



OLIVER BYRNE

1810 - 1880 | Civil Engineer, Mathematician, Author

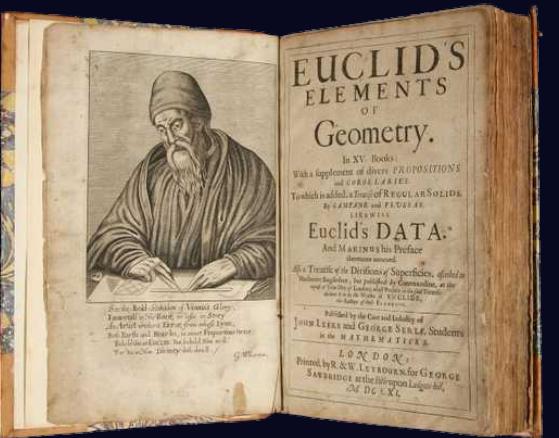
His most innovative educational work was a version of the first six books of Euclid's Elements that used coloured graphic explanations of each geometric principle.



EUCLID (of Alexandria)

300 BC | Mathematician

"founder/ father of Geometry" :  
In the 'Elements', he deduced the theorems of what is now called Euclidean Geometry from a small set of axioms.



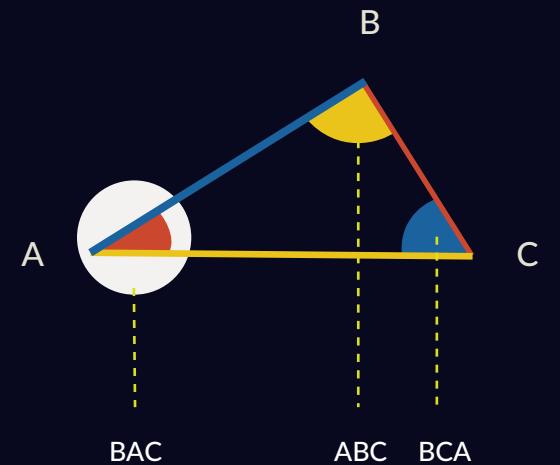
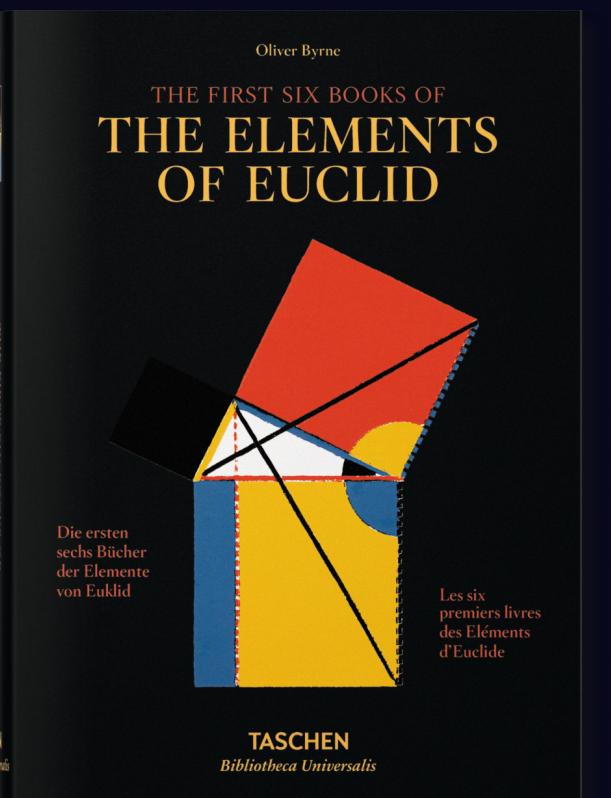
- ▶ a mathematical treatise consisting of 13 books
  - ▶ a collection of definitions, postulates, propositions (theorems and constructions), and mathematical proofs of the propositions
  - ▶ plane and solid Euclidean geometry,
  - ▶ elementary number theory,
  - ▶ incommensurable lines
  - ▶ Elements is the oldest extant large-scale deductive treatment of mathematics
- it has proven instrumental in the

# The purpose of illustrating Euclid's 'Elements'?

THIS WORK has a greater aim than mere illustration; we do not introduce colours for the purpose of entertainment, or to amuse by certain combinations of tint and form, but to assist the mind in its researches after truth, to increase the facilities of instruction, and to diffuse permanent knowledge. If we

Euclid's Elements have become, by common consent, the basis of mathematical science all over the civilized globe. But this will not appear extraordinary, if we consider that this sublime science is not only better calculated than any other to call forth the spirit of inquiry, to elevate the mind, and to strengthen the reasoning faculties, but also it forms the best introduction to most of the useful and important vocations of human life.

Symbols , abbreviations & colored diagrams used instead of letters for the greater ease of learners



Properties of Right-Angled Triangle:

$$BAC + BCA + ABC = 2 * ABC$$



$$CAB + ACB = ABC$$



# BOOK 1

- Pythagorean theorem
- Equality of angles and areas
- Parallelism
- The sum of the angles in a triangle
- The construction of various geometric figures

1. 5] PROPOSITIONS 4, 5

**PROPOSITION 5.**

In isosceles triangles the angles at the base are equal to one another, and, if the equal straight lines be produced further, the angles under the base will be equal to one another.

Let  $ABC$  be an isosceles triangle having the side  $AB$  equal to the side  $AC$ ; and let the straight lines  $BD, CE$  be produced further in a straight line with  $AB, AC$ . [Post. 2]

I say that the angle  $ABC$  is equal to the angle  $ACB$ , and the angle  $CBD$  to the angle  $BCE$ .

Let a point  $F$  be taken at random on  $BD$ ; from  $AE$  the greater let  $AG$  be cut off equal to  $AF$  the less; [1. 3] and let the straight lines  $FC, GB$  be joined. [Post. 1]

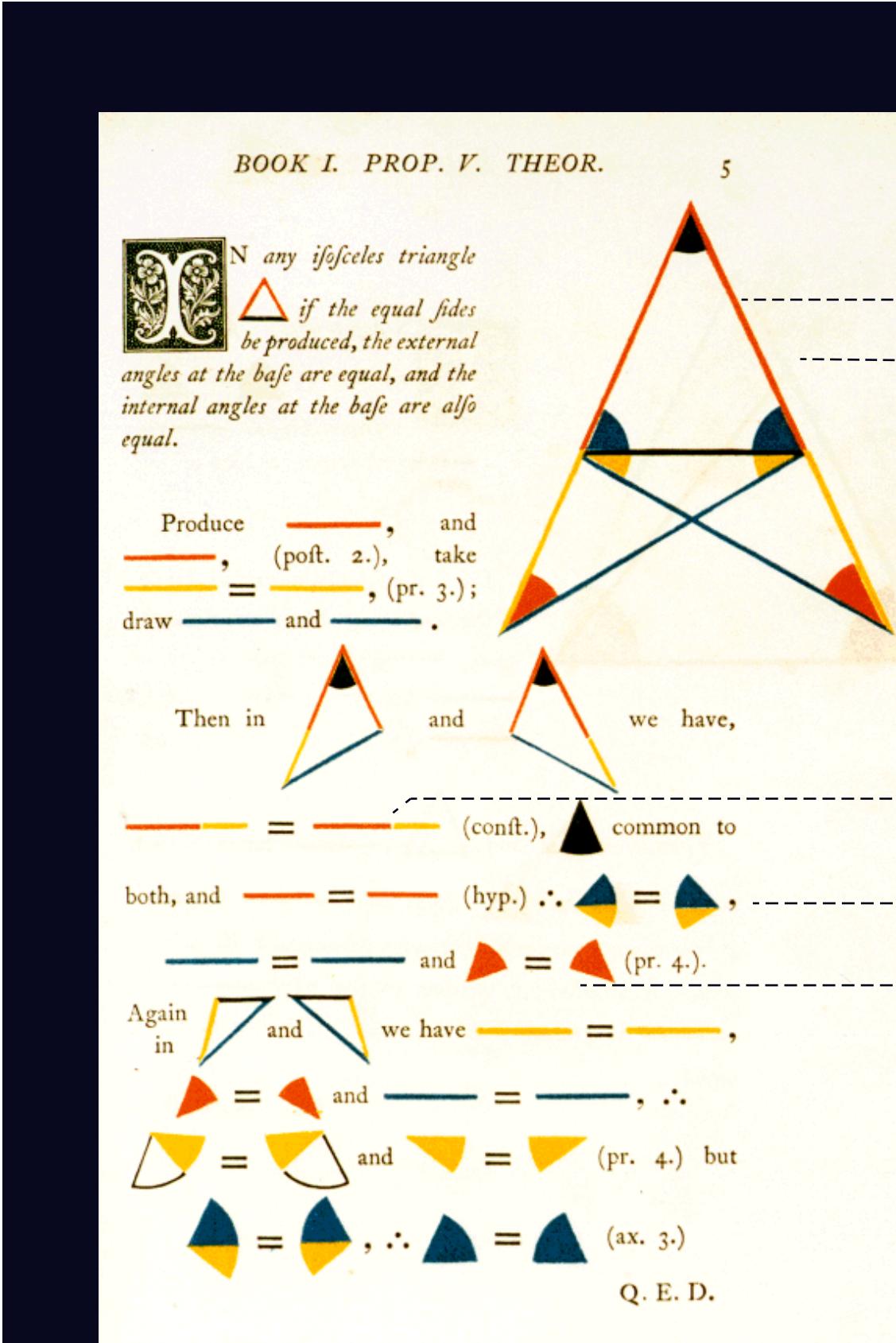
Then, since  $AF$  is equal to  $AG$  and  $AB$  to  $AC$ , the two sides  $FA, AC$  are equal to the two sides  $GA, AB$ , respectively; and they contain a common angle, the angle  $FAG$ . [1. 8]

