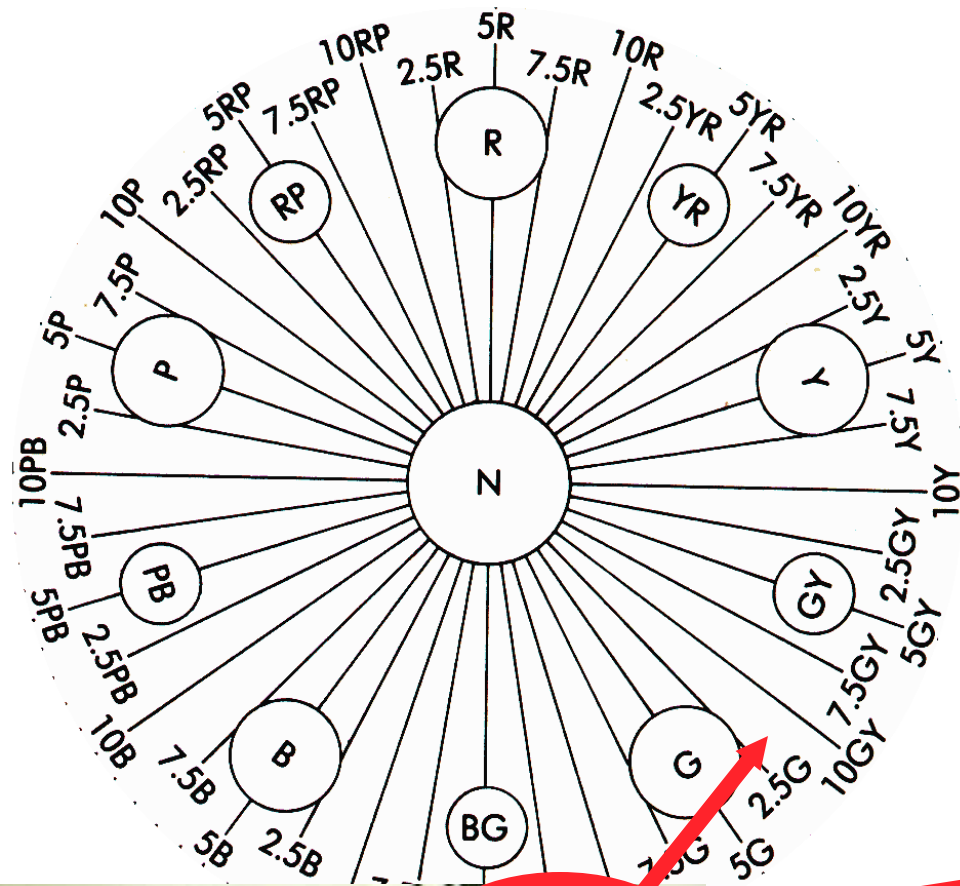


2.5G5/10



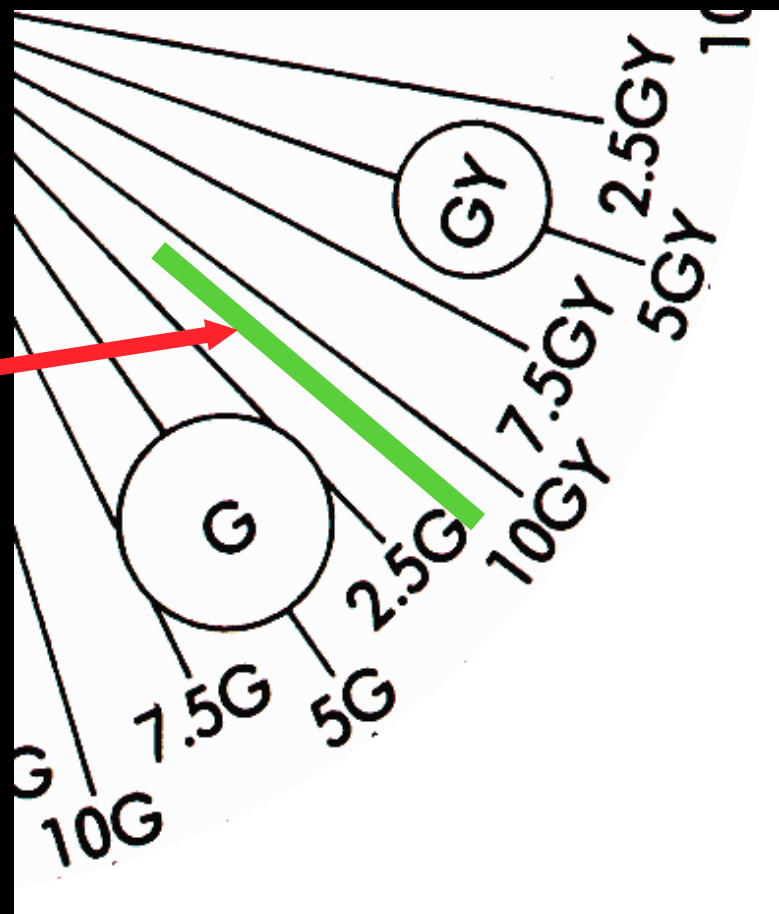
# Munsell Color Notation System

Letter-Number (hour-minute?) system describes a particular HUE.



MUNSELL HUE: 1.2G  
VALUE: 4.9  
CHROMA: 10

YG	G	BG
	*	
	⋮	





# ***Wilhelm Ostwald***

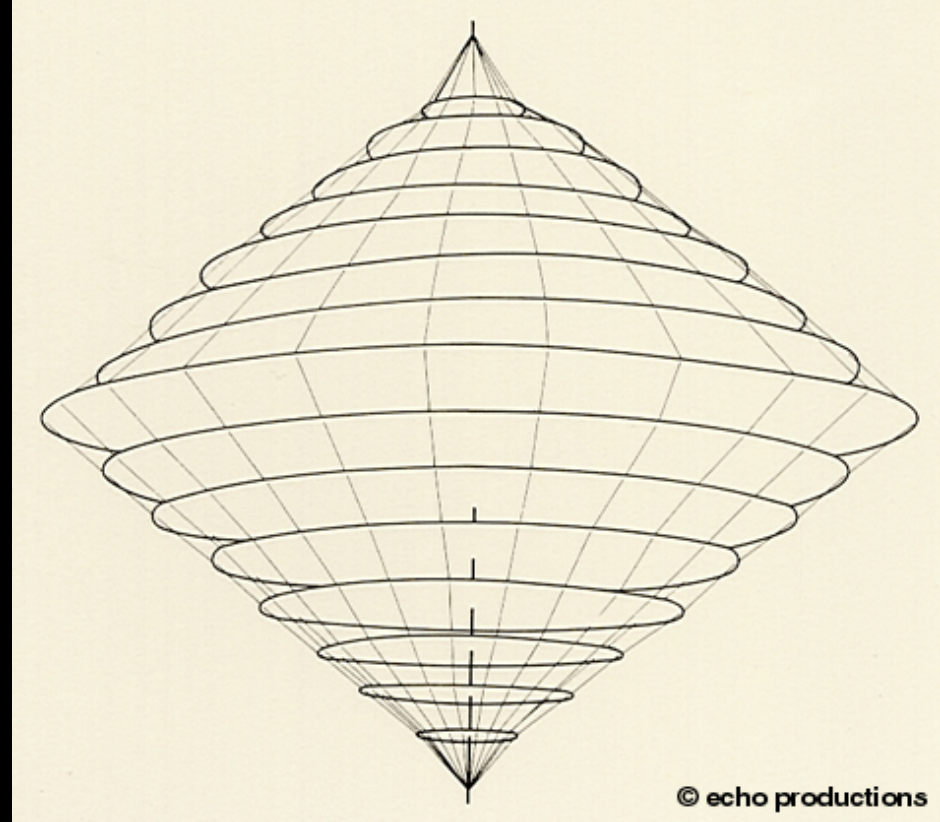
- **German Chemist (1853-1932) (Nobel Prize, 1909)**
- **Color theories based on Hering's work.**
- **Developed a highly technical means of specifying pigmented color.**

# ***Ostwald: organizing color by white/black/value relationships***

- ***Color model based on mathematical steps from black to white***
- ***Uses geometrical progression based on Fechner's observations.***
- ***Explicitly defined and used Tinting, shading, & toning (reducing chroma) by adding black and white.***

# *Wilhelm Ostwald*

- *System considered “too scientific” or formulaic for many art/design applications.*
- *Major influence was among the highly rational Bauhaus school of design.*
- *Useful in printing industry testing.*







Ostwalds  
major hues  
(color-  
content)

