

Color theories through 1800

CS 48N, Winter 2011

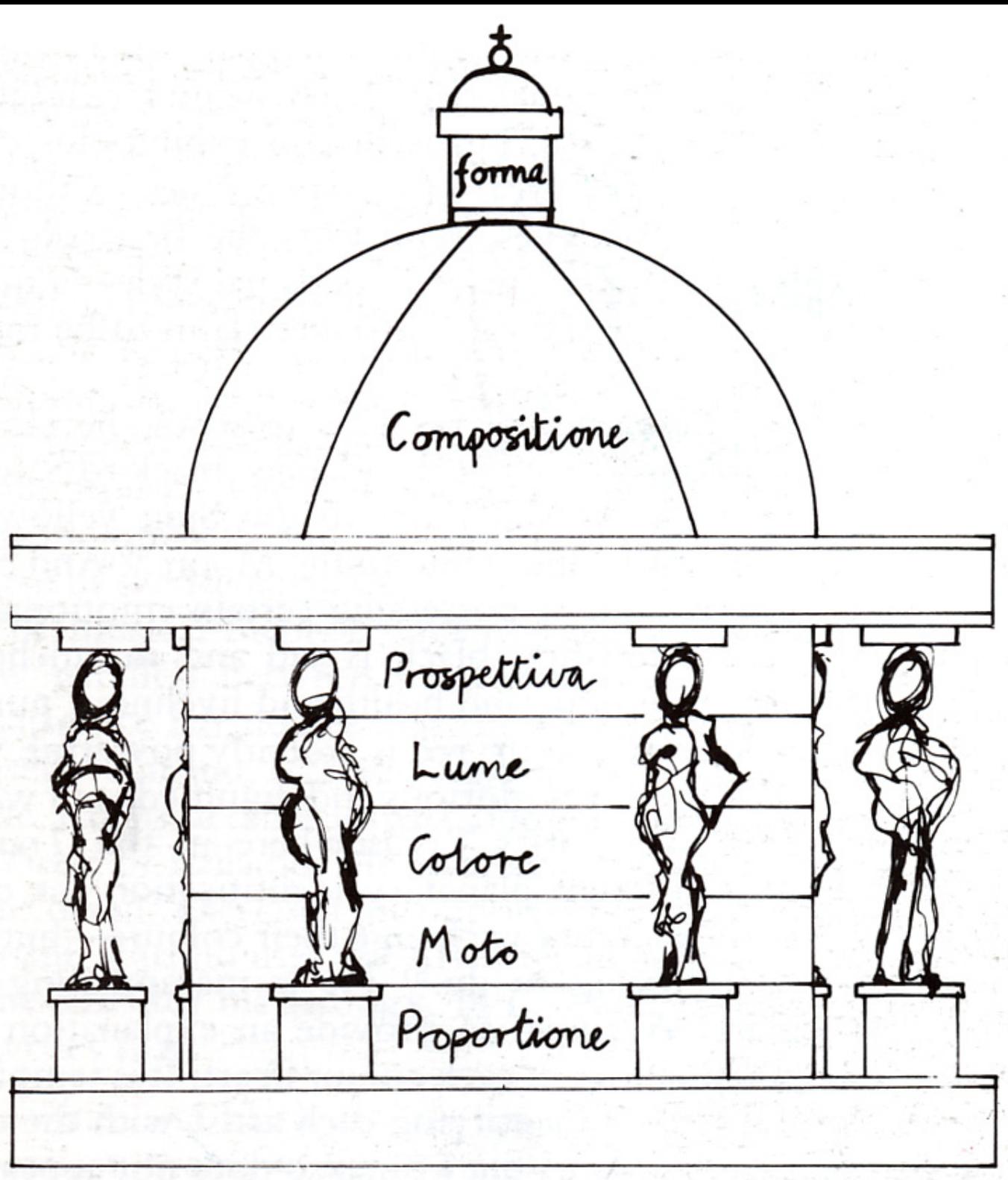


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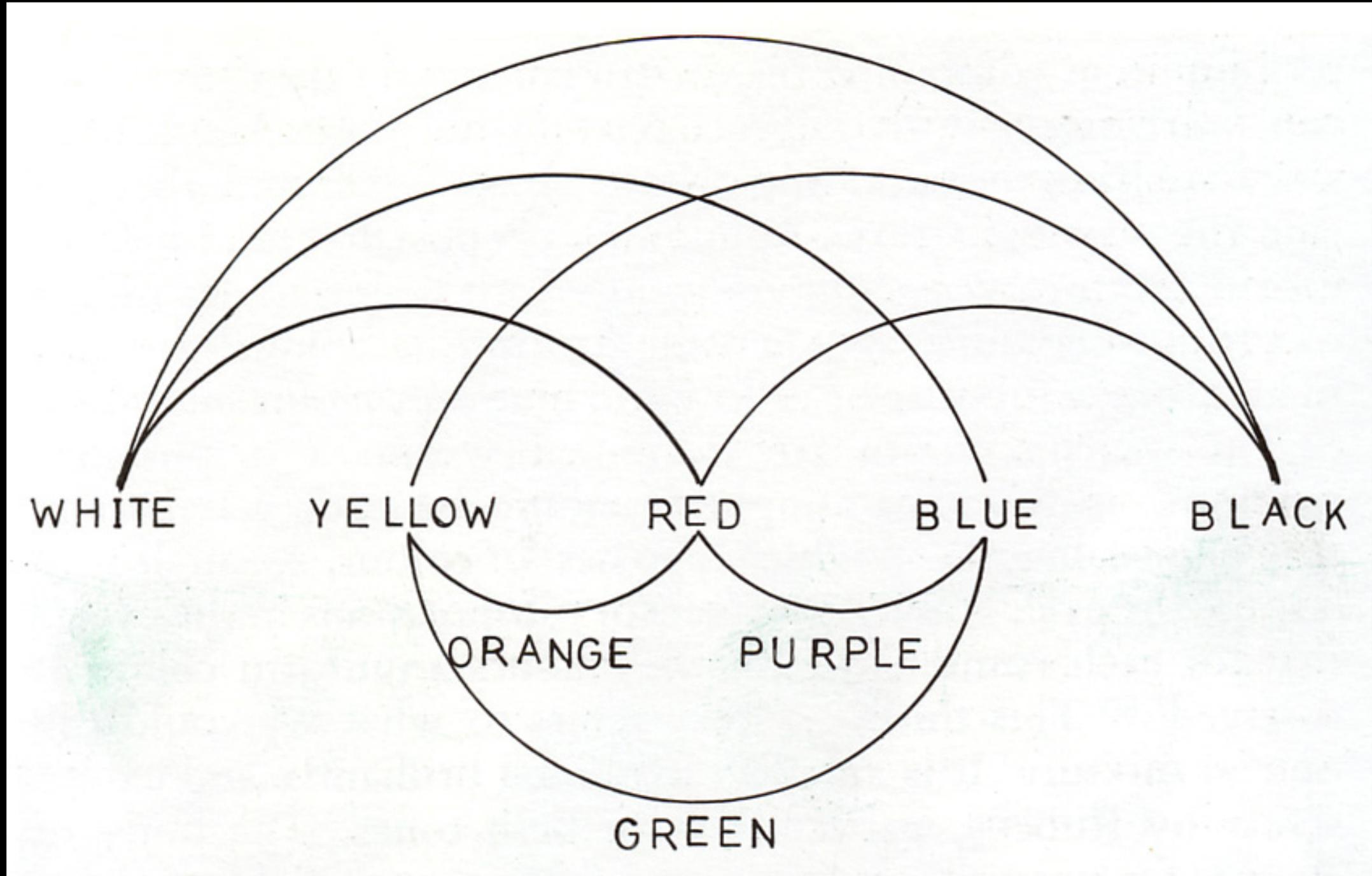
Musical intervals