Therefore the base  $FC$  is equal to the base  $GB$ , and the triangle  $AFC$  is equal to the triangle  $AGB$ , and the remaining angles will be equal to the remaining angles respectively, namely those which the equal sides subtend, that is, the angle  $ACF$  to the angle  $ABG$ , and the angle  $AFC$  to the angle  $AGB$ . [1. 4]

And, since the whole  $AF$  is equal to the whole  $AG$ , and in these  $AB$  is equal to  $AC$ , the remainder  $BF$  is equal to the remainder  $CG$ .

But  $FC$  was also proved equal to  $GB$ ; therefore the two sides  $BF, FC$  are equal to the two sides  $CG, GB$  respectively; and the angle  $BFC$  is equal to the angle  $CGB$ , while the base  $BC$  is common to them; therefore the triangle  $BFC$  is also equal to the triangle  $CGB$ , and the remaining angles will be equal to the remaining

ref: the thirteen books of Euclid's elements



The internal and external angles at the base of an isosceles triangle and equal.

equal sides of an isosceles triangle

base of the triangle

sides of triangles

angles opposite to blue sides

+

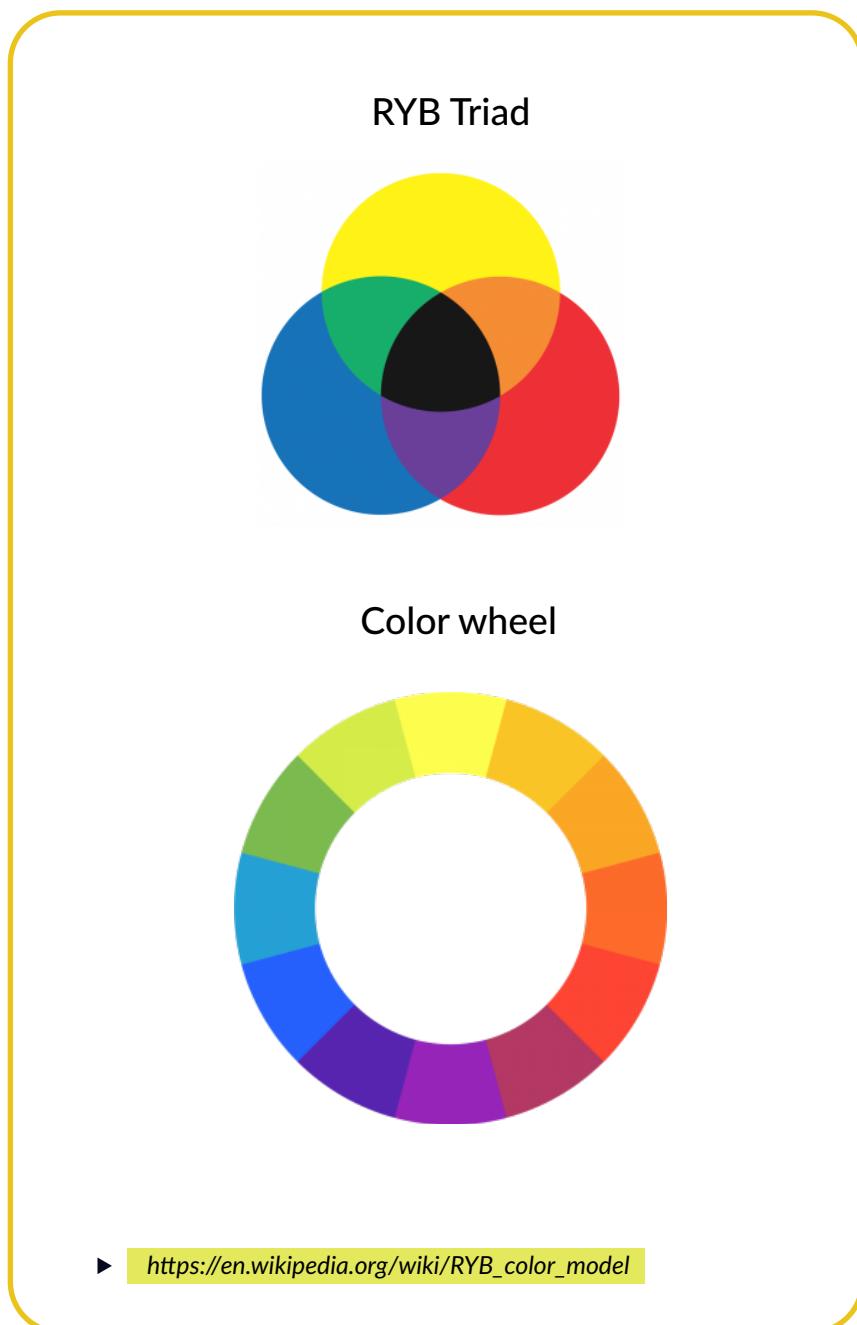
angles opposite to yellow sides

angles opposite to red sides

► Sub parts of the main diagram taken as is (without changing the orientation- making it easy to relate) to the main diagram

► Help with cognition and remembering the theorems/ propositions

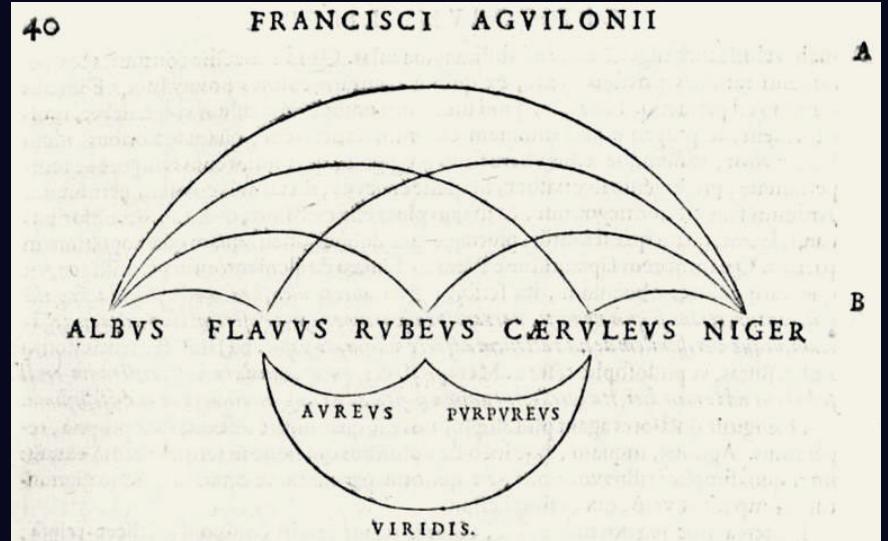
## RYB Triad



## FRANCISCUS AGUILONIUS

1567- 1617 | Mathematician,  
Physicist, Architect.