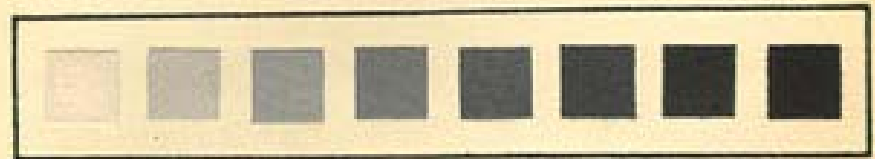
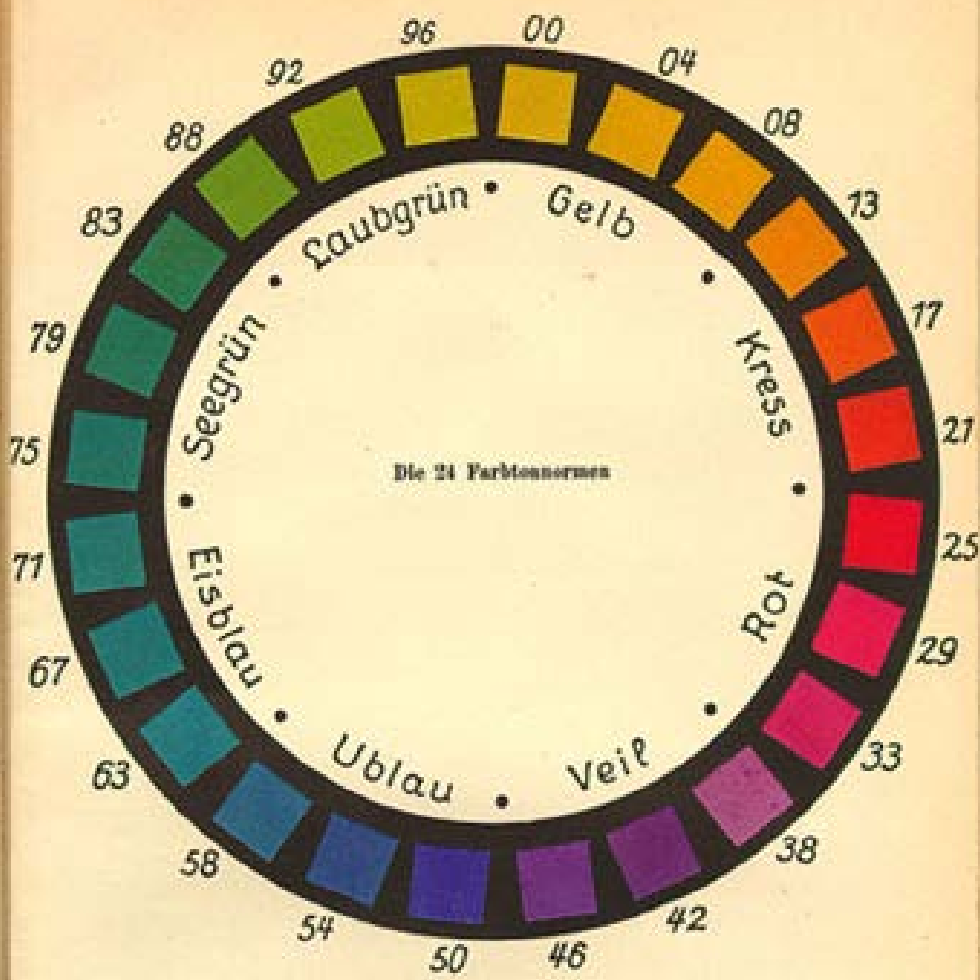
Yellow

Red

Blue

Sea-green  
(GBG)

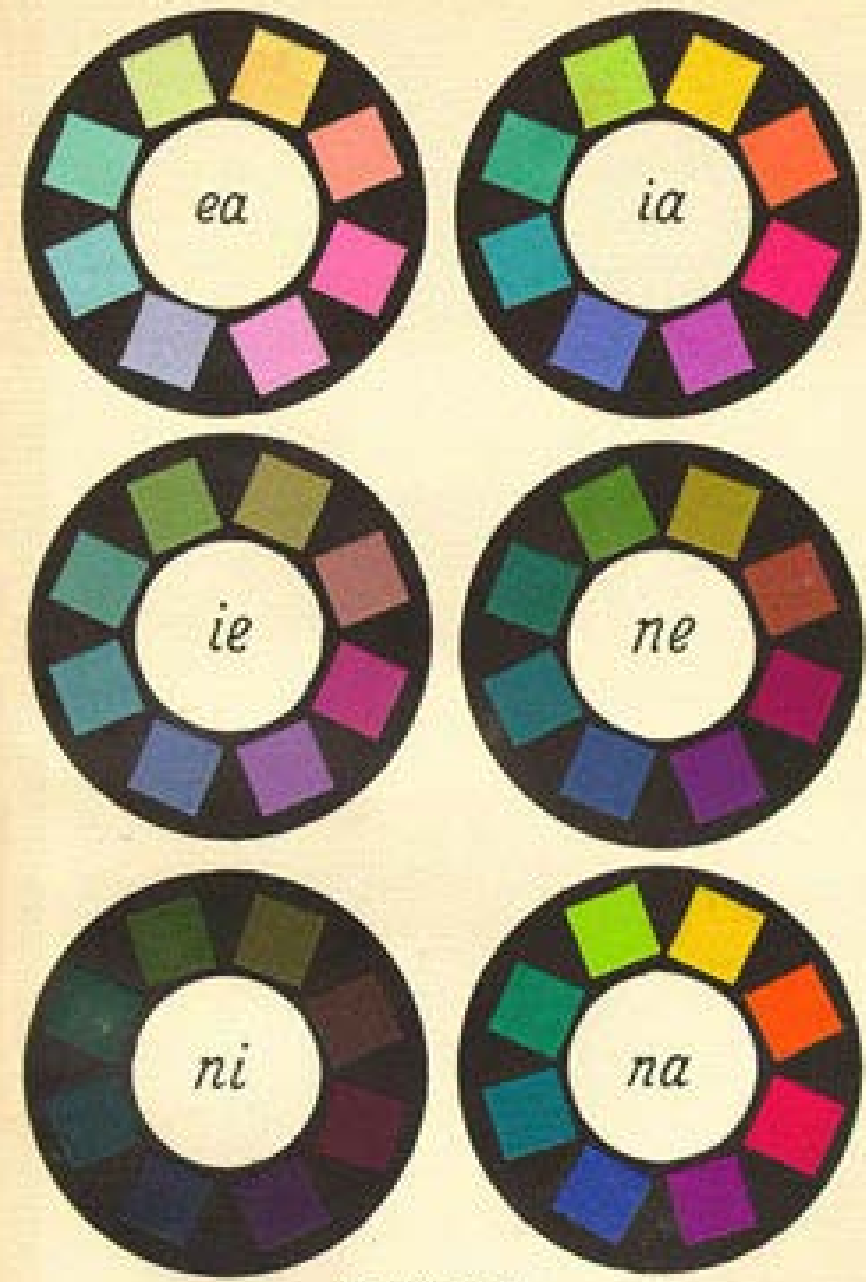




a c e g i l n p

Die achtsten Normen.

(Hergestellt von dem Verlag Unesma, G. m. b. H., Leipzig.)



Wertgleiche Kreise.

(Hergestellt von dem Verlag Unesma, G. m. b. H., Leipzig.)





## *Ostwald*

- ***harmony:***  
***any colors that have the same hue, white content, and black content will be harmonious, regardless of value differences.***

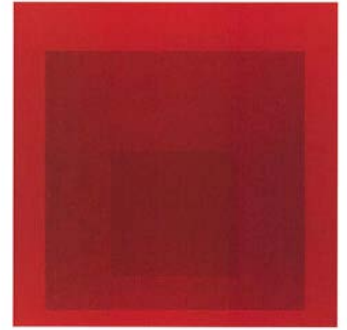
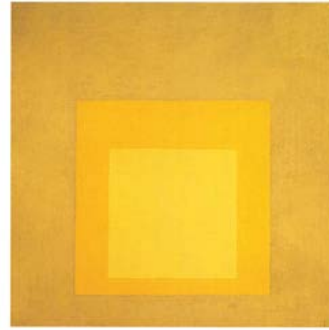
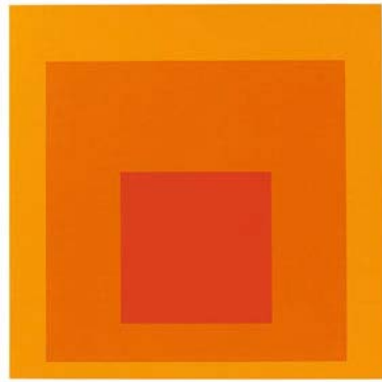
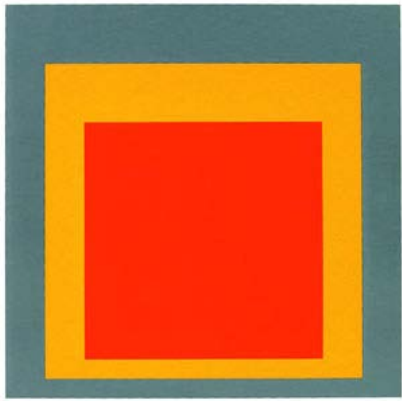


## *Ostwald*

- ***Also renowned for exploring fuel cell technologies – which are only now being considered for mass-production in electric-powered automobiles.***

# Frans Gerritsen

- ***Wrote *Evolution in Color* (1982)***
- ***Classifies four types of color theories:***
- ***Color as an ordering of light and dark. (Aristotle)***
- ***Opponent systems, emphasizing primary hues and complementary pairs. (Hering)***
- ***Systems based on physical mixing characteristics.***
- ***Color systems based on color perception (Maxwell, CIE, & Gerritsen)***
- ***Gerritsen contends that RGB additive color is the best guide for color-theoretical systems.***

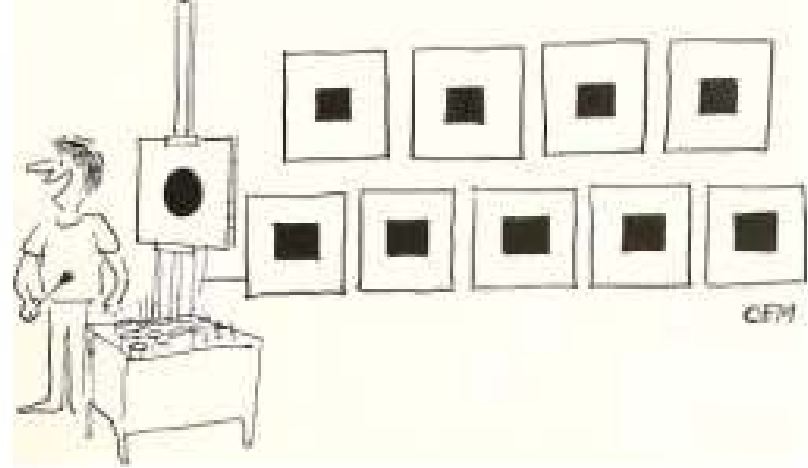
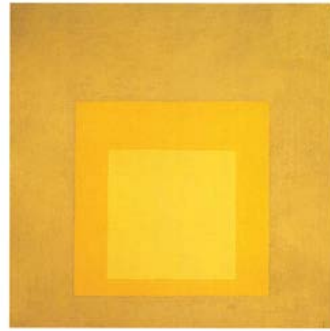


# *Josef Albers*

- *artist/designer/educator*
- Associated with the Bauhaus School in Weimar, Germany.
- German-born American Abstract Painter and Designer, 1888-1976
- Founding member of the American Abstract Artists group, 1936.