Number of semitones	Name	5-limit tuning (pitch ratio)	Comparison of interval width (in cents)			
			5-limit tuning	Pythagorean tuning	1/4-comma meantone	Equal temperament
0	Perfect unison	1:1	0	0	0	0
1	Minor second	16:15	112	90	117	100
2	Major second	9:8	204	204	193	200
3	Minor third	6:5 75:64 32:27	316 (wolf) 275 294	294 318	310 (wolf) 269	300
4	Major third	5:4 512:405 32:25 81:64	386 406 (wolf) 427 408	408 384	386 (wolf) 427	400
5	Perfect fourth	4:3 675:512 27:20	498 478 520	498 (wolf) 522	503 (wolf) 462	500
6	Augmented fourth Diminished fifth	45:32 64:45	590 610	612 588	579 621	600
7	Perfect fifth	3:2 40:27 1024:675	702 680 722	702 (wolf) 678	697 (wolf) 738	700
8	Minor sixth	8:5	814	792	814	800
9	Major sixth	5:3	884	906	890	900
10	Minor seventh	9:5 16:9	1018 996	996	1007	1000
11	Major seventh	15:8	1088	1110	1083	1100
12	Perfect octave	2:1	1200	1200	1200	1200

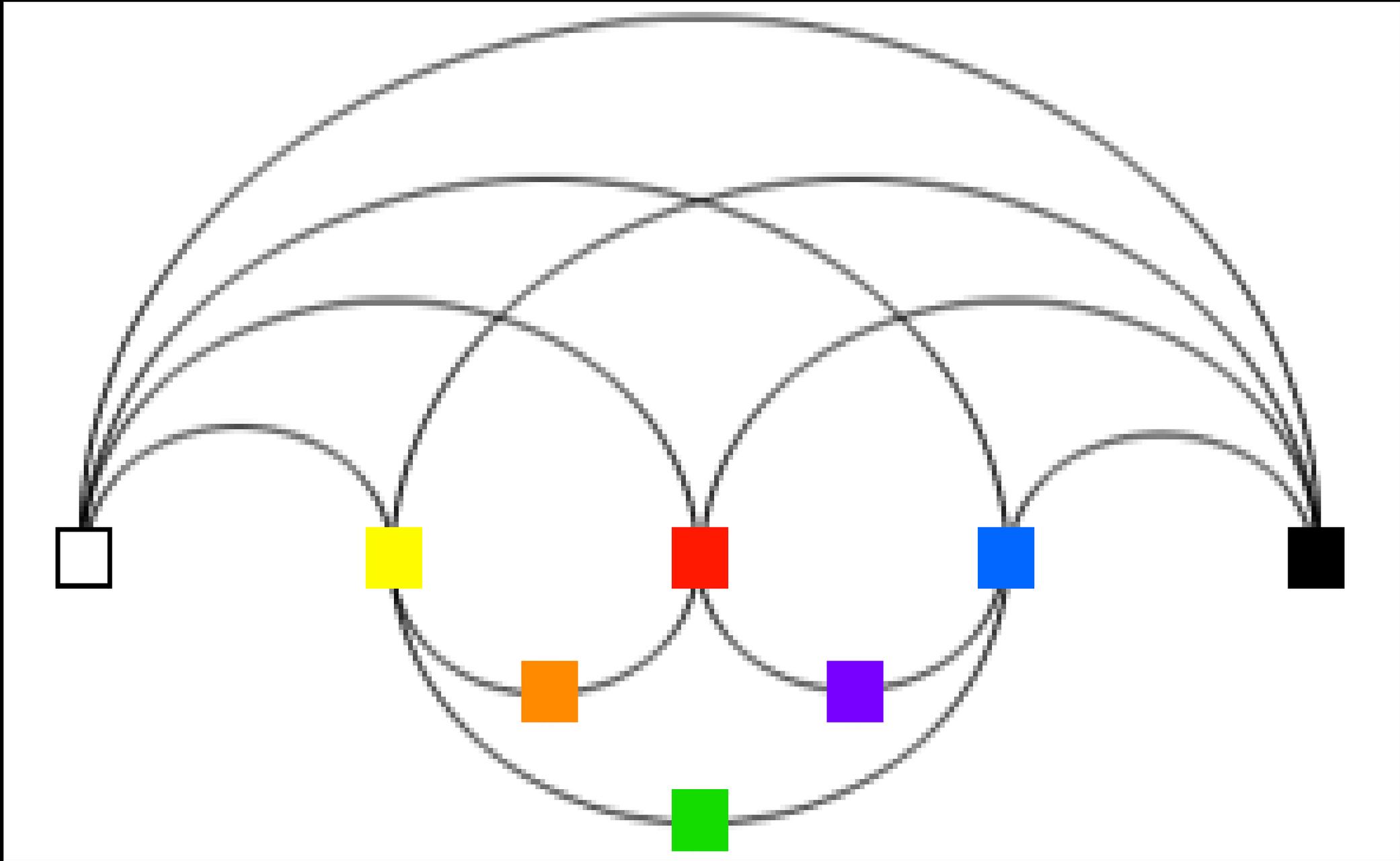
(Wikipedia)



Giovanni Lomazzo, Temple of Painting (1584)



Francois d'Aguilonius, *De lumine et colore* (w. Peter Paul Rubens) (1613)



Francois d'Aguilonius, *De lumine et colore* (w. Peter Paul Rubens) (1613)

Mantegna
Madonna and Child
(1495)



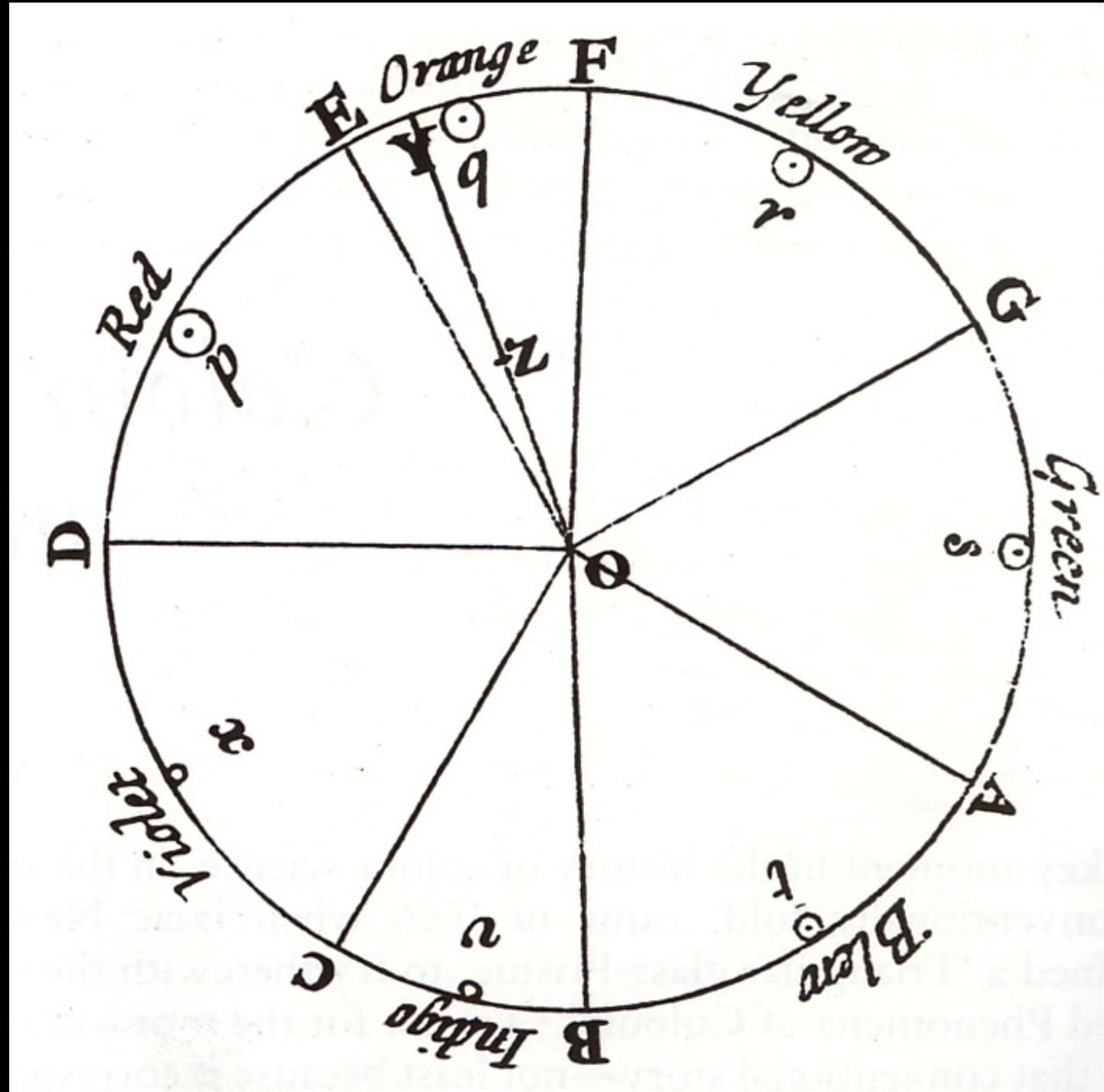


🔍 Rubens, Blessings of Peace (1630)