He was the first to propose  
a colour line extending  
from white (albus) to black  
(niger). This was published  
in his **six volume treatise**  
**on optics**, whose title page  
and illustrations were  
designed by Peter Paul  
Rubens.



- ▶ a colour line extending from white (albus) to black (niger), passing through the primaries of yellow (flavus), red (rubeus), and blue (caeruleus).
- ▶ Below that are secondary combinations of orange (aureus) and purple (purpureus), with green (viridis).
- ▶ This was the first mention of RYB as primary colors

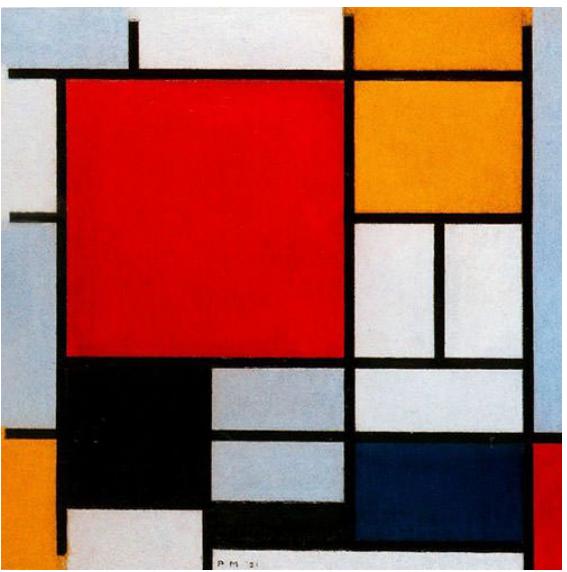
## SHAPES & COLORS : LEARNING



▶ Have you ever wondered why most early childhood programs teach children their colors and shapes early in the year? Why not letters and numbers? Why not cats and dogs? It's because color and shape are two very noticeable attributes of the world around us. When you look out your window, you may not be saying it ... but your mind is noticing and identifying the green trees, brown rectangle buildings, square windows, and blue sky. Color and shape are ways children observe and categorize what they see. These very recognizable characteristics encourage children to define and organize the diverse world around them.

▶ When young children are asked to mathematically sort objects (such as leaves, rocks, shells, or keys) they usually use the most obvious attributes of color and shape, plus size, to categorize the items. When your child plays, he uses sorting and classifying skills as he observes similarities and differences of color and shape, makes comparisons, and organizes this information into piles. This seemingly simple process (that we use every week when we sort the laundry or find things in the grocery aisles) is the foundation for living in a mathematical world. Sorting by color and shape prepares your child for the future application of these skills in making graphs or searching for a book at the library.

## PIET MONDRIAN



Piet Mondrian is best known for his artistic style Neoplasticism in which he simplified visual compositions to the most basic elements of the straight line, the three primary colors, and the neutrals of black, white and gray.

De Stijl : Dutch artistic movement founded in 1917 (Netherlands)

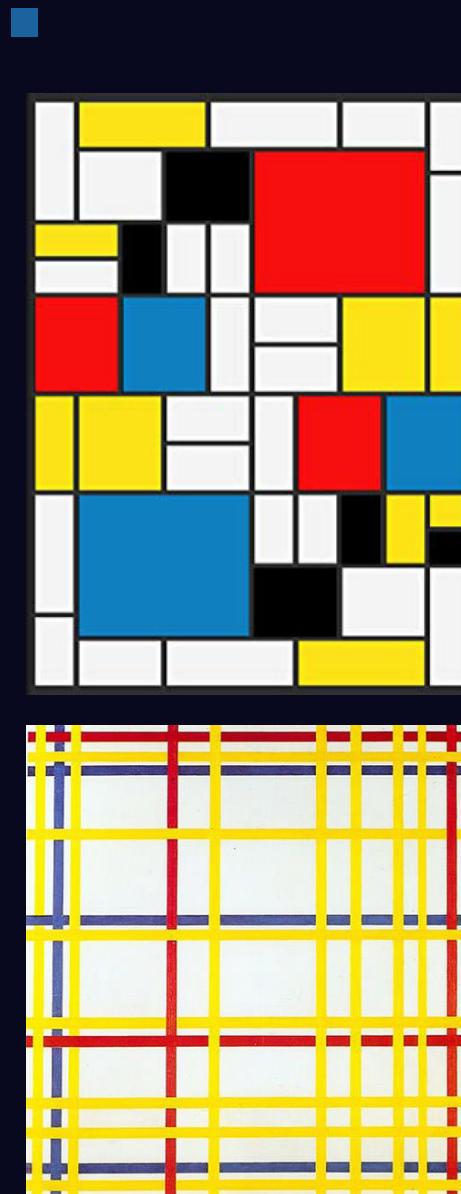
Advocated pure abstraction and universality by a reduction to the essentials of form and colour; they simplified visual compositions to vertical and horizontal, using only black, white and primary colors.



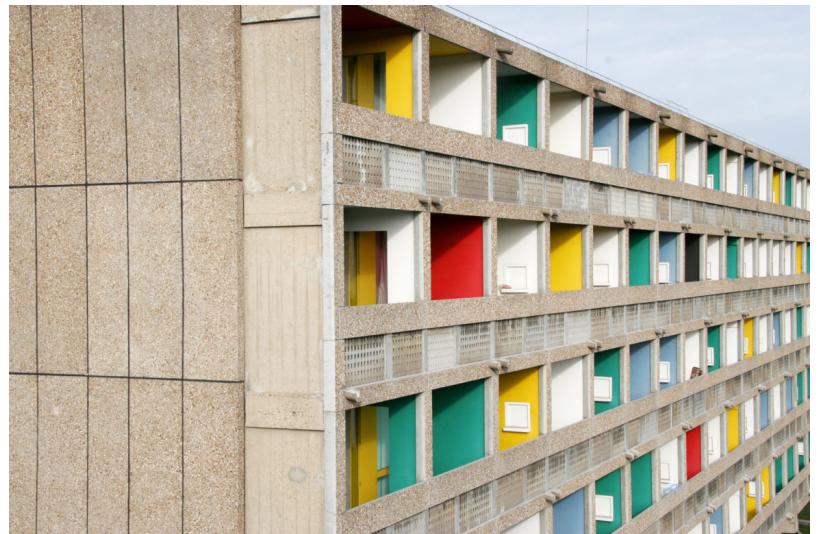
PIET MONDRIAN

1872 -1944 | Painter

He is known for being one of the pioneers of 20th century abstract art, as he changed his artistic direction from figurative painting to an increasingly abstract style, until he reached a point where his artistic vocabulary was reduced to simple geometric elements.



## LE CORBUSIER



- ▶ Swiss artist's designs combine the functionalism of the modern movement with a bold, sculptural expressionism
- ▶ He was the first architect to make a studied use of rough-cast concrete, a technique that satisfied his taste for asceticism and for sculptural forms.