# Josef Albers

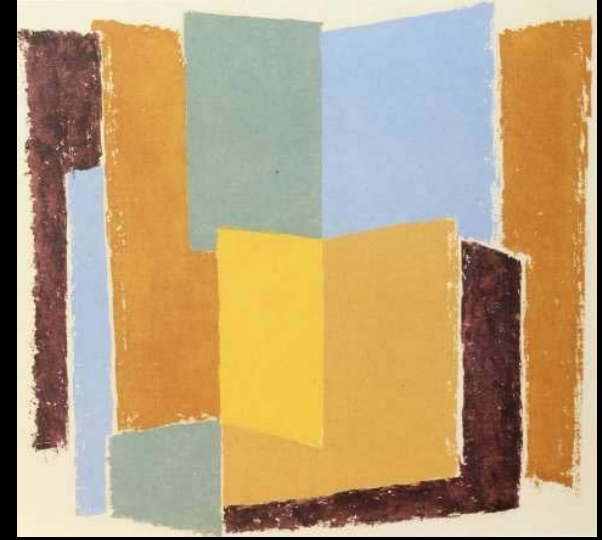
- *"He did not teach painting, but seeing:*

*not art,  
but the psychology and  
philosophy of art."*

*noted art historian Werner Spies*



Self-Portrait, ca. 1915 Oil on canvas



# Joseph Albers

- *“Josef Albers was the sum of many parts: painter, designer, teacher, theoretician.”*
- *The first of several Bauhaus faculty members to come to America after that school closed in 1933, he came to Black Mountain College, near Asheville, North Carolina, to assume the position of professor of art.*
- *There he taught with his wife Anni Albers, the distinguished weaver and herself a Bauhaus graduate, and developed a curriculum that revolutionized art education in America.”*





# Bauhaus

Weimar & Berlin Germany, 1919-1933

“The Bauhaus was founded in 1919 in the city of Weimar by German architect Walter Gropius (1883–1969).

Its core objective was a radical concept: to *reimagine the material world to reflect the unity of all the arts.*

Gropius explained this vision for a union of art and design in the *Proclamation of the Bauhaus* (1919), which described a utopian craft guild combining architecture, sculpture, and painting into a single creative expression.

Gropius developed a *craft-based curriculum* that would turn out artisans and designers capable of creating useful and beautiful objects appropriate to this new system of living.”

[http://www.metmuseum.org/toah/hd/bauh/hd\\_bauh.htm](http://www.metmuseum.org/toah/hd/bauh/hd_bauh.htm)







# Bauhaus

Weimar & Berlin Germany, 1919-1933

- “The nucleus of Bauhaus teaching was the principle that the architect, painter or sculptor should be soundly *trained as a craftsman*. To that end, the school was to be a practical workshop for design with emphasis placed on *the study and use of materials*.”

Preface Josef Albers: *A Retrospective* 1988

- “Following their immersion in Bauhaus theory, students entered specialized workshops, which included metalworking, cabinetmaking, weaving, pottery, typography, and wall painting.

...stressing the importance of *designing for mass production*. It was at this time that the school adopted the slogan "*Art into Industry*.”

[http://www.metmuseum.org/toah/hd/bauh/hd\\_bauh.htm](http://www.metmuseum.org/toah/hd/bauh/hd_bauh.htm)



Albers – Stacking Tables





# *Bauhaus*

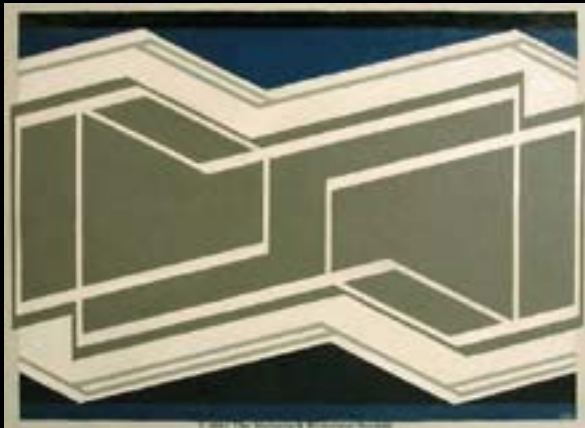
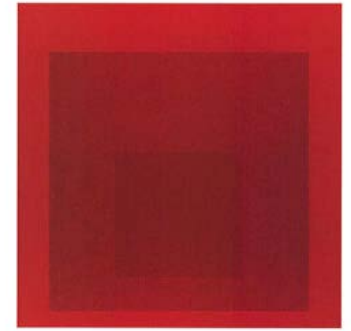
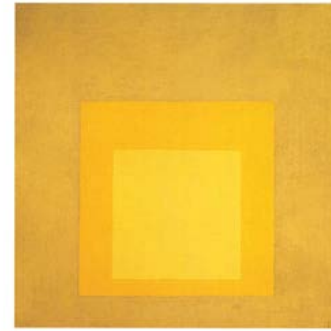
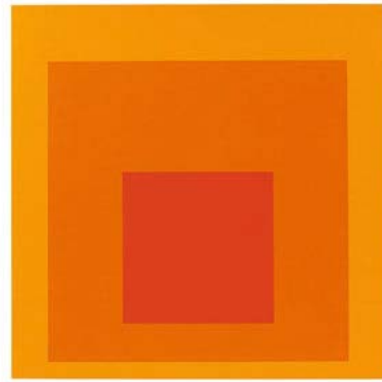
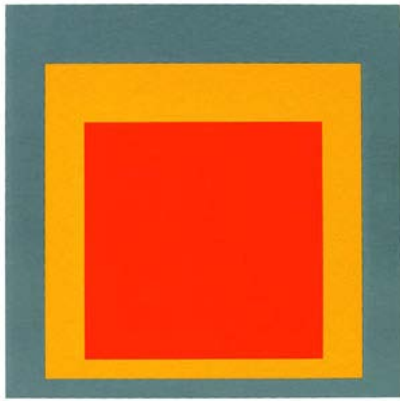
*Escaping Nazi oppression...to the U.S.*

“During the turbulent and often dangerous years of World War II, many of the key figures of the Bauhaus emigrated to the United States, where their work and their teaching philosophies influenced generations of young architects and designers.

Marcel Breuer and Josef Albers taught at Yale, Walter Gropius went to Harvard, and Moholy-Nagy established the New Bauhaus in Chicago in 1937.”

[http://www.metmuseum.org/toah/hd/bauh/hd\\_bauh.htm](http://www.metmuseum.org/toah/hd/bauh/hd_bauh.htm)

Mies van der Rohe developed the curriculum for architects at the Illinois Institute of Technology (IIT) and completed a wide variety of International Style buildings in the Chicago area.



# Joseph Albers

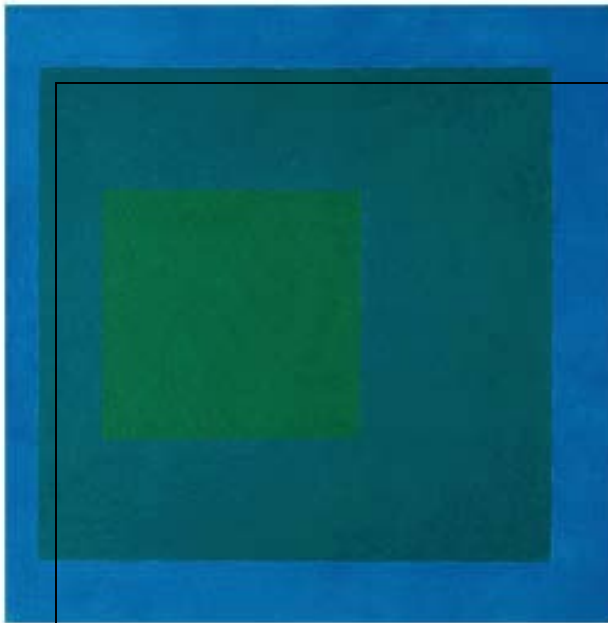
- Known for his series of paintings: **Homage to the Square**

*These paintings and prints were not 'about squares' so much as about color relationships of depth and of contrast. These extensive studies of color contrast were the means of his exploration of color perception and color harmony.*

*Explored color-transparency illusions based on degrees of contrast.*

1919, 33yrs





Study for Homage to the Square: Beaming  
JOSEF ALBERS

## ***Josef Albers on the variability of color perception.***

- ***“Change is a result of influence...***
- ***...optical illusions deceive. They lead us to “see” and to “read” other colors than those with which we are confronted physically.***
- ***...certain colors are hard to change...***
- ***We try to find those colors which are more inclined to exert influence and to distinguish them from those which will accept influence.”***