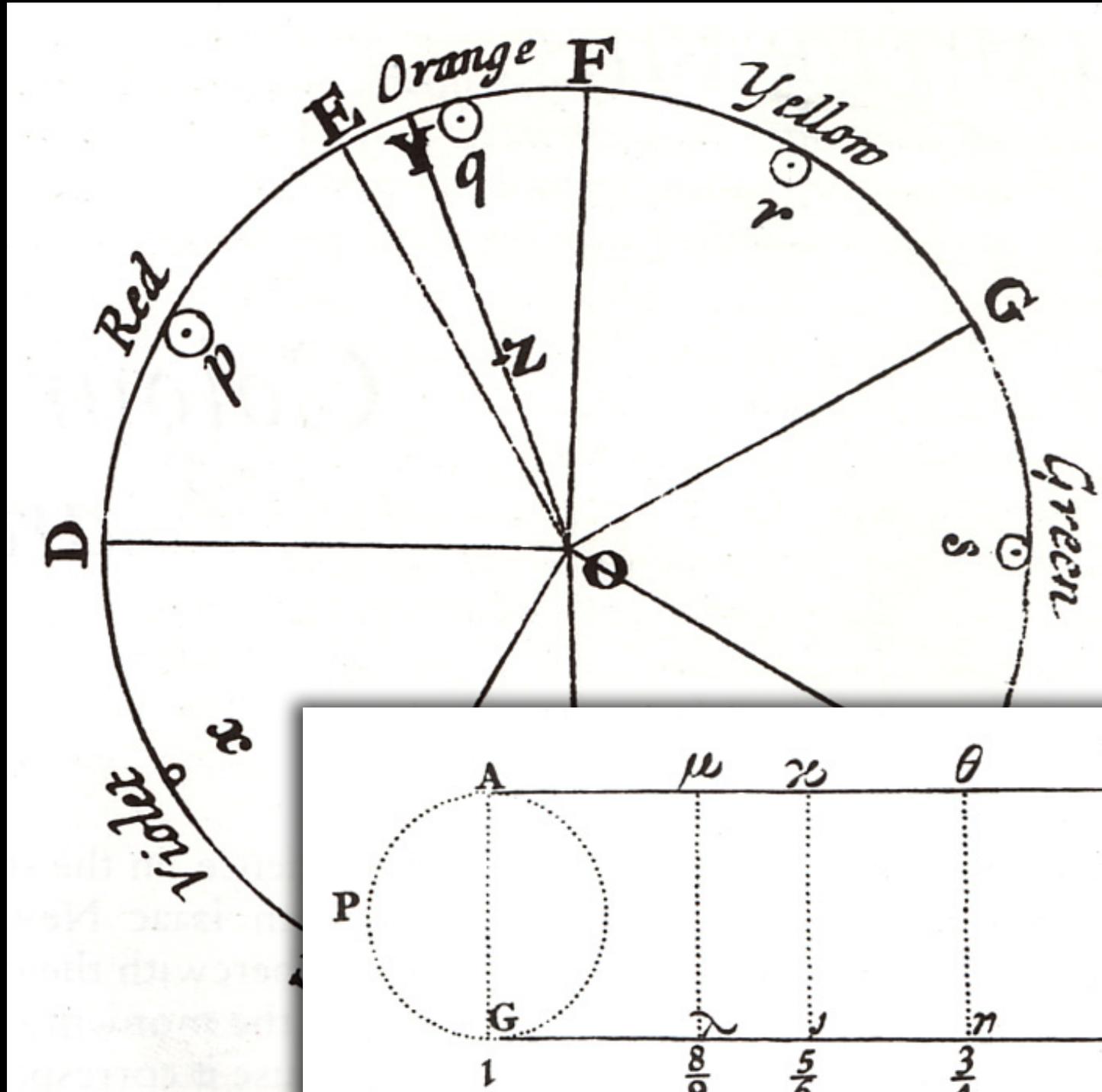


Rubens, Blessings of Peace (1630)





Isaac Newton, Optiks (1666, published 1704)

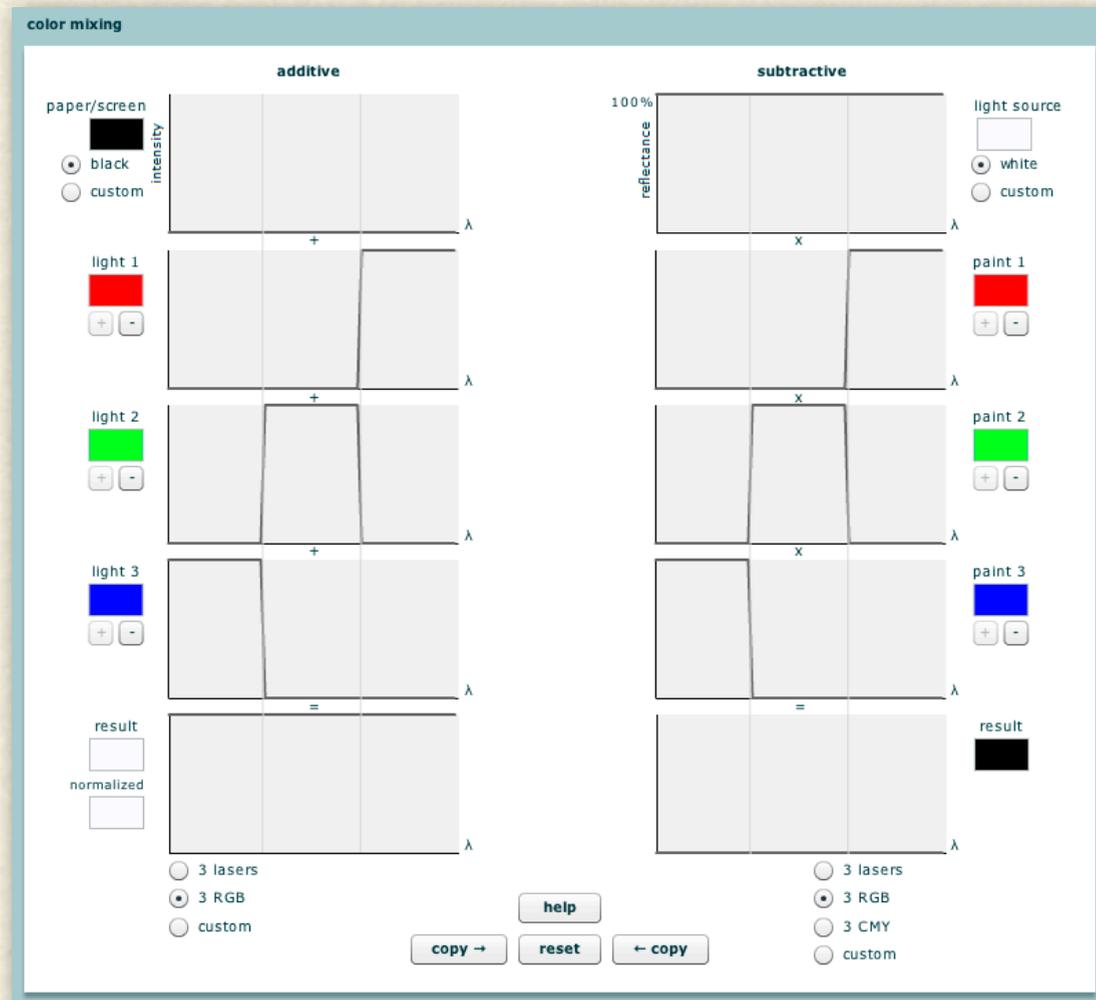


Isaac Newton, Optiks (1666, published 1704)