### LE CORBUSIER

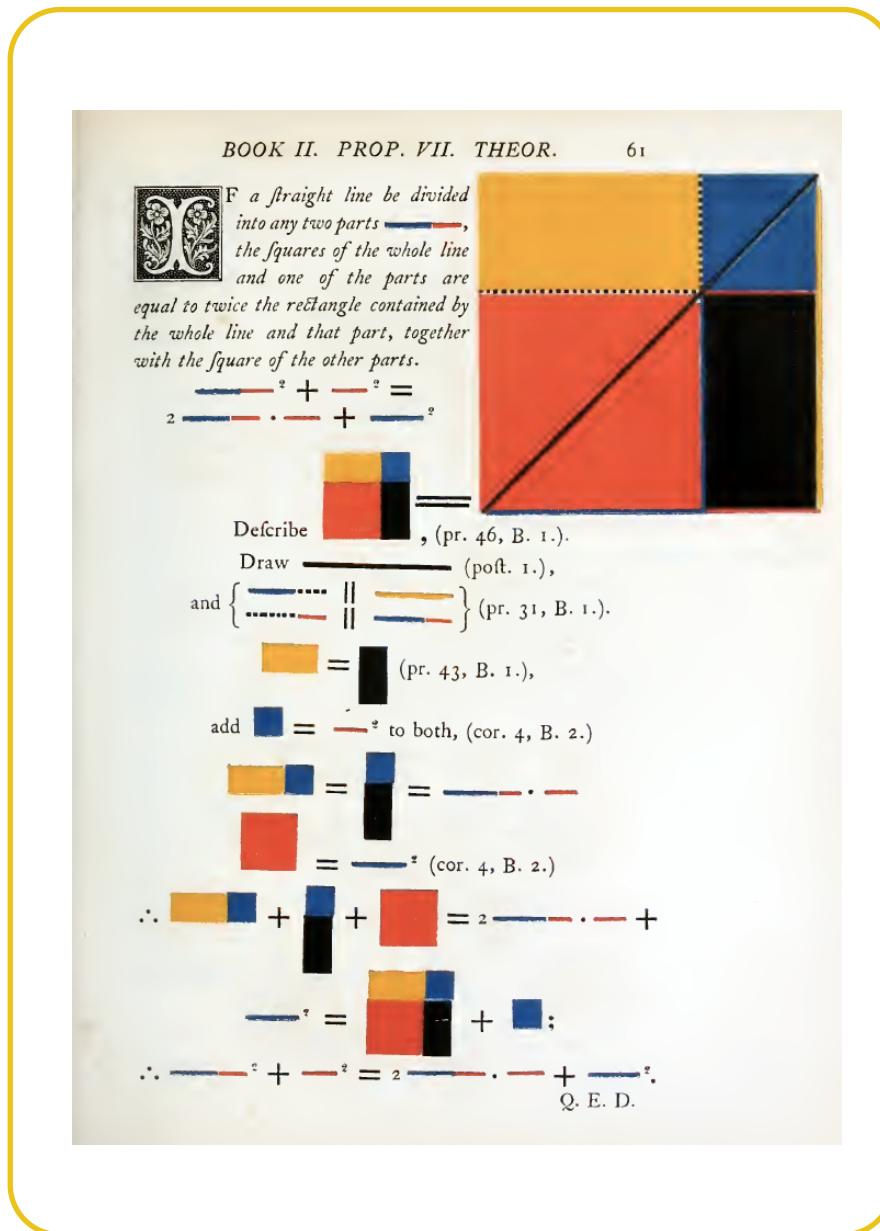
1887-1965 | Architect, Designer,  
Painter, Urban planner, Writer

One of the pioneers of modern architecture. Dedicated to providing better living conditions for the residents of crowded cities, Le Corbusier was influential in urban planning, and was a founding member of the Congrès International d'Architecture Modeme (CIAM).



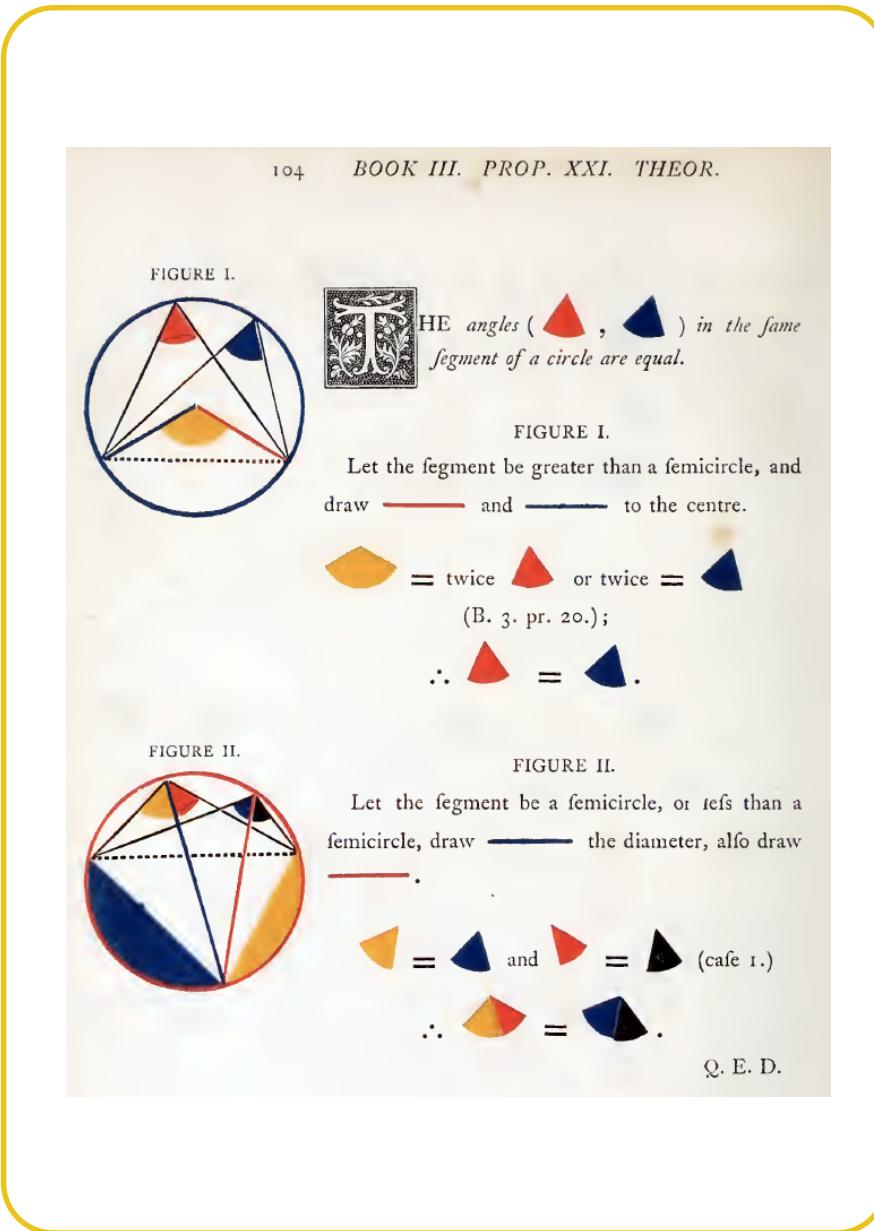
## BOOK 2

- The equality of rectangles and squares
- Construction of the golden ratio
- A way of constructing a square equal in area to any rectilineal plane figure



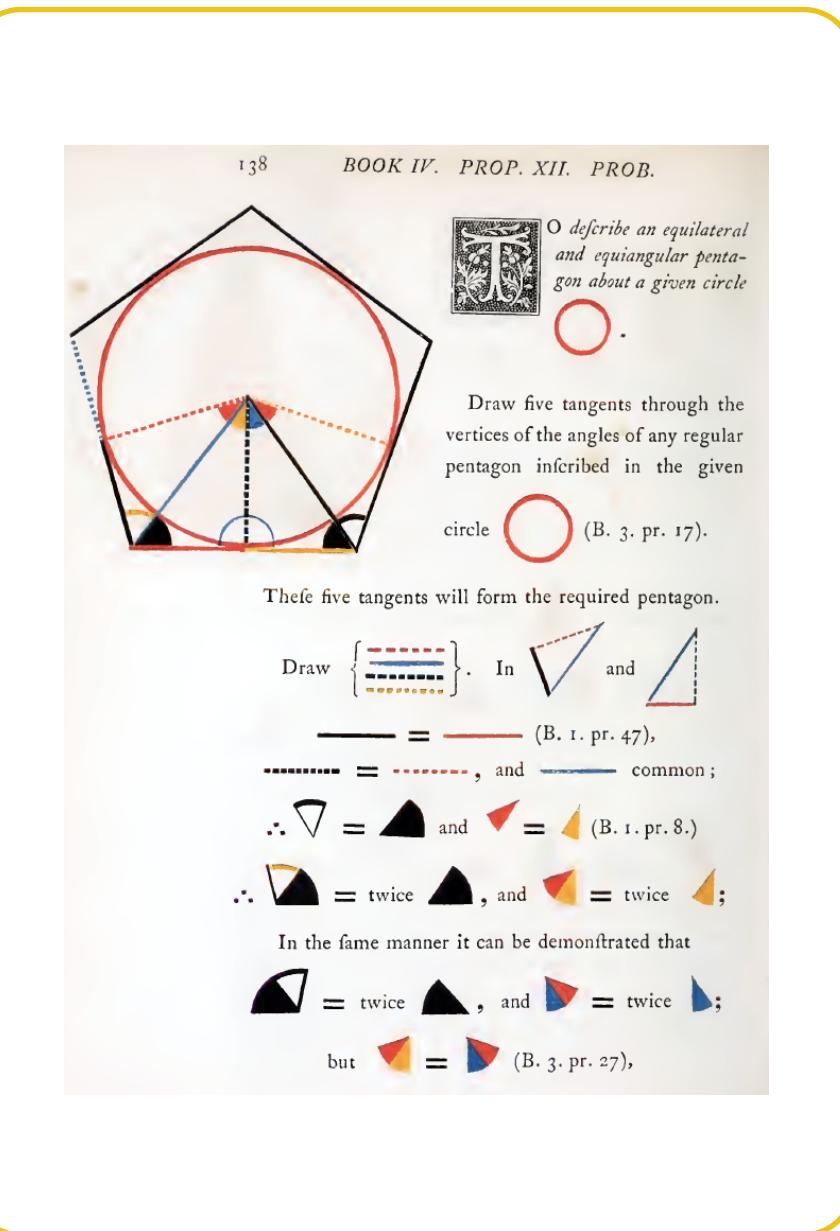
## BOOK 3

- Circles and their properties
- Finding the center, inscribed angles, tangents
- Thales' theorem, Power of a point