*Joseph Albers,*

*The Interaction of Color,*

*1975*







# ***Josef Albers on the variability of color perception.***

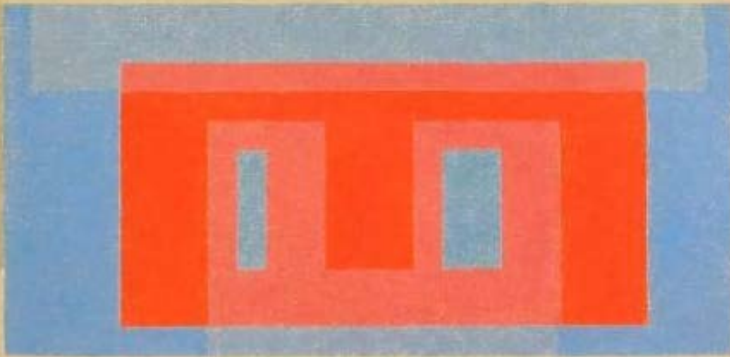
***“...clear reading (of color) depends upon the recognition of context.***

***In musical compositions, so long as we hear merely single tones, we do not hear music. Hearing music depends on the recognition of the in-between of the tones, of their placing and of their spacing.***

***In writing, a knowledge of spelling has nothing to do with an understanding of poetry.***

***Equally, a factual identification of colors within a given painting has nothing to do with a sensitive seeing nor with an understanding of the color action within the painting.”***

*Joseph Albers, The Interaction of Color, 1975*



# *Josef Albers on the variability of color perception.*

*“Our concern is the interaction of color; that is, seeing what happens between colors.*

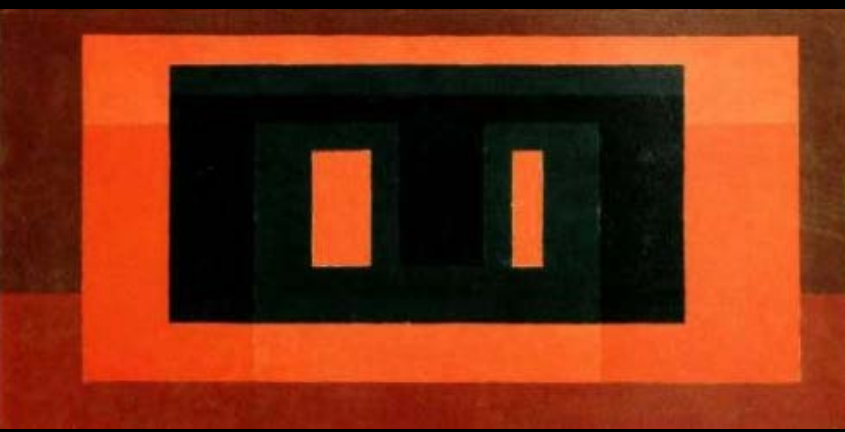
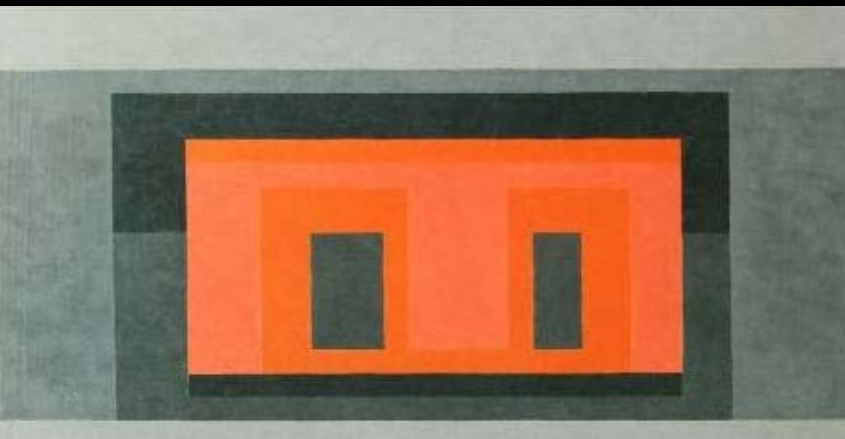
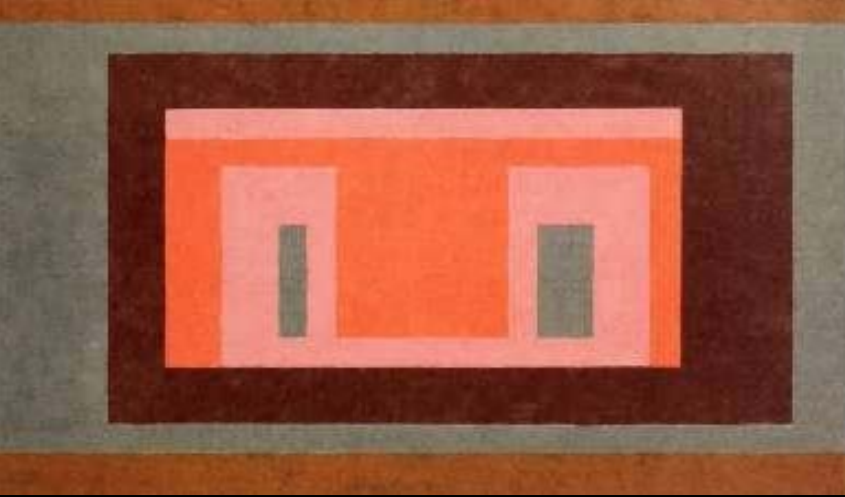
*... We are able to hear a single tone. But we almost never ... see a single color unconnected and unrelated to other colors.*

*Colors present themselves in continuous flux, constantly related to changing neighbors and changing conditions.*

*Joseph Albers, The Interaction of Color, 1975*



1929, 43 yrs

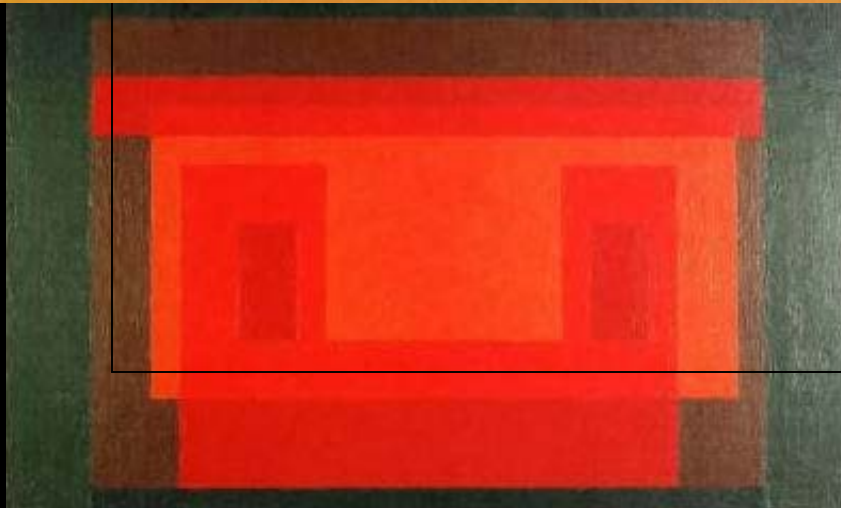
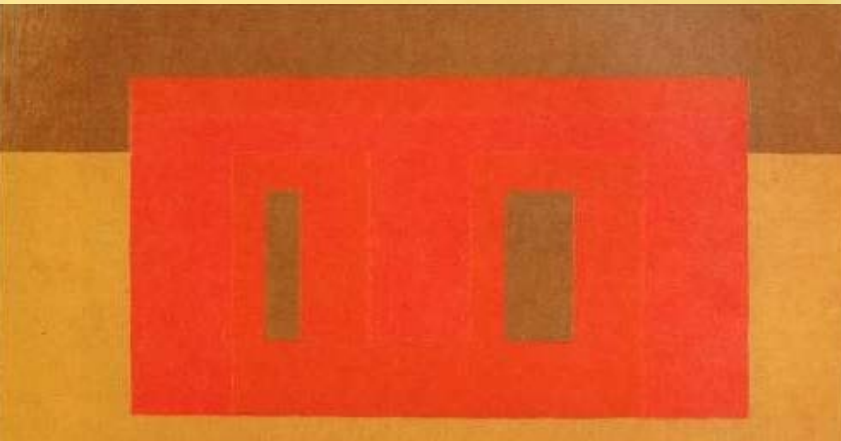


# ***Josef Albers on the variability of color perception.***

***“As a consequence, this proves for the reading of color what Kandinsky often demanded for the reading of art: what counts is not the what but the how.”***

***In visual perception a color is almost never seen as it really is – as it physically is. This fact makes color the most relative medium in art.”***