Jakob le Blon, 3-color printing (c. 1720)

Additive versus subtractive mixing

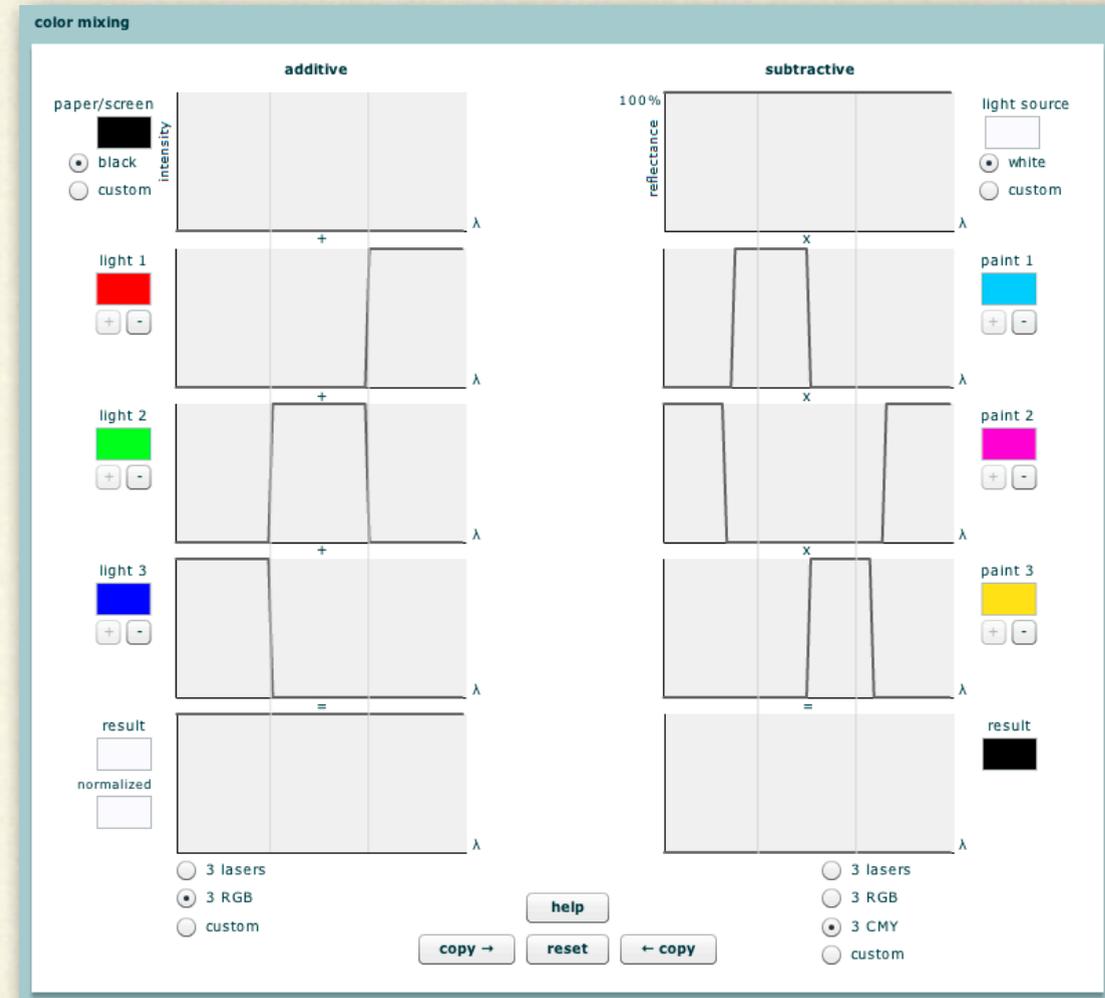
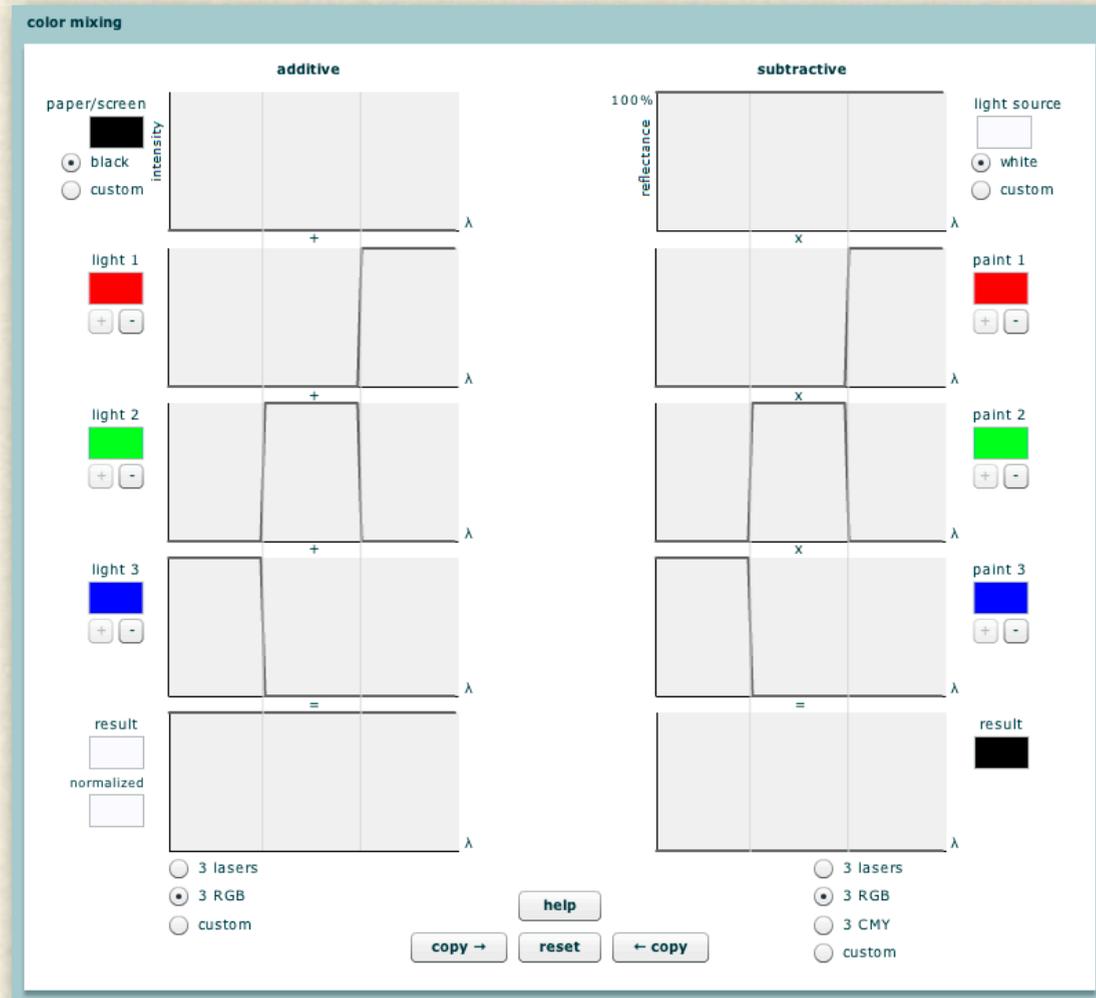