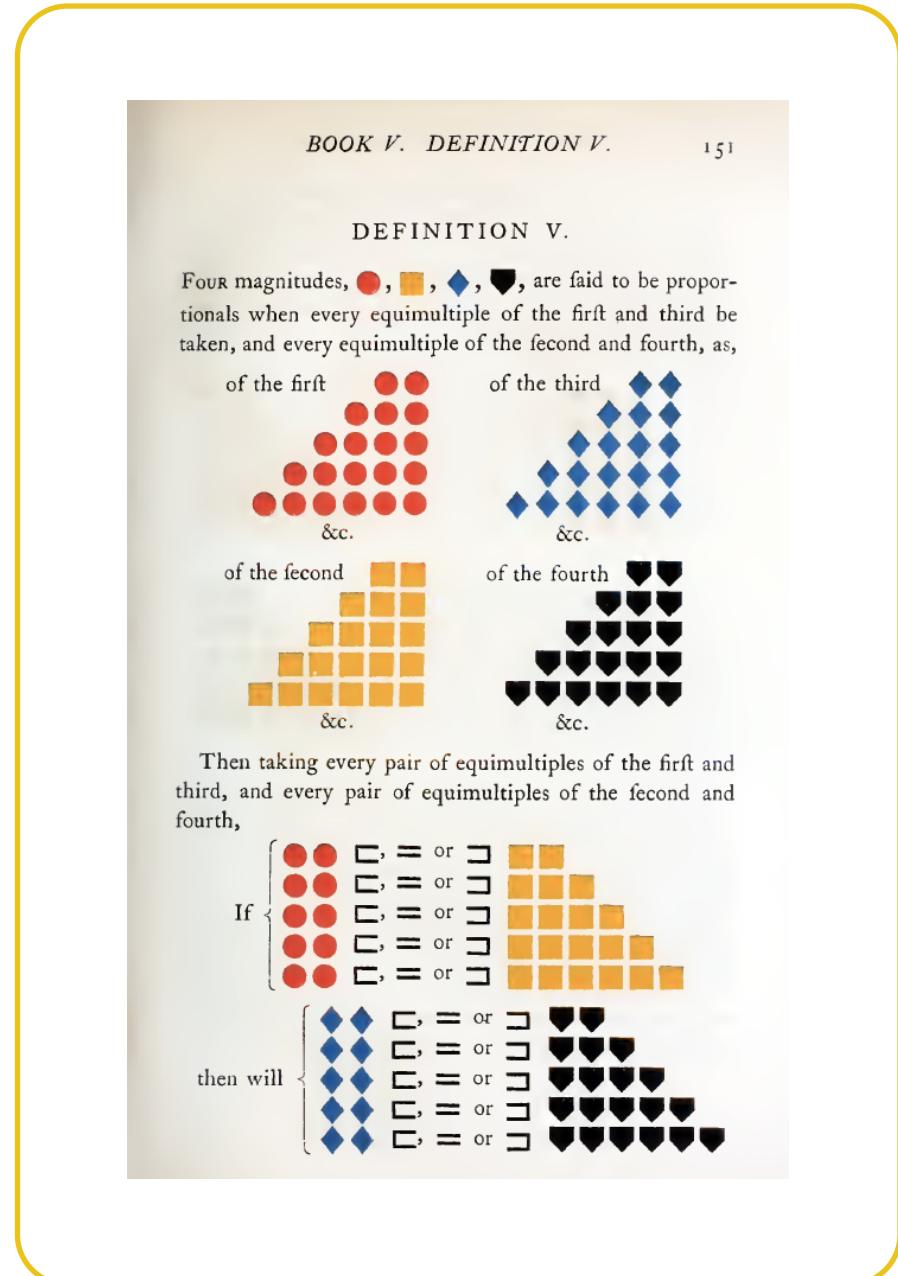
## BOOK 4

- The incircle and circumcircle of a triangle
- Polygons with 4, 5, 6, and 15 sides



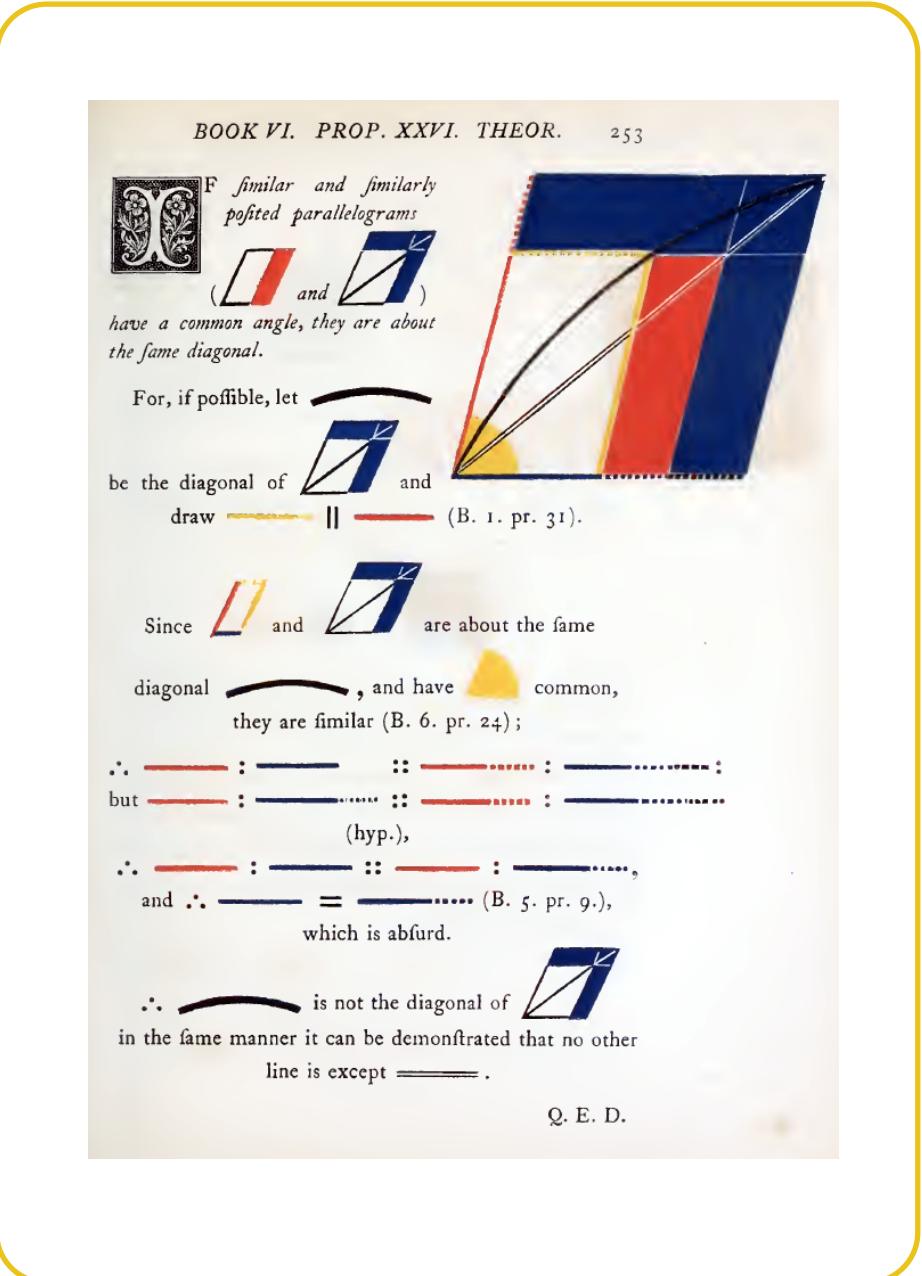
## BOOK 5

- ▶ Proportions of magnitudes
- ▶ "alternation" (if  $a : b :: c : d$ , then  $a : c :: b : d$ )



## BOOK 6

- ▶ Applies proportions to plane geometry
- ▶ The construction and recognition of similar figures



Oliver Byrne's Euclid at the Mathematical Association :  
<https://www.youtube.com/watch?v=zvu4QSrlAs>

<https://www.youtube.com/watch?v=3GY5blTTeSA>

## GESTALT LAWS

The principle of similarity states that, all else being equal, perception lends itself to seeing stimuli that physically resemble each other as part of the same object, and stimuli that are different as part of a different object.