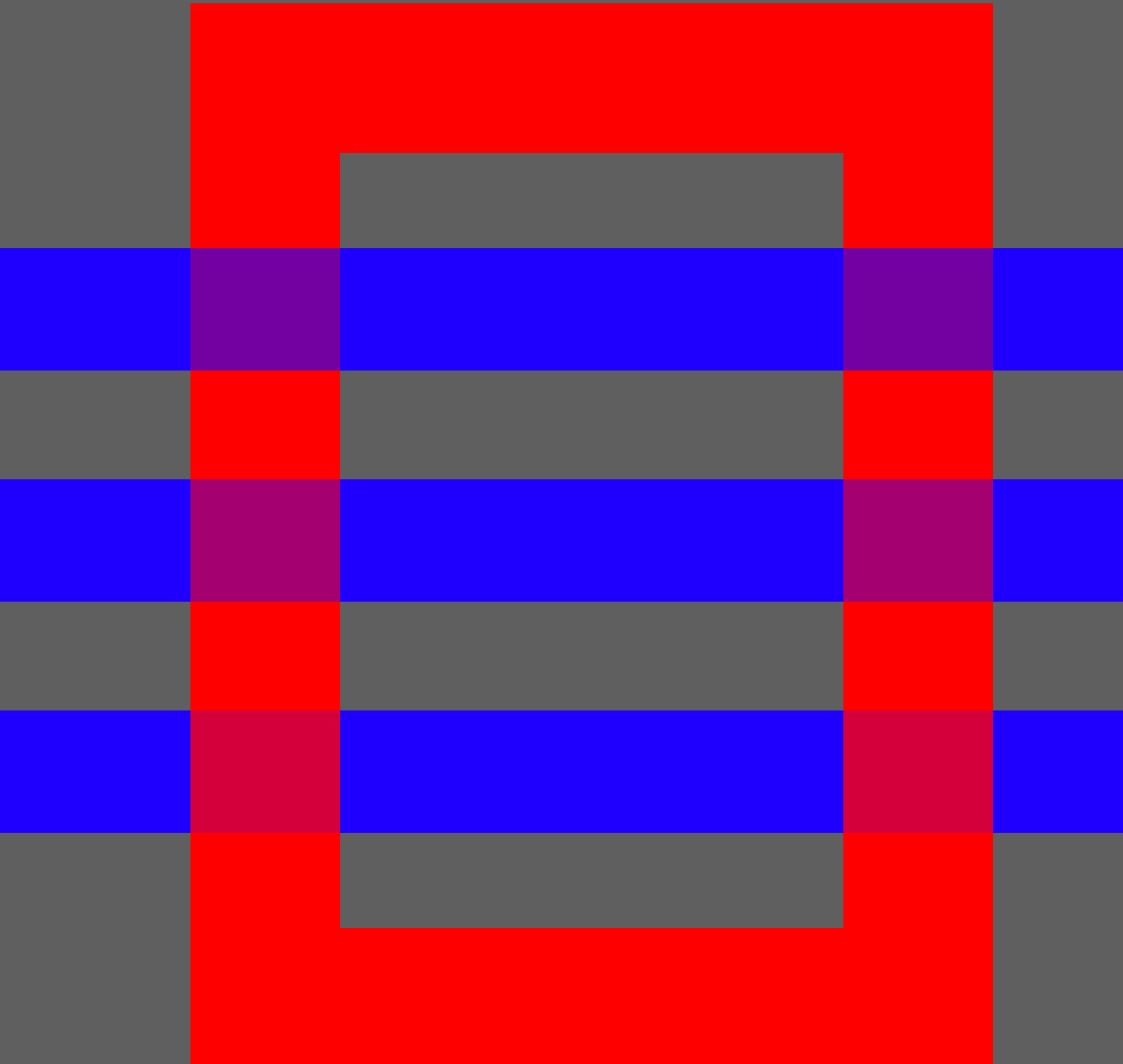
*Josef Albers,  
The Interaction of Color,  
1975*







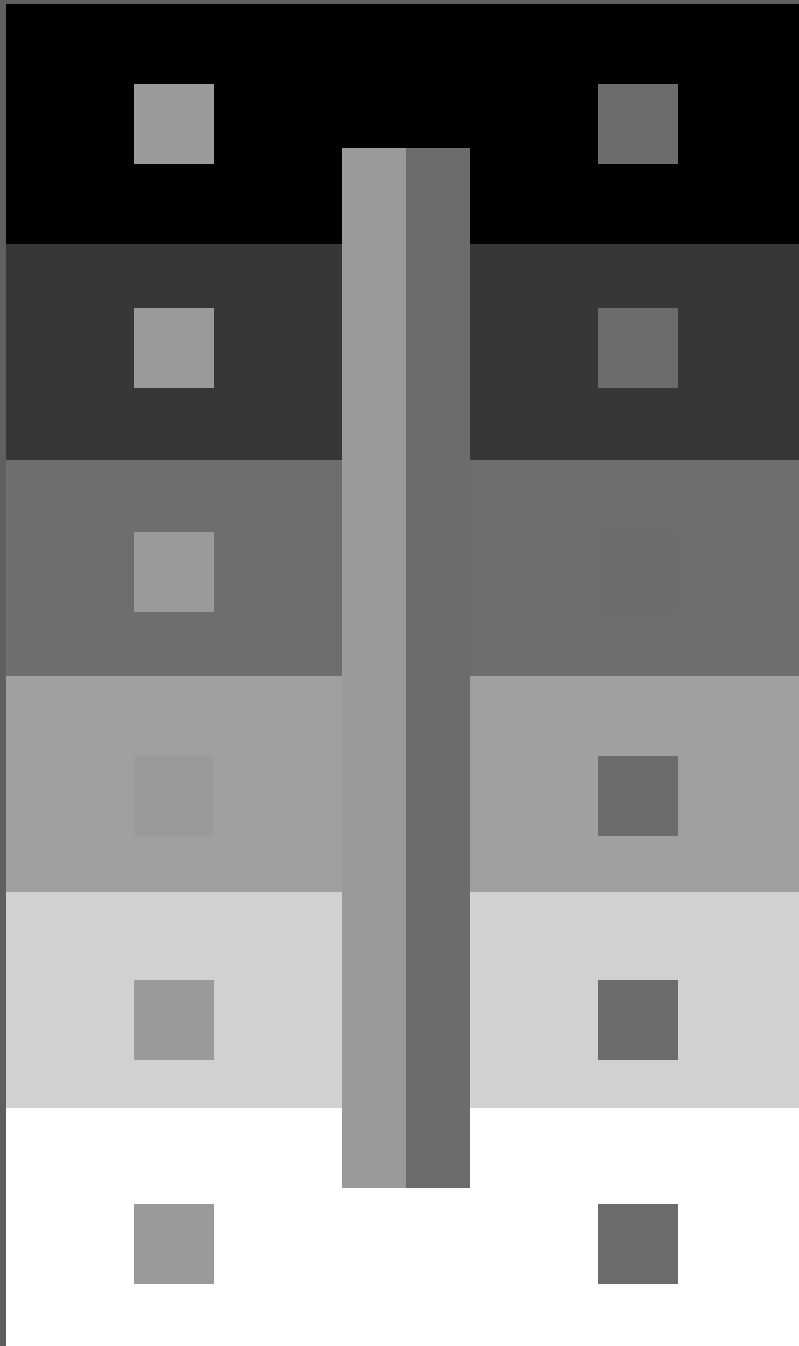
*Josef Albers-  
transparency study*



- The illusion of ‘thickness’ and/or transparency is altered by the similarity of the overlapping color to the two intersecting forms.

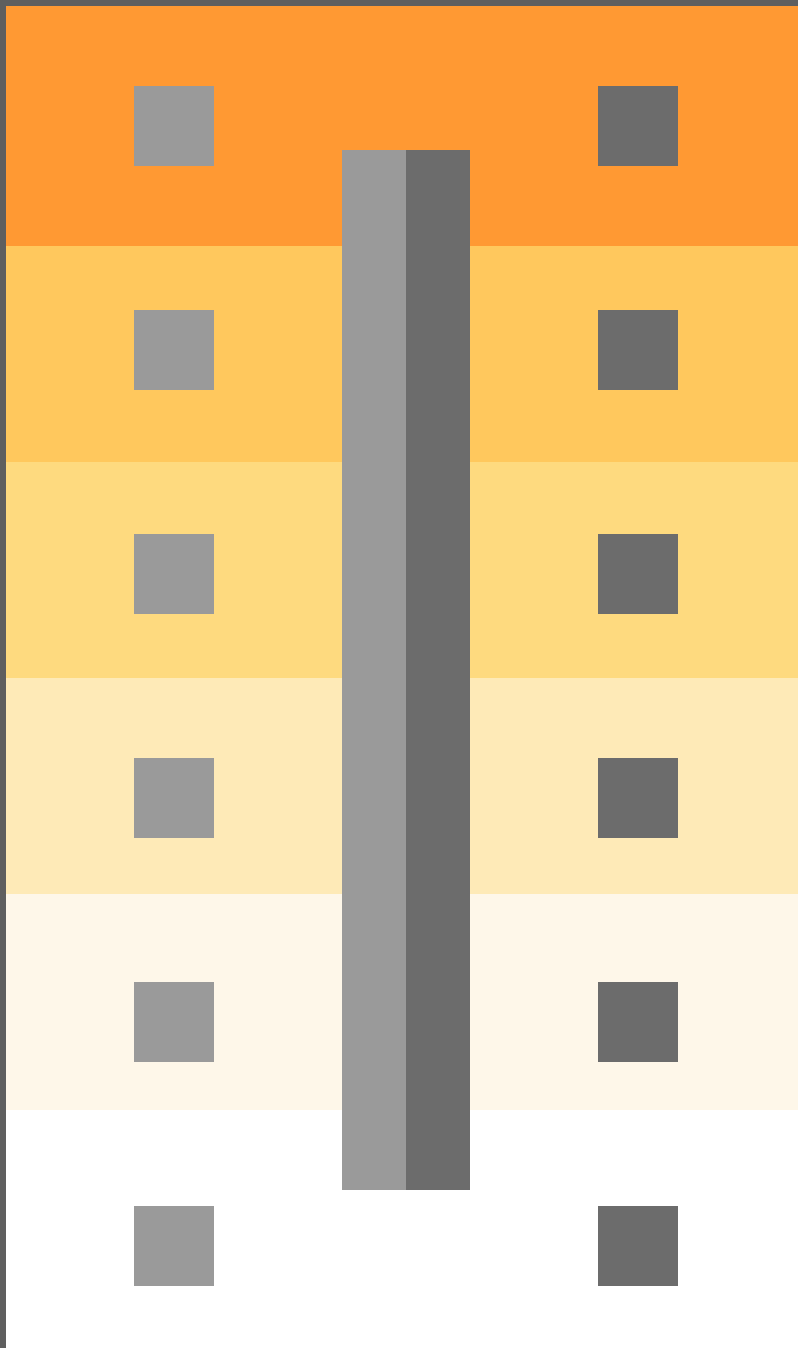
Which shape appears to be on top?