(FLASH DEMO)

<http://graphics.stanford.edu/courses/cs178/applets/ColorMixing-narrowCMY.swf>

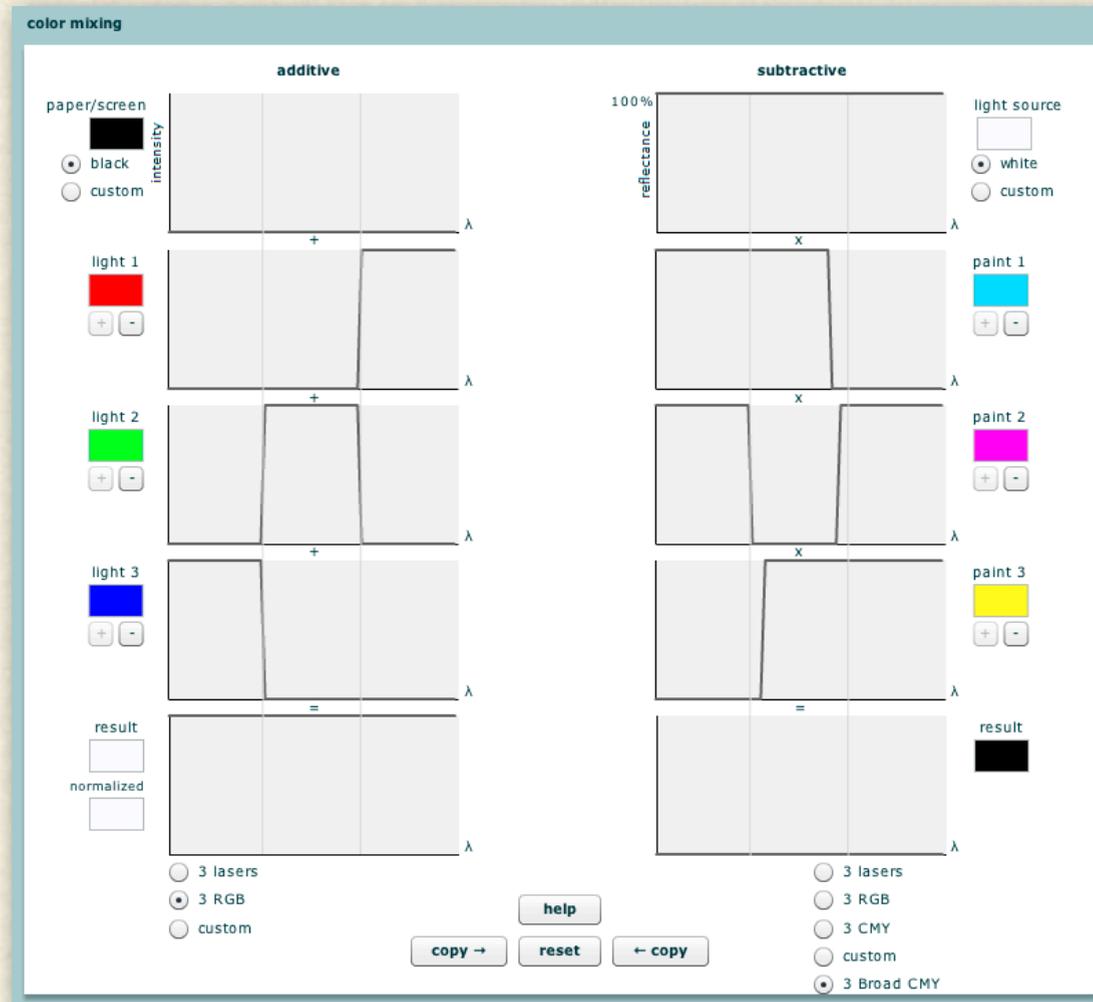
- ❖ superimposed colored lights or small adjacent dots combine *additively* - by adding their spectra wavelength-by-wavelength
- ❖ layered dyes or sequenced color filters combine *subtractively* - by multiplying their transmittance spectra wavelength-by-wavelength

Additive versus subtractive mixing



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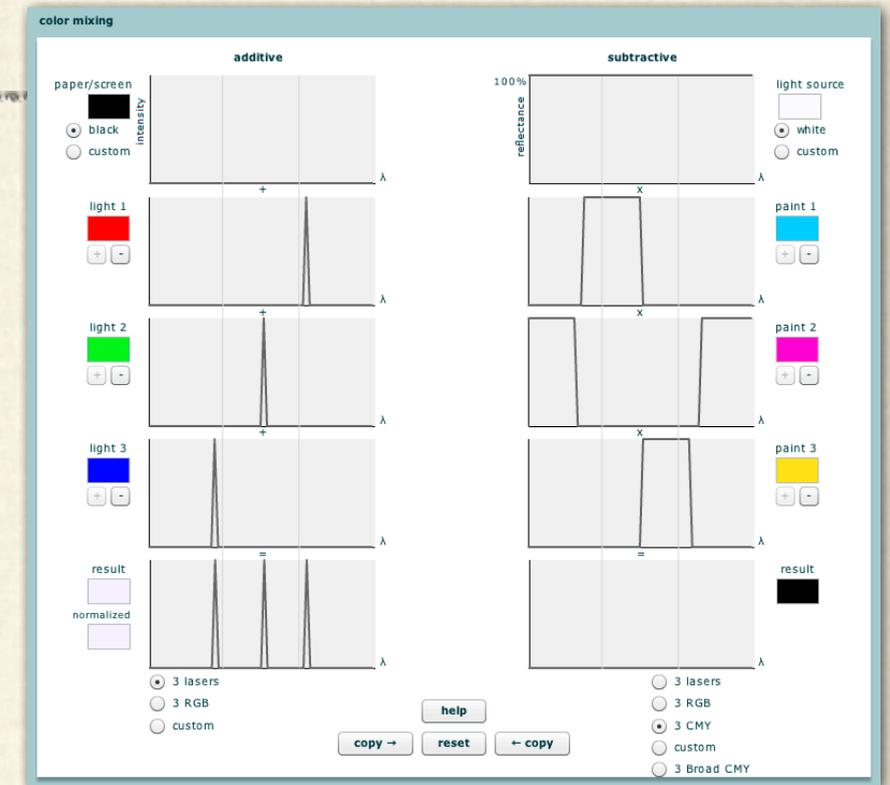
Additive versus subtractive mixing