The principle of closure refers to the mind's tendency to see complete figures or forms even if a picture is incomplete, partially hidden by other objects, or if part of the information needed to make a complete picture in our minds is missing.

## SYMBOLS & ABBREVIATIONS

$\parallel$  signifies *parallel to.*

$\perp$  . . . . *perpendicular to.*

. *angle.*

. . *right angle.*

two *right angles.*

or briefly designates a *point.*

$\square$ ,  $=$ , or  $\Box$  signifies *greater, equal, or less than.*

The square described on a line is concisely written thus,

$\underline{\quad}$ <sup>2</sup>.

In the same manner twice the square of, is expressed by

$2 \cdot \underline{\quad}$ <sup>2</sup>.

def. signifies *definition.*

pos. . . . . *postulate.*

ax. . . . . *axiom.*

$\neq$  means the same as if the words '*not equal*' were written.

$\square$  signifies *greater than.*

$\square \square$  . . . . *less than.*

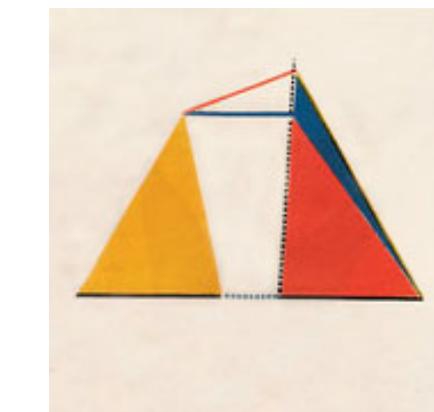
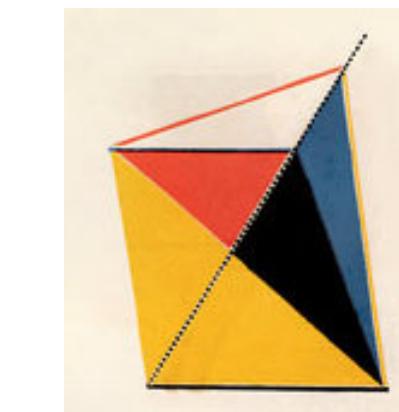
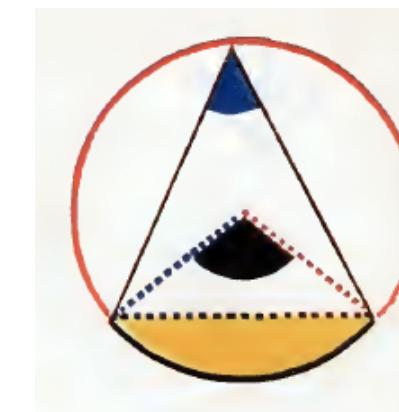
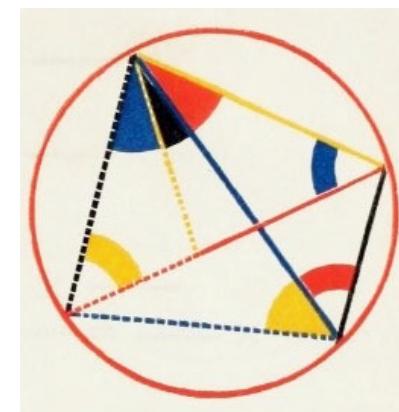
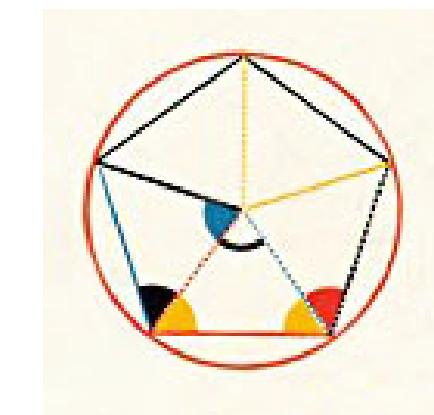
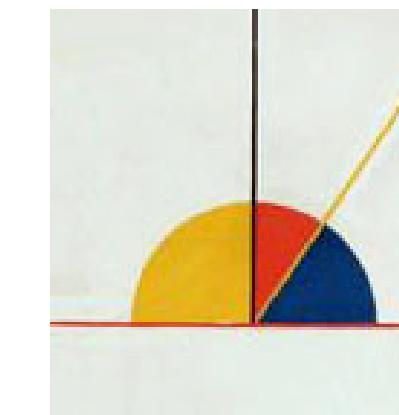
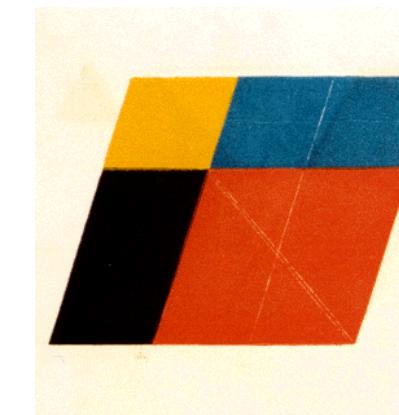
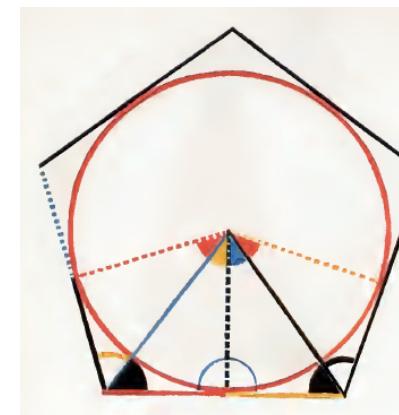
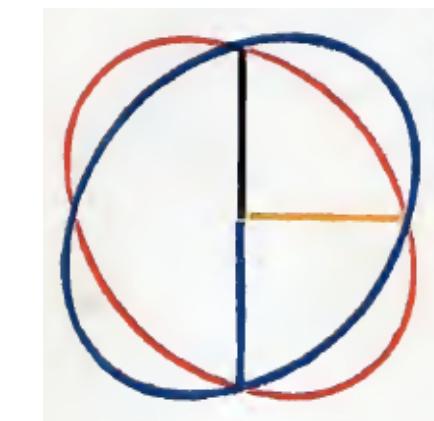
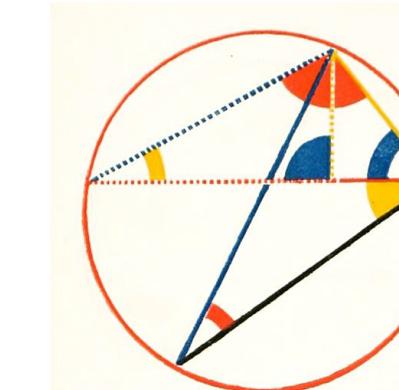
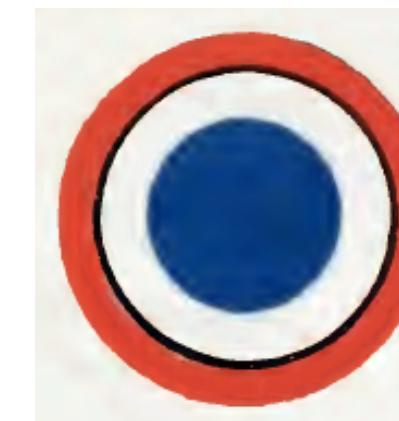
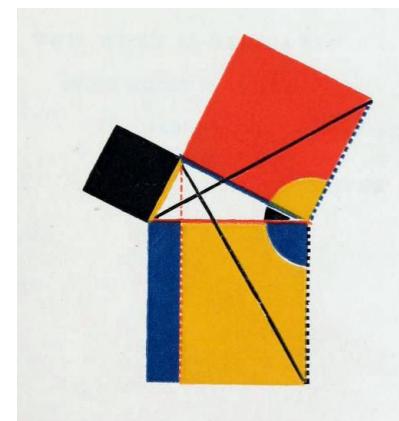
$\square \square \square$  . . . . *not greater than.*