- How does color effect that illusion?



*Josef Albers-  
value variability*

- “This instability of value is extremely characteristic of color. Resulting from the afterimage, a light grey, for instance, may look dark at one time and almost white at another, and at various times like a shade or a tint of any color, as green may look reddish.

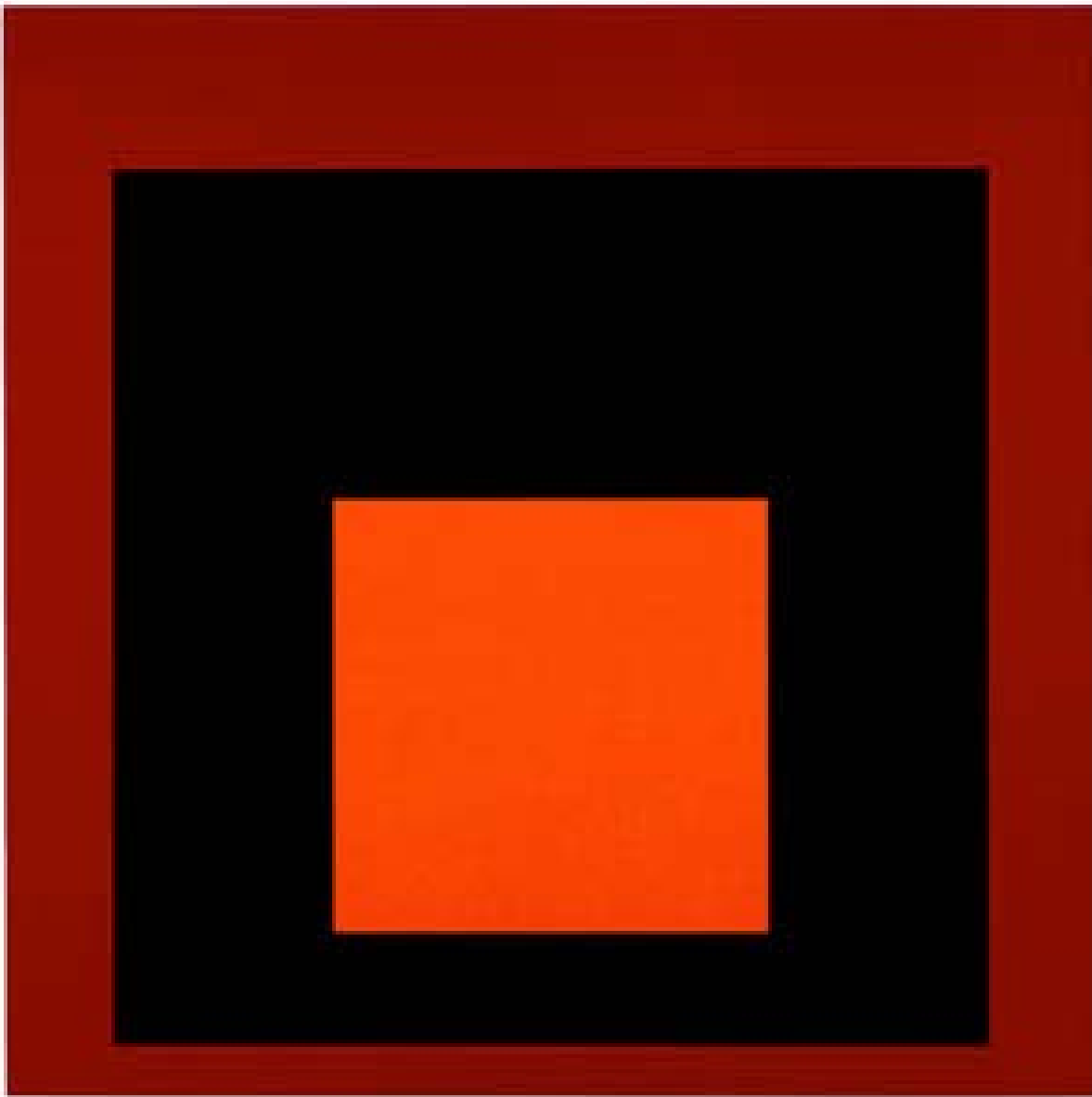


*Josef Albers-  
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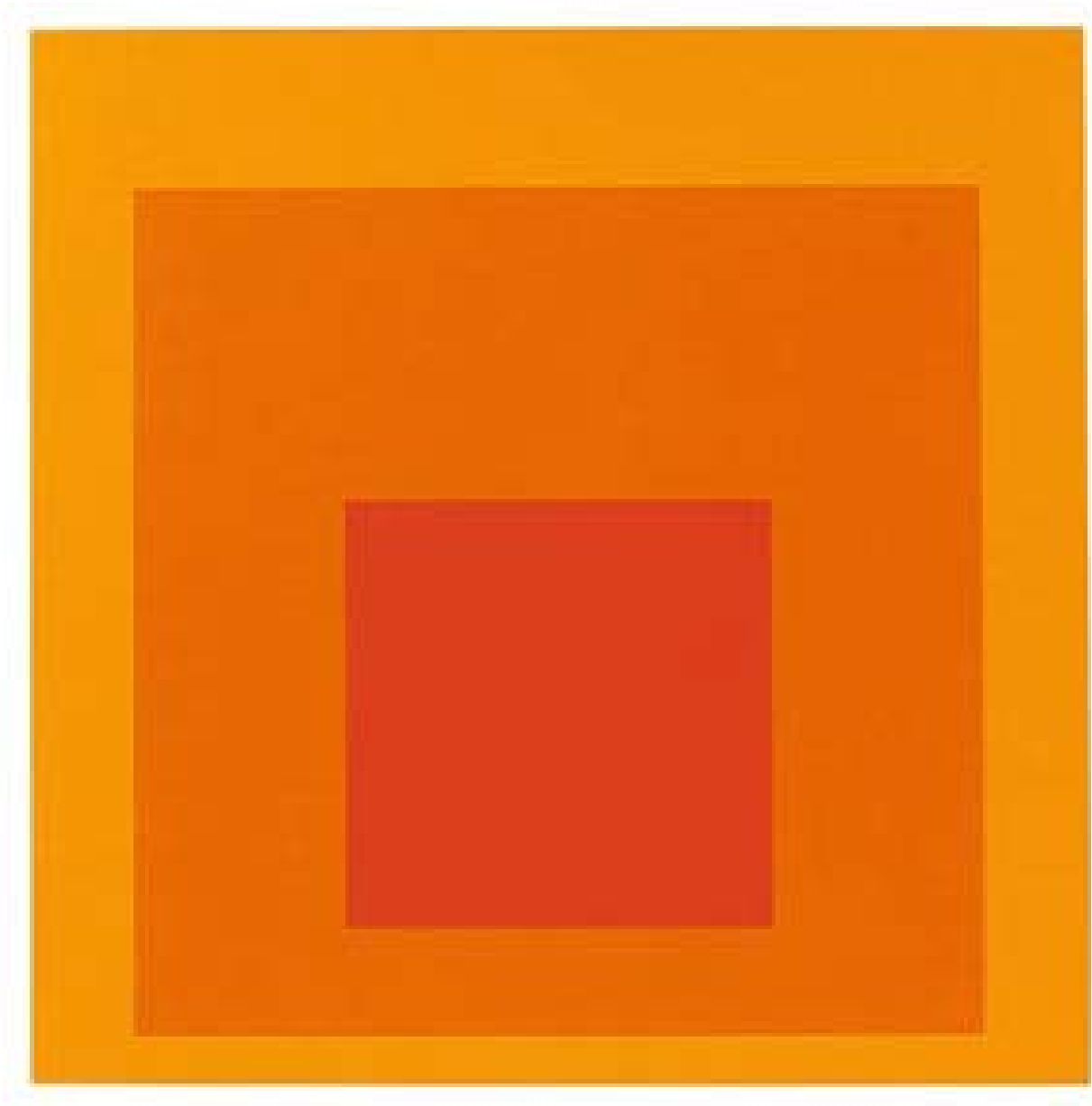