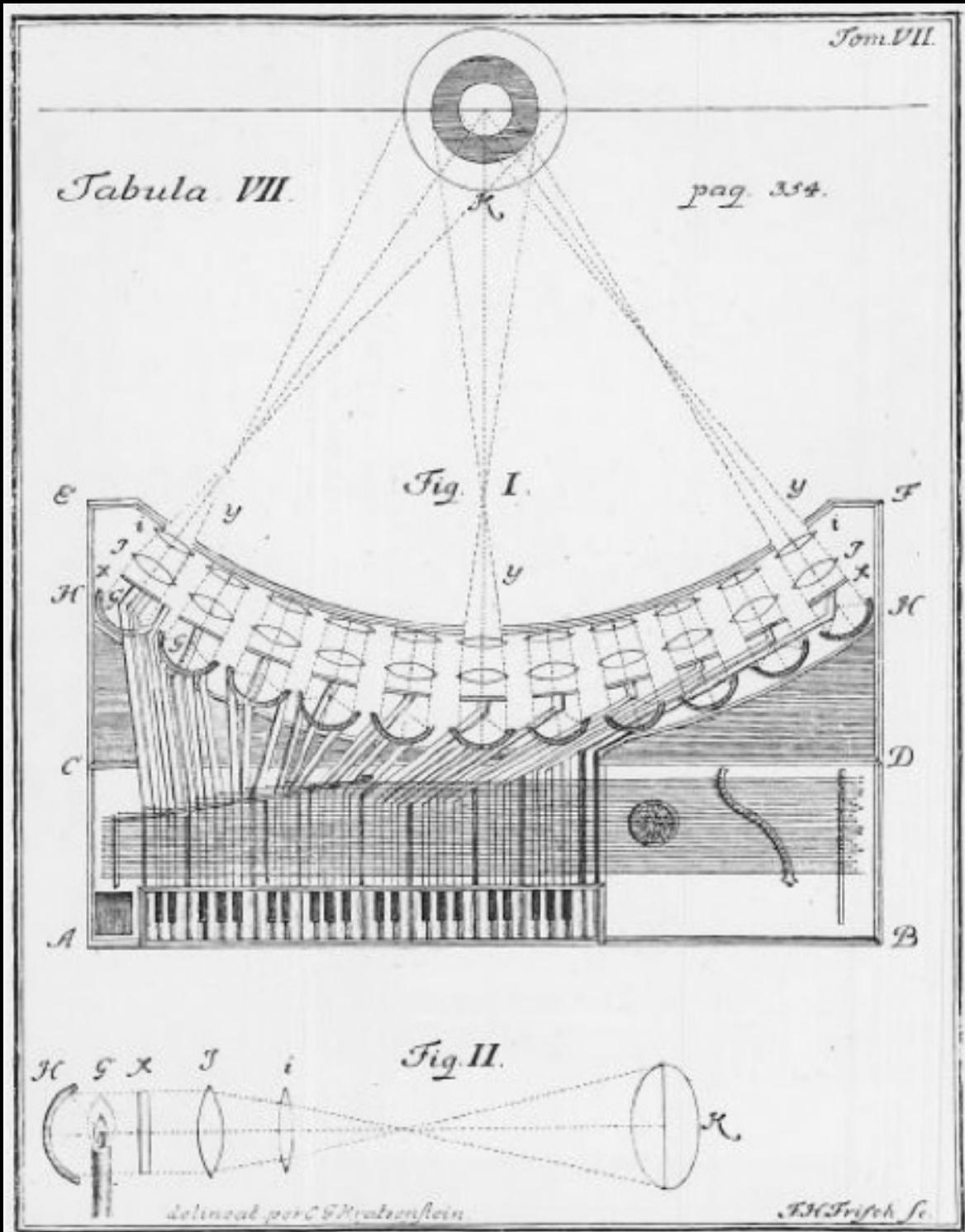


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Additive versus subtractive mixing

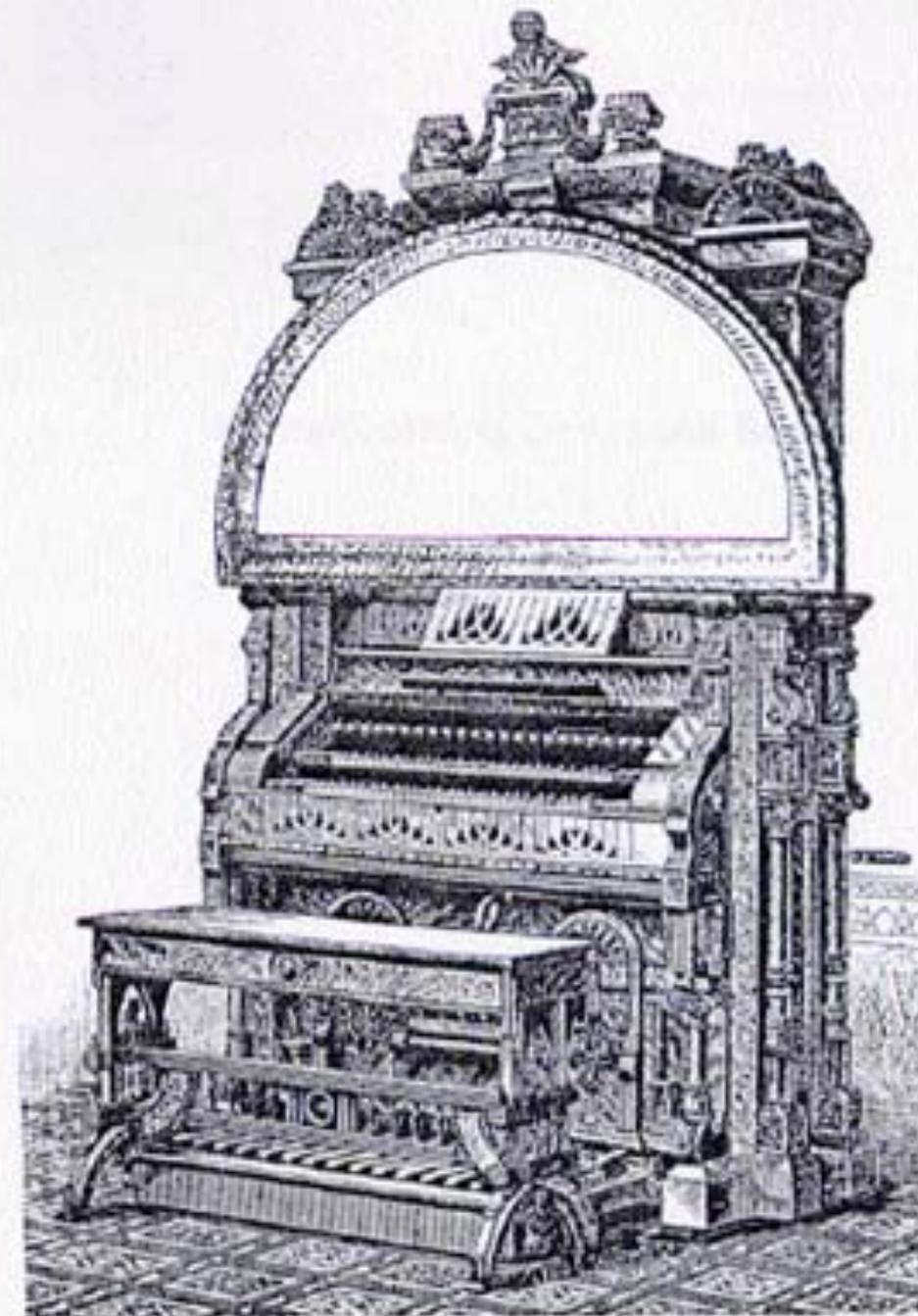
- ❖ narrow spectra, widely spaced in wavelength, are best for primaries that are to be combined additively
- ❖ wide spectra that overlap are best for primaries that are to be combined subtractively, but product of all three must be black
- ❖ the particular spectra chosen is flexible; additive primaries need not be R,G,B, nor subtractive primaries C,M,Y
- ❖ additional primaries may be added to either system, resulting in a larger gamut of reproducible colors; adding black to a subtractive system (CMYK) ensures a deep black