$\square \square \square$  . . . . *not less than.*

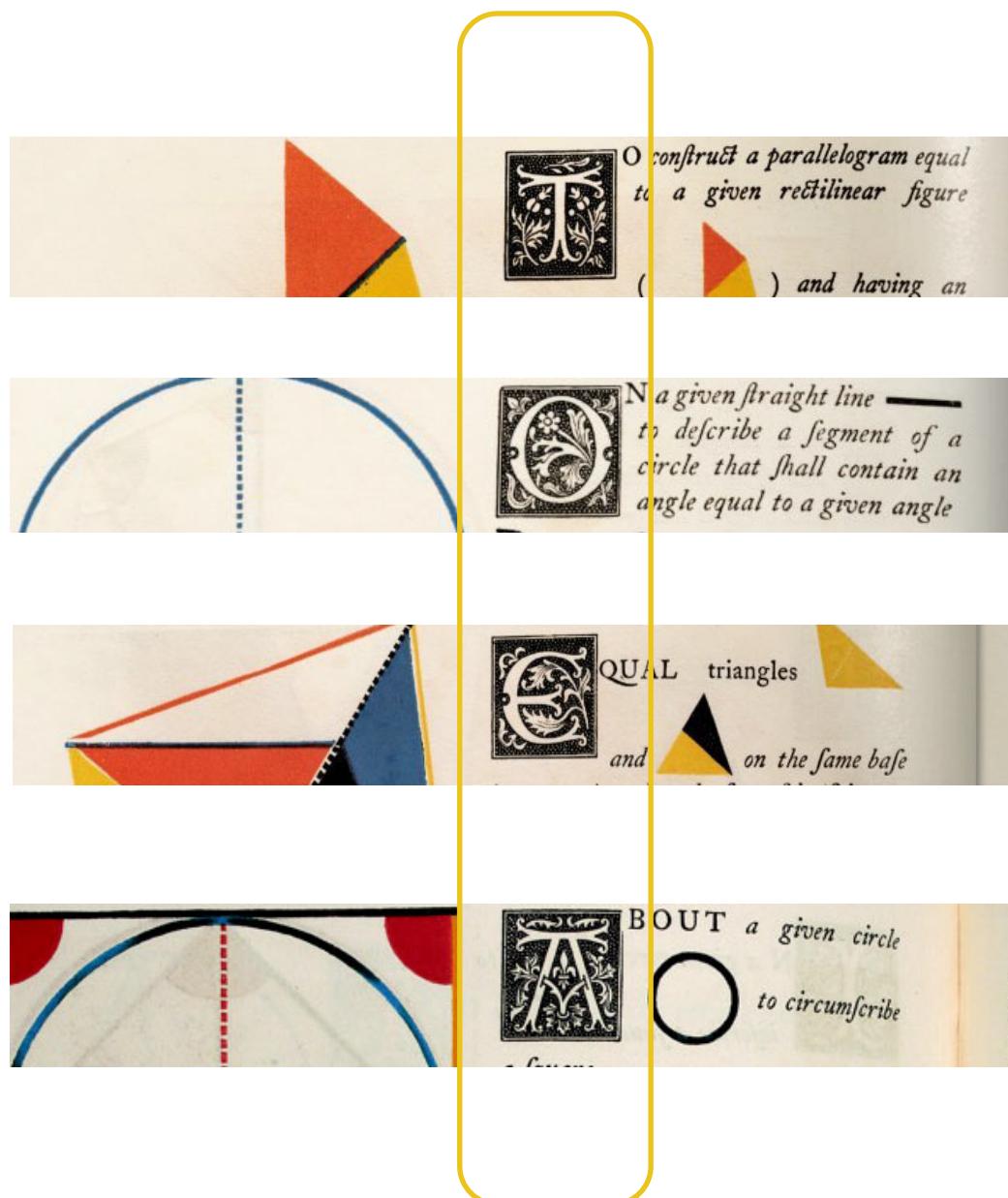
$+$  is read *plus (more)*, the sign of addition ; when interposed between two or more magnitudes, signifies their sum.

$-$  is read *minus (less)*, signifies subtraction ; and when placed between two quantities denotes that the latter is to be taken from the former.

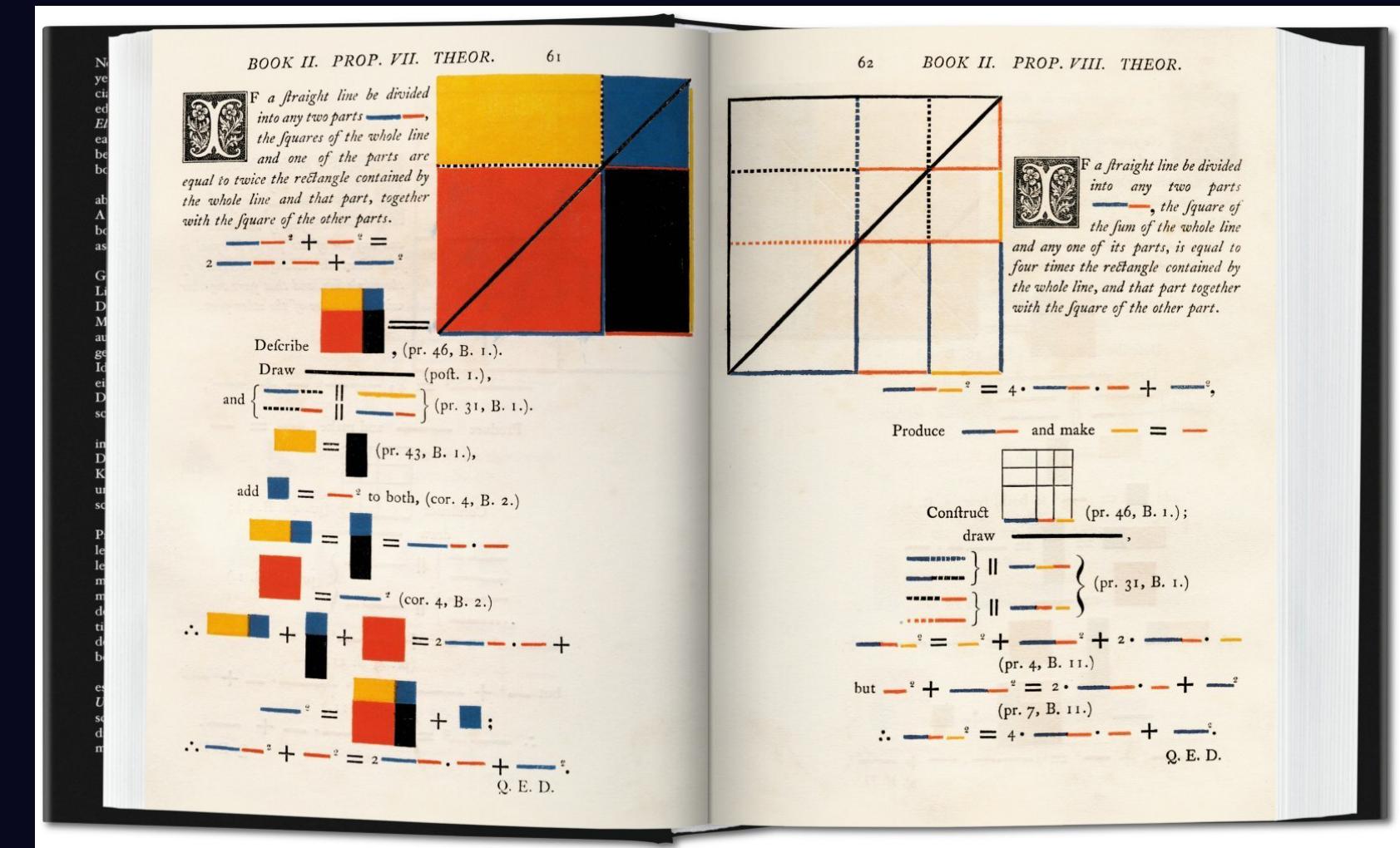
## PATTERNS : GENERATIVE EXERCISE : A SYSTEM / A LANGUAGE