***Albers***



***Albers***





***Albers***



***Albers***



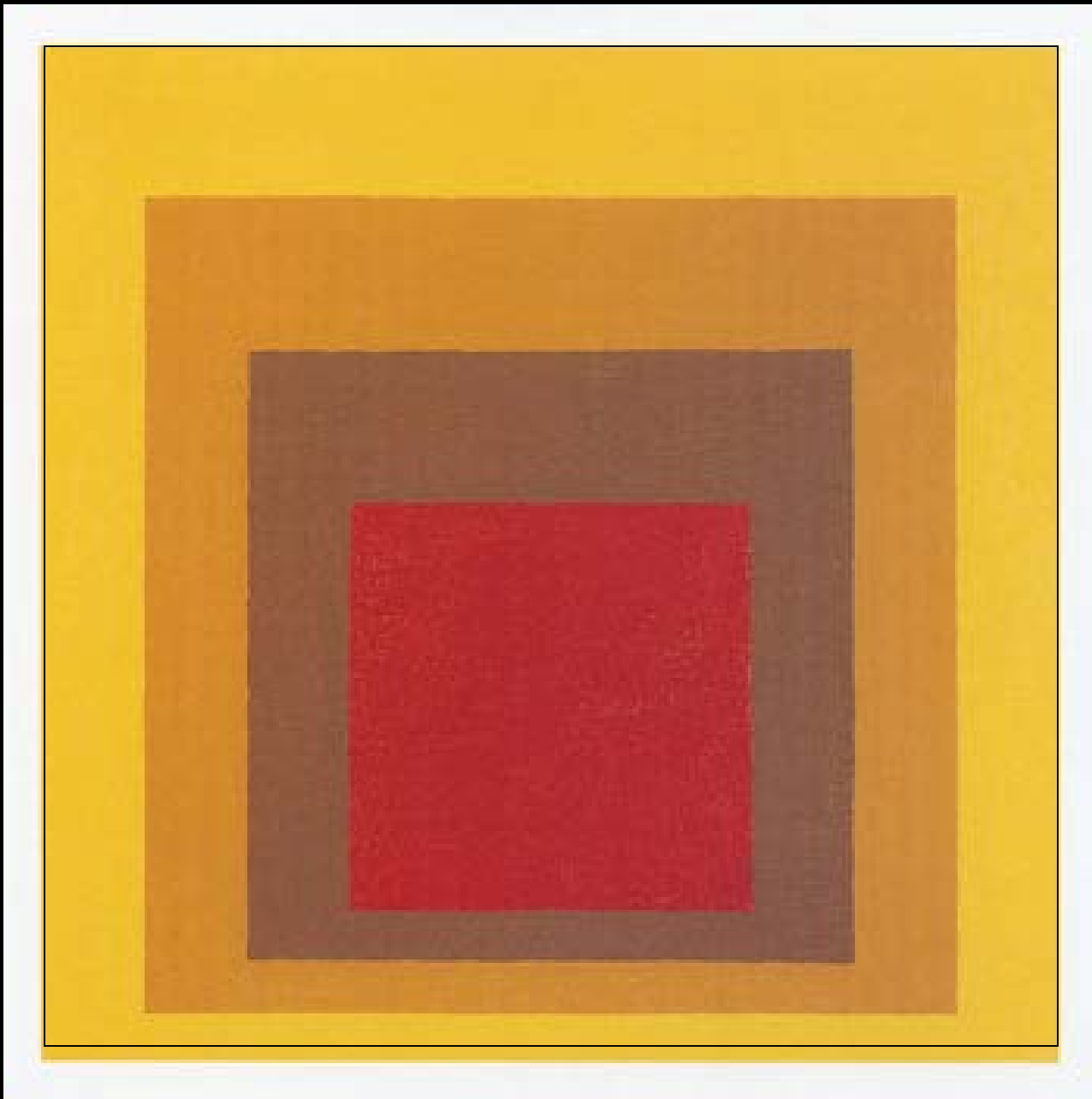
***Albers***



***Albers***



***Albers***

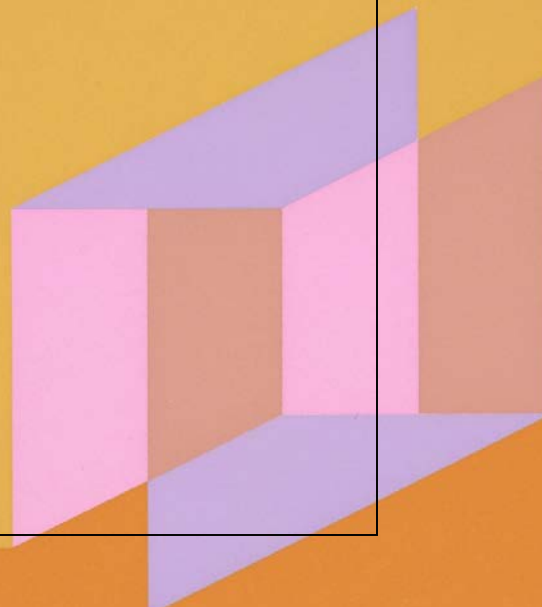
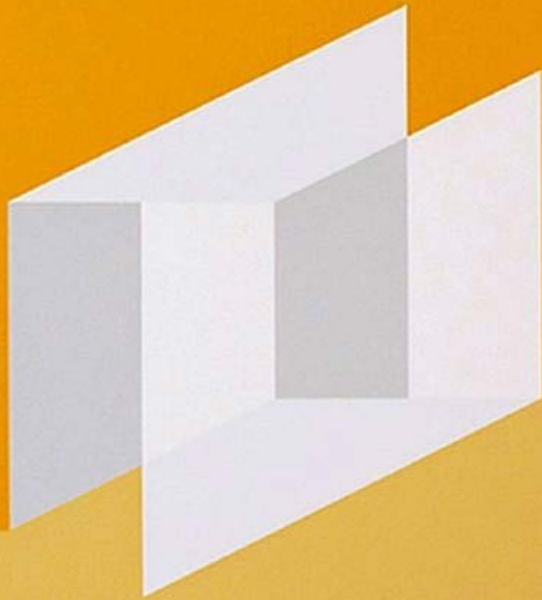


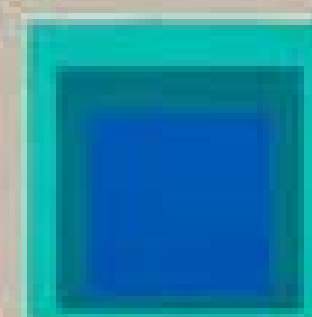
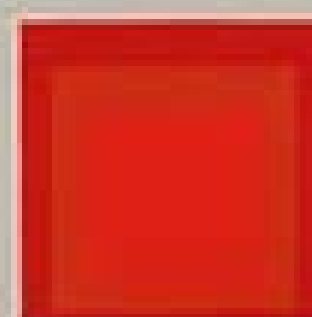
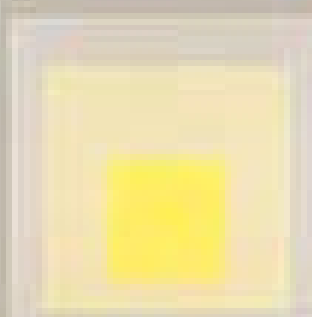
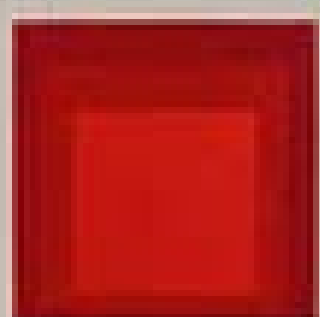
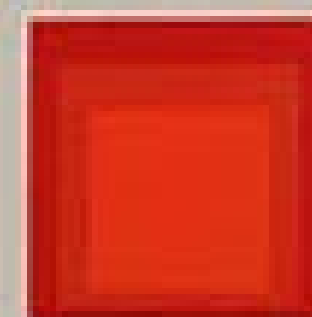
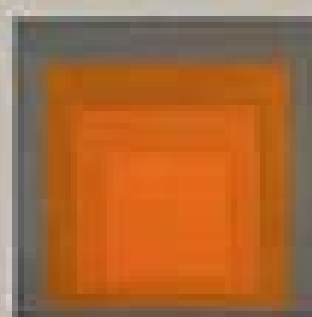
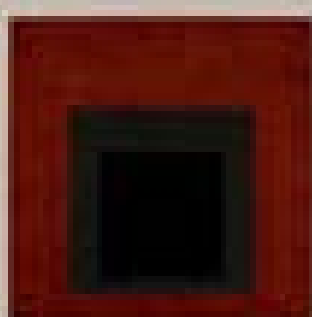
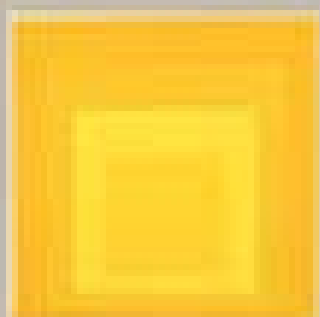
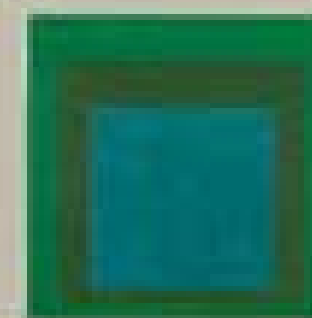
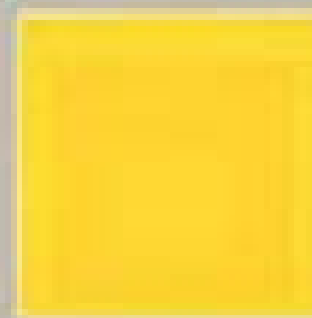
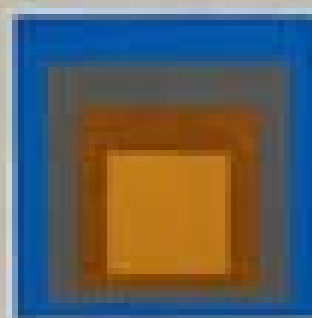
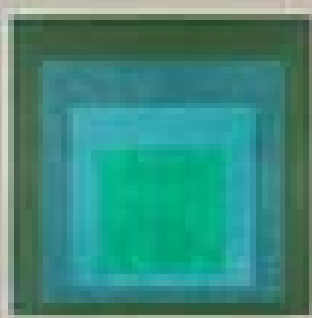
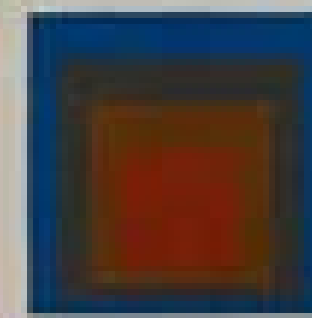
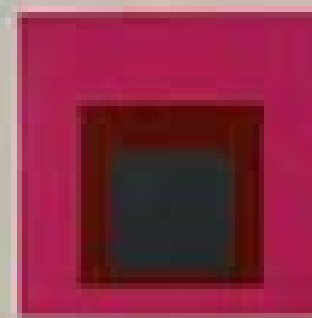
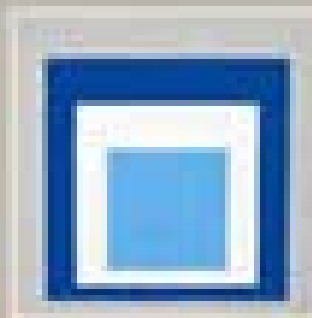
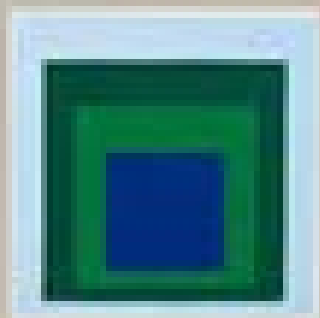
*Albers*