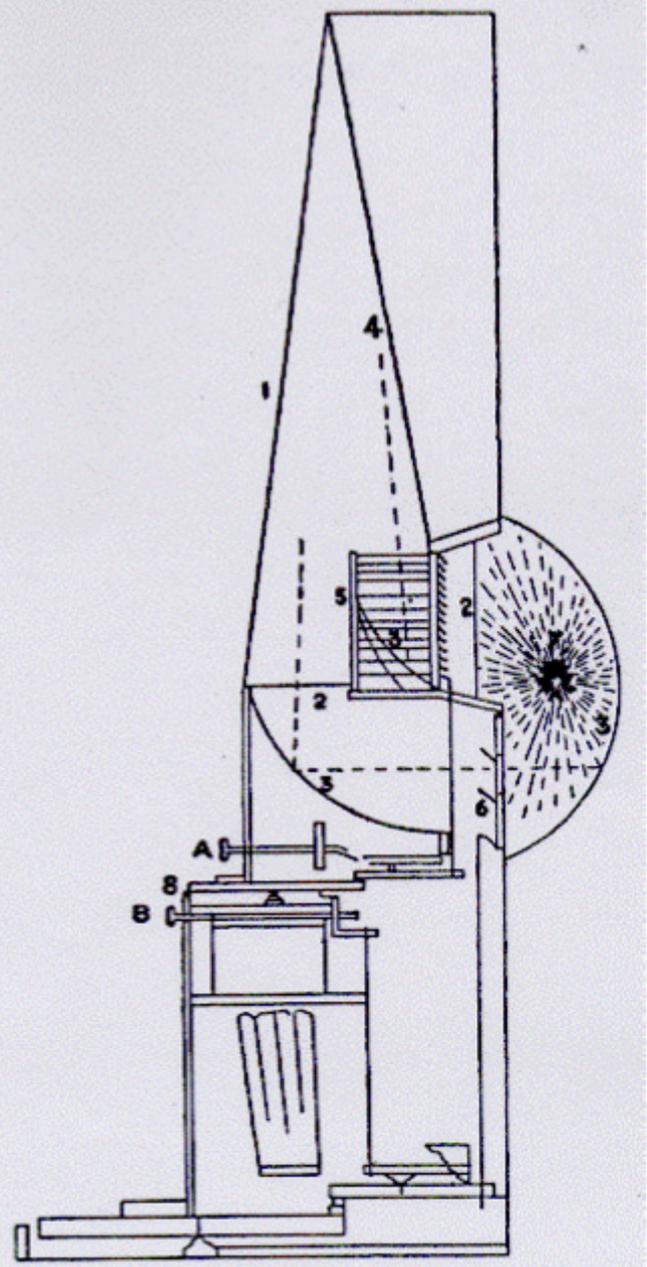
Johann Gottlob Krüger
Ocular Harpsichord
(1743)

Bainbridge Bishop
Color Organ
(1893)



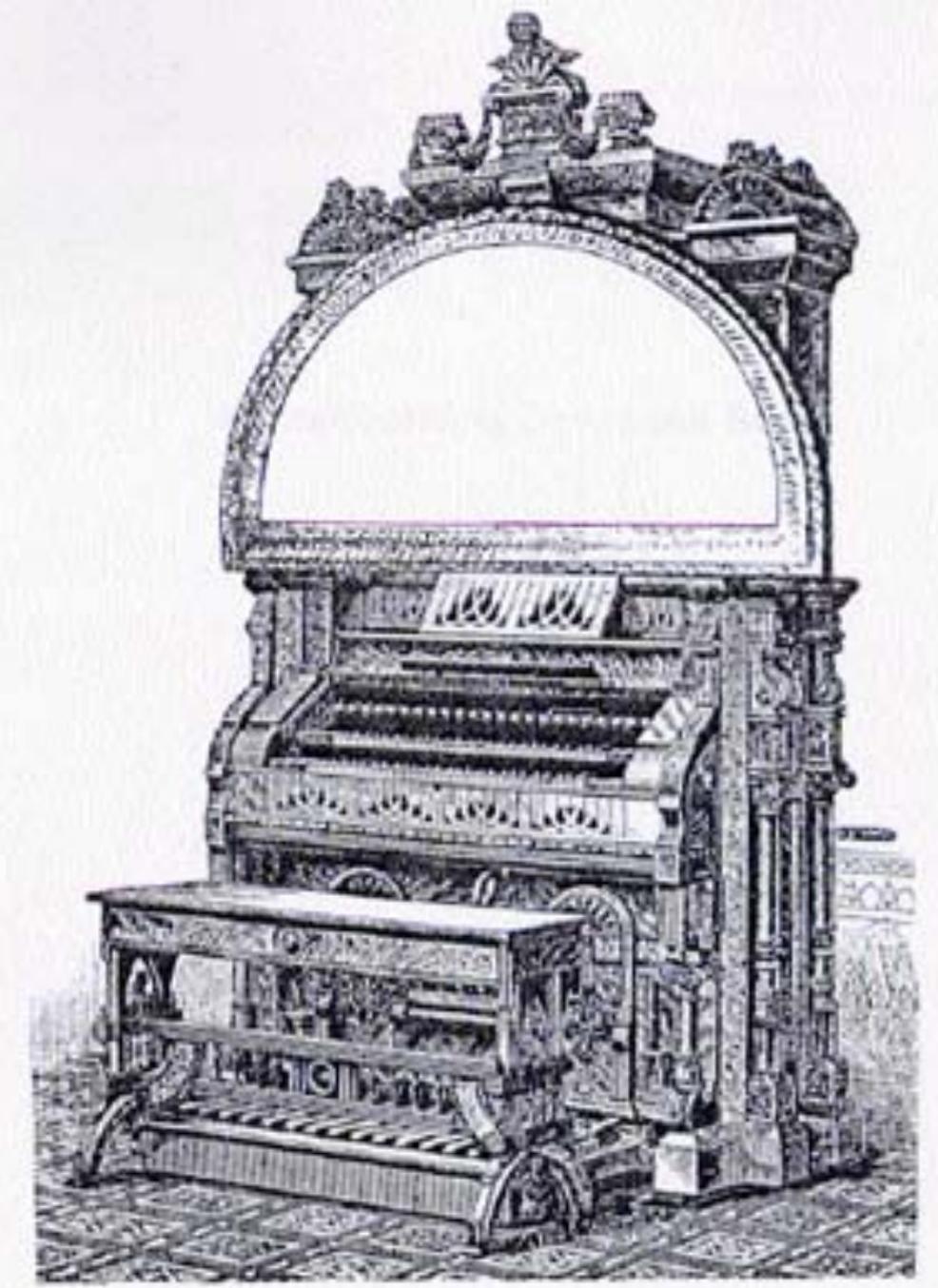
THE COLOR-ORGAN.

Louis Bertrand Castel, Ocular Clavichord (1754)



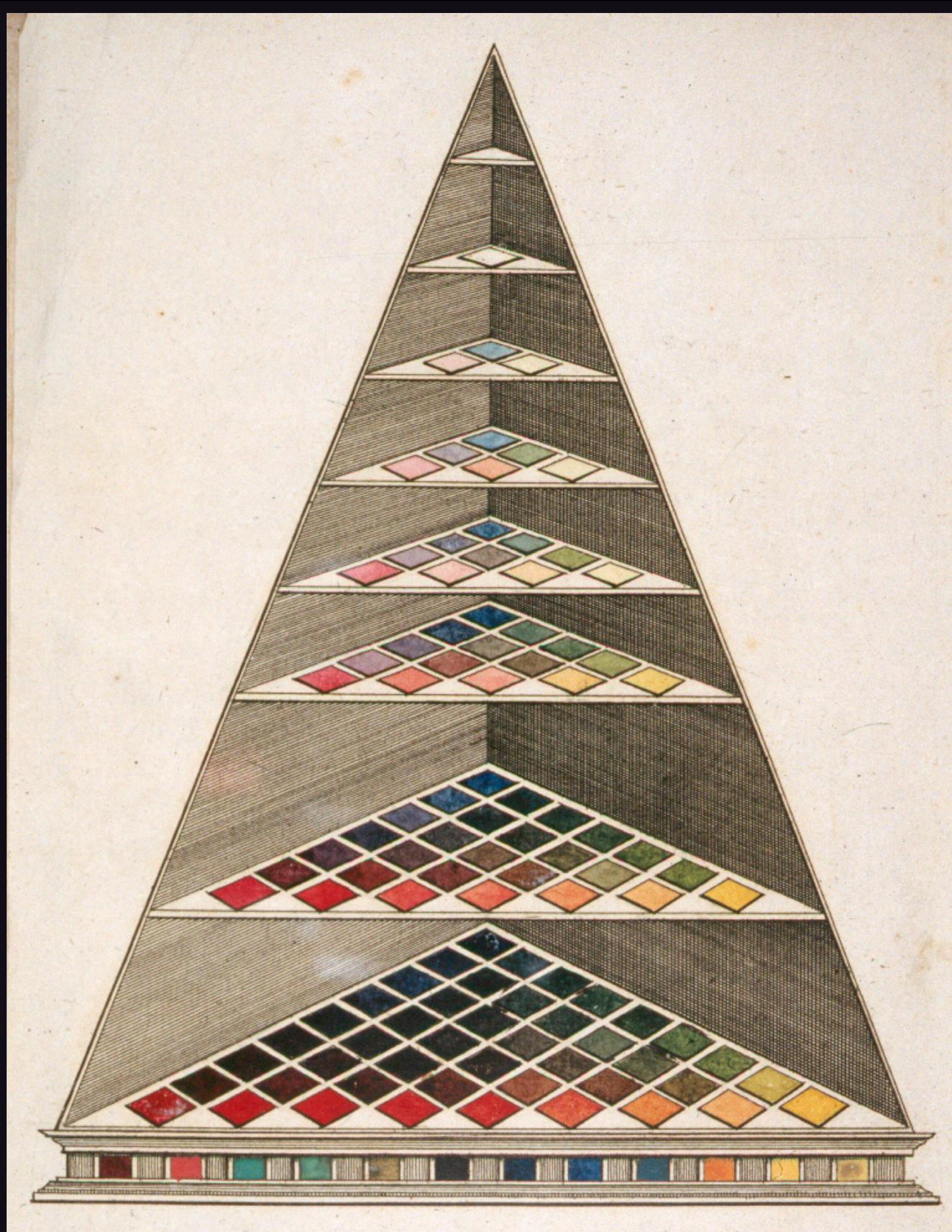
1. Ground glass tablet.
 2. Ground glasses to diffuse light.
 3. Reflectors.
 4. White screen.
 5. Upper sash.
 6. Lower sash.
 7. Electric light.
 8. Keyboard.
- A. Color-stop for keyboard.
B. Color-stop for pedals.