## ORNAMENTAL ENGRAVINGS

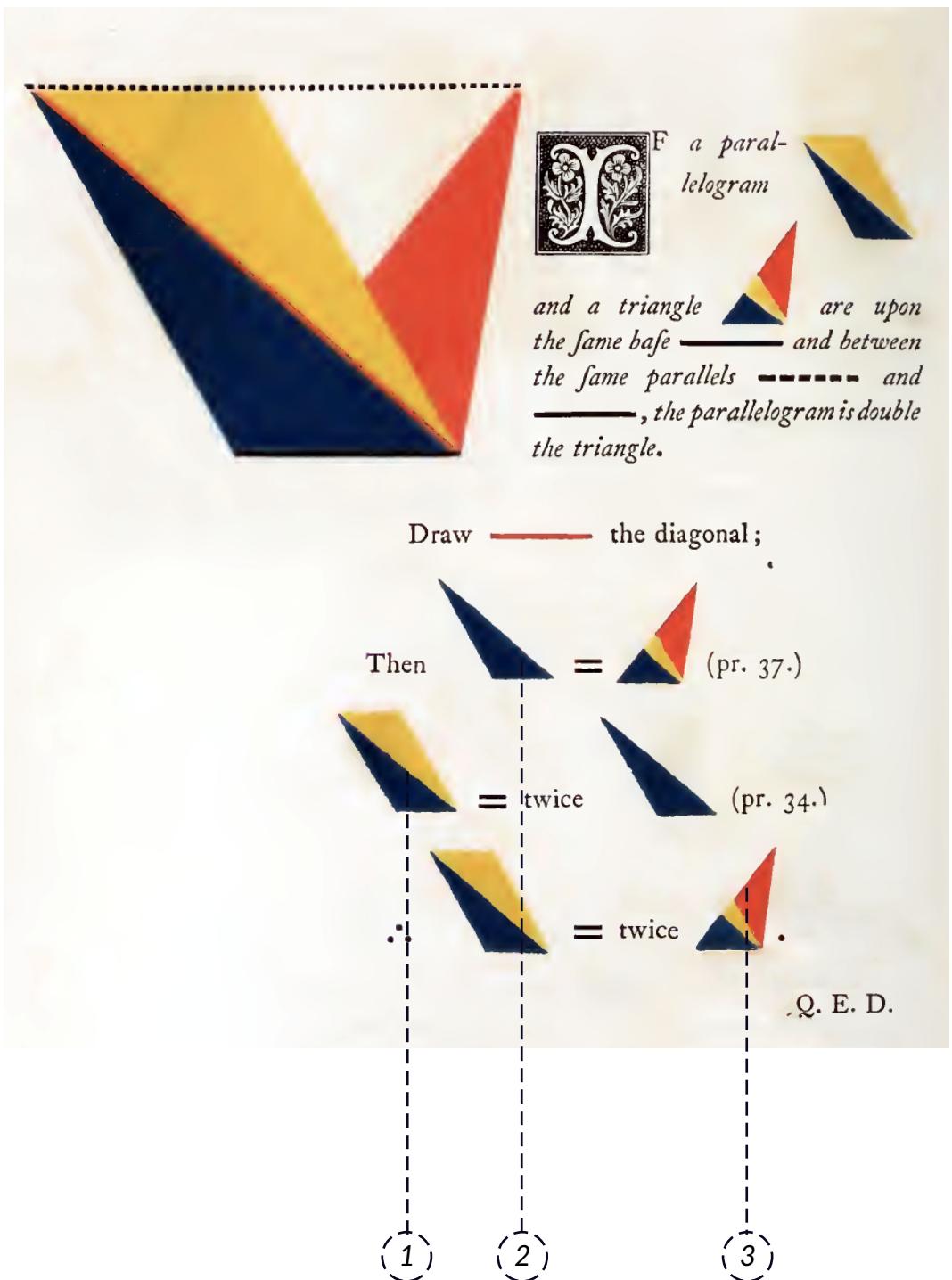


## LAYOUT



- ▶ Prominent Alignment
- ▶ Flow of the content - placement of main diagram
- ▶ Use of colorful solid and bordered shapes

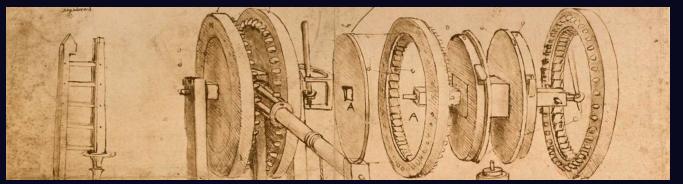
## EXPLODED VIEW



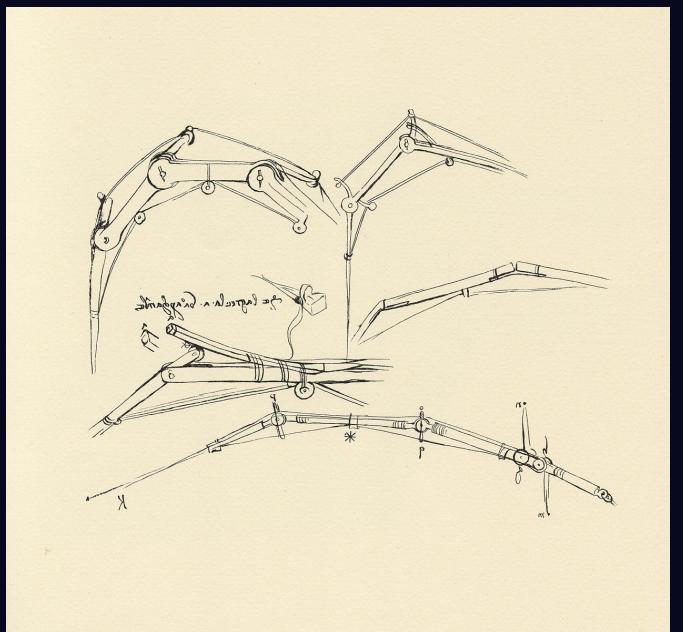
1452 - 1519

The exploded view was among the many graphic inventions of the Renaissance, which were developed to clarify pictorial representation in a renewed naturalistic way

The exploded view can be traced back to the early fifteenth century : Giorgio (1439-1502) and Leonardo da Vinci. (1452-1519)



mechanical drawings gear technology



proposed diagram of flying machine

## ADDITIONAL RESOURCES:

Euclid's Elements of Geometry:  
<http://www.math.ubc.ca/~cass/euclid/euclid.html>

Oliver Byrne's edition of 1847:  
<http://www.math.ubc.ca/~cass/euclid/byrne.html>

David Joyce's Java edition of Euclid:  
<https://mathcs.clarku.edu/~djoyce/java/elements/elements.html>

Oliver Byrne: The Matisse of Mathematics:  
<https://www.maa.org/press/periodicals/convergence/oliver-byrne-the-matisse-of-mathematics>

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<https://www.maa.org/press/periodicals/convergence/oliver-byrne-the-matisse-of-mathematics>

<https://www.youtube.com/watch?v=zvu4QSrlIAs>

Author of:

“The New and Improved System of Logarithms.”  
“The Doctrine of Proportion.”  
“The Practical, Complete, and Correct Gager.”  
“The Elements of Euclid by Colours.”  
“A Practical, Treatise on Spherical Trigonometry.”  
“How to Measure the Length of a Degree on the Earth's Surface  
by the assistance of Railroads.”

Inventor of:

“The Patent Calculating Instruments.”  
“The System of Facilitating the Acquirement of Geometry, &  
of other Linear Arts and Sciences by Colours, &c.”  
“Proposer of the New Theory of the Earth, which accounts for  
many Astronomical, Geographical, and Geological Phenomena,  
hitherto unaccounted for.”

*Is Oliver Byrne's work considerate of the universal design principles?*

*Does having many symbolic expressions help/hamper the learning process?*

*What is your opinion on the scalability of Byrne's work?*



THANK YOU