# Josef Albers

- *Albers recognized that we perceive 2D patterns of light and color, yet our minds actively and even aggressively work to construct an interpretation of 3D mass, space and planes.*
- *He shifts color relationships to both evoke a sense of depth, and to confound it.*

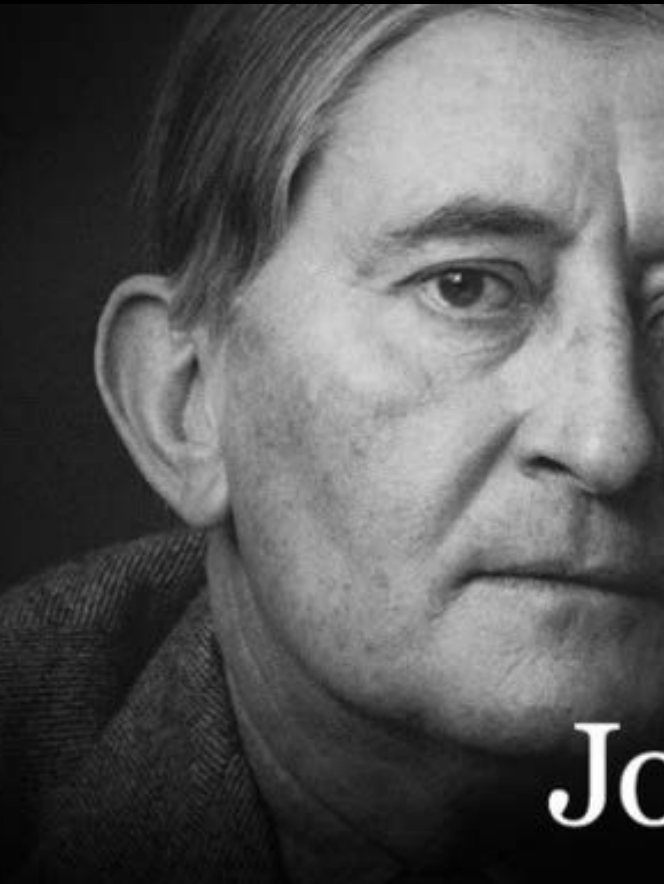




# Josef Albers

- **Interactive demo of Albers/Itten concepts:**  
<http://www.cs.brown.edu/courses/cs092/VA10/HTML/AlbersExplanation.html>
- Links on color topics: <http://www.cs.brown.edu/courses/cs092/VA10/HTML/links.html#Albers>

(several links are broken...applets of not so great)



Good teaching is more a giving of  
right questions than a giving of right  
answers.

— Josef Albers —

# *Faber Birren*

- Artist/Painter/Color Theorist
- Explored principles of harmony.

# ***General Limitations***

- ***No single color system is considered adequate for all color concerns.***
- ***Each theory, each system, each color model has strengths and weakness.***
- ***The theory must be selected according to the tasks to be accomplished.***  
***(e.g. are you working with light, with pigment, with digital specs?)***

# ***More Recently Emphasis has included...***

- ***...a scientific understanding of the physics of light and color perception.***
- ***...international standardization of colors. (Commission International D' Eclairage – CIE – 1931)***

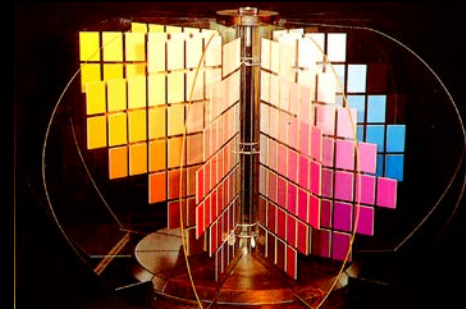
# *Highlights*

- *Goethe--colored shadows*
- *Rood--reliable complementaries, optical mixing*
- *Munsell -- pigment specification system and 3d color model*
- *Chevreul--simultaneous contrast, optical mixing.*
- *Ostwald--printing industry testing*



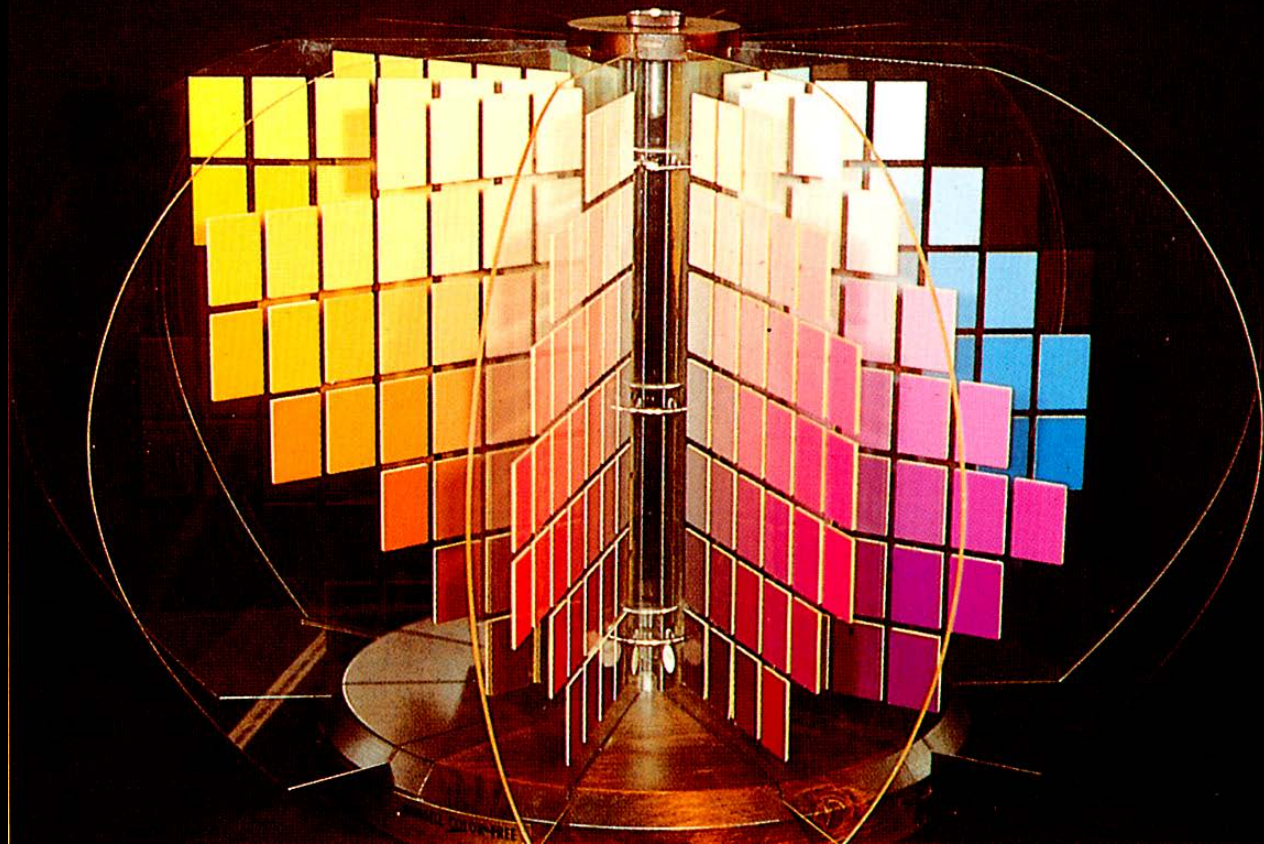
# *Useful Results?*

- *For 2500 years scientists, artists and philosophers have studied and considered the phenomenon and the experience of color.*
- *What have we got so far?*
- *What remains to be understood?*



# *The Most Useful Result?*

- *The color wheel(s) & color solids -- theoretical models of color relationships.*



# *What did they contribute?*

- *They observed how color behaves, they speculated on why it behaves that way, and they posed theories and created models to explain how.*
- *A color scheme is a very basic color theory—it aims to anticipate what colors might harmonize.*

# *What did they contribute?*

- *We now have ways of describing color (color notation systems),*
- *...ways of conceiving color relationships (color models),*
- *...and theories of perception, composition, and meaning.*
- *None are complete, none are universal. Each serves a purpose or prompts insights.*