Bainbridge Bishop
Color Organ
(1893)



THE COLOR-ORGAN.

Johann Lambert
Color Pyramid
(1772)





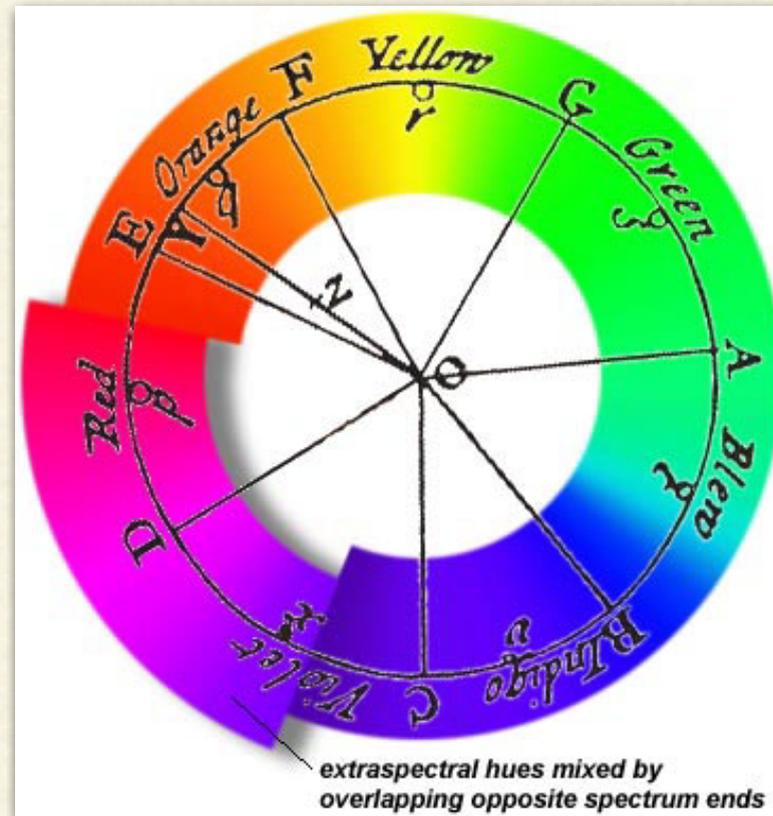


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afterimage

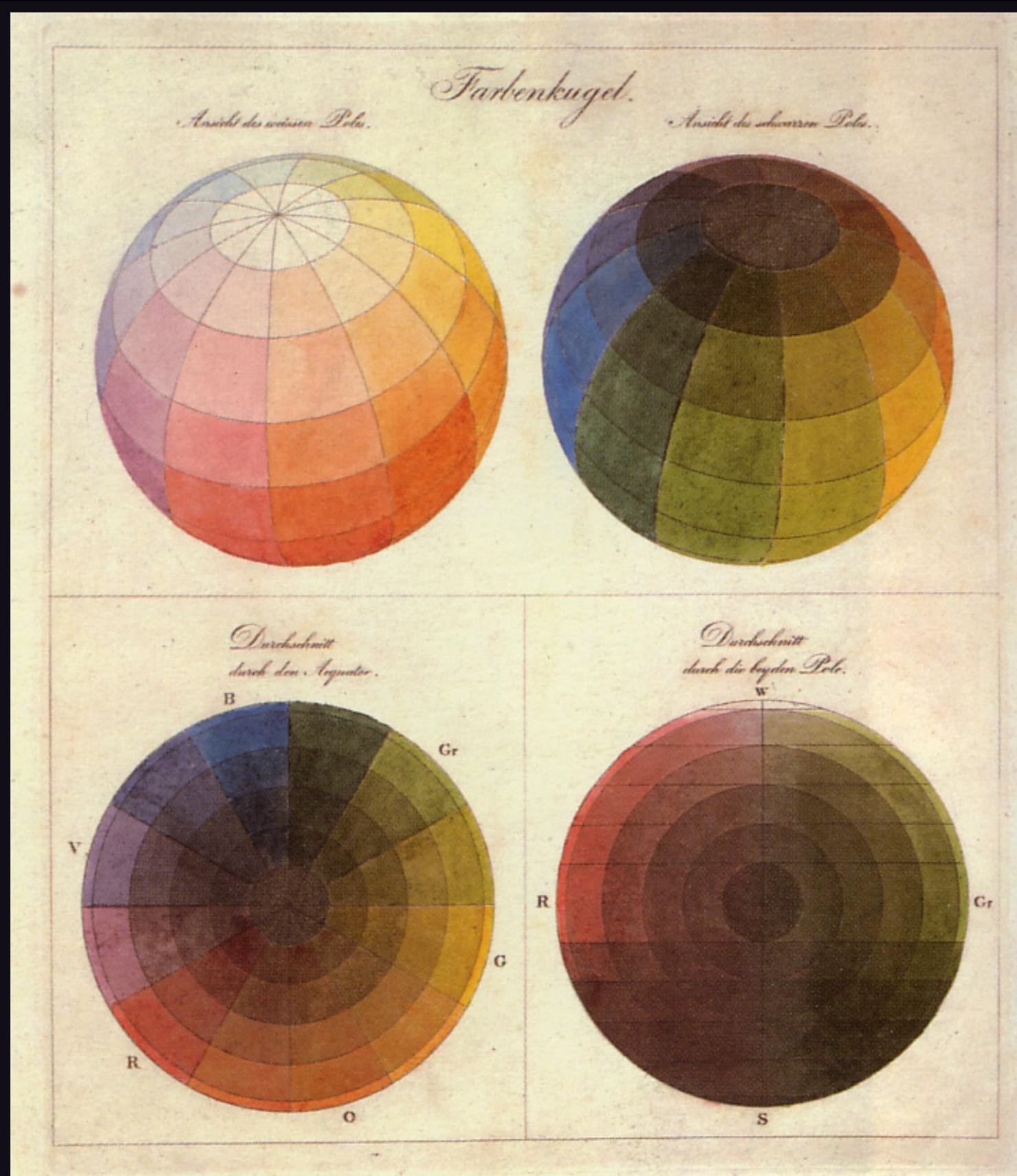
Complementary colors



(<http://www.handprint.com/HP/WCL/color6.html>)

- ❖ Leonardo described complementarity of certain pairs of colors
- ❖ Newton arranged them opposite one another across his circle
- ❖ Comte de Buffon (1707-1788) observed that afterimage colors were exactly the complementary colors

Philipp Runge
Color Spheres
(1810)



Philipp Runge
Color Spheres
(1810)

