

Divine Ratio

Envisioning Aesthetic Proportion
in
Architecture and Art

HRS 290

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Timeaus

- "For whenever in any three numbers, whether cube or square, there is a mean, which is to the last term what the first term is to it; and again, when the mean is to the first term as the last term is to the mean—then the mean becoming first and last, and the first and last both becoming means, they will all of them of necessity come to be the same, and having become the same with one another will be all one"; (31c - 32a)

Plato's Cosmos of Geometric Solids

- Demiurge crafts the cosmos from “solids”
- Solids, the particles of Plato's cosmos, consist of triangles
- Triangles are the “atoms” of Plato, the indivisible
- Later Greek philosophers assign the dodecahedron to the aether; having 12 faces. Our number symbolism associates 12 with the zodiac.

Plato's Cosmos of Mixed Solids

Thus Fire and Earth need intermediates to achieve divine mixing proportions

Hence the god set Water and Air between Fire and Earth so that

What Fire is to Air

Air is to Water

What Air is to Water

Water is to Earth

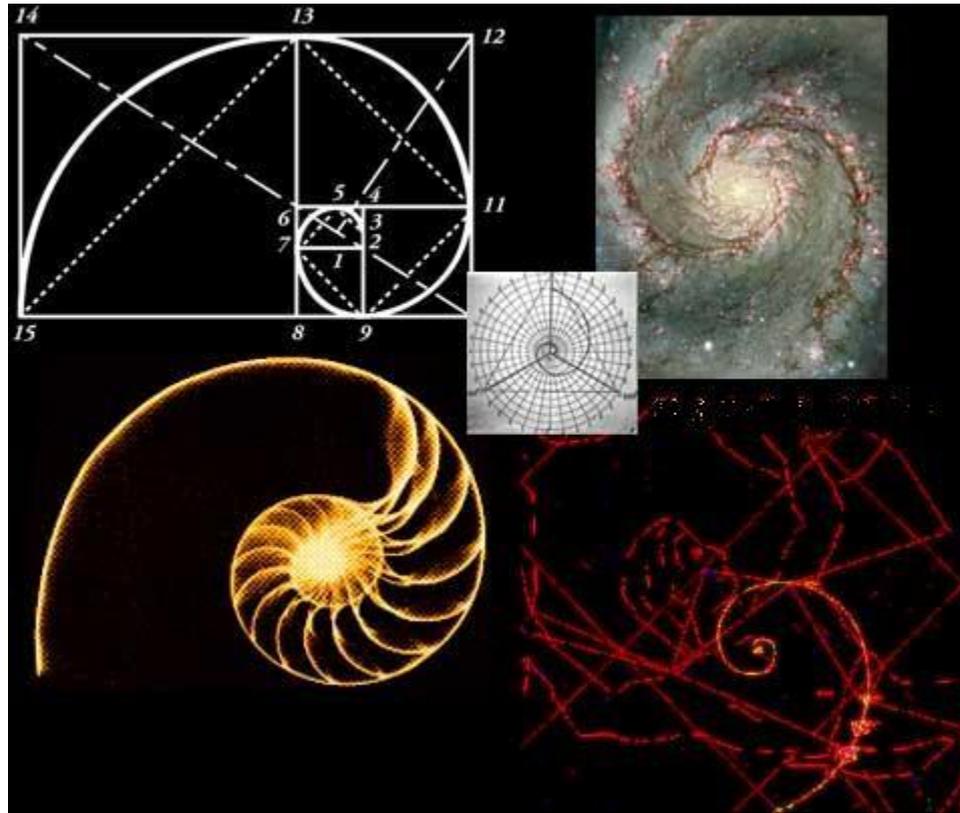
- This is why “these four particular constituents were used in a symphony of proportion” (32c)

Theology of Timeaus

- Divine Demiurge crafts “instances” of that which comes to be from perfect Forms
- Forms are enduring perfect models of Beauty
- Matter and beings are temporal artifacts modeled after Forms
- Something crafted upon the likeness of other temporal substance would lack Beauty

Divine Forms

What could have inspired Plato?



Egyptians

- 18th Century BCE Ahmes (?1800 -)
- Rhind Papyrus – “directions for knowing all dark things” - Collection of Problems in Geometry and Arithmetic, British Museum
- Exact Measurers – “rope stretchers”
- Right Triangle – 3-4-5
- Could construct angles for square, pentagon, hexagon and heptagon

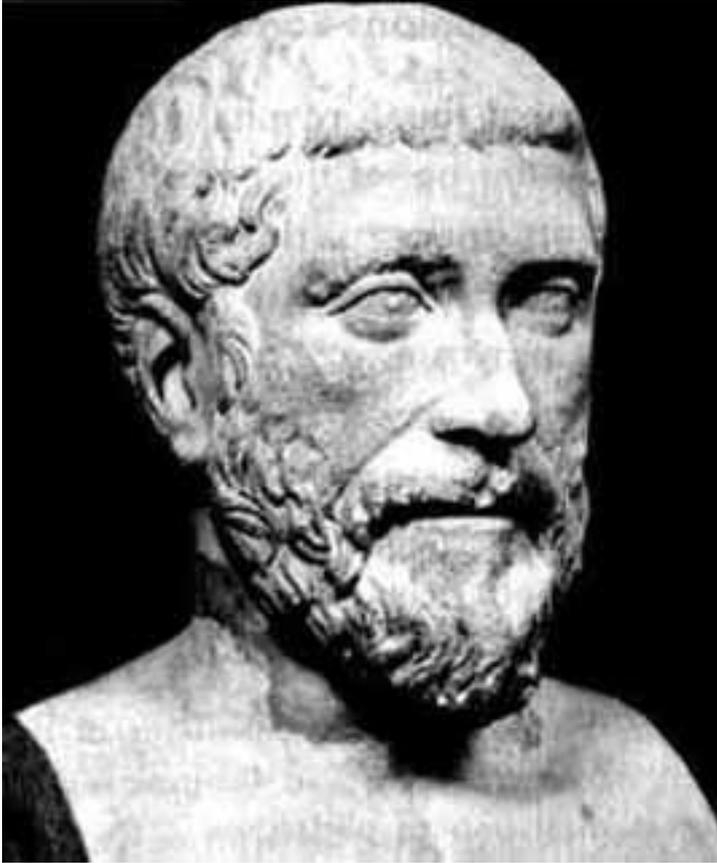
Thales – Greek Sage

- Father of Greek mathematics, astronomy and philosophy
- “asserted the existence of the abstract and the more general”
- “the very idea of abstracting all solidity and area from a material shape, such as square or triangle, and pondering upon it as a pattern of lines”

Pythagoras and Geometric Philosophy

- Pythagoras of Samos - about 569 BC - 475 BC
- Encouraged Thales, he studied counting and arithmetic with Egyptian priests
- Legend tells us the shadow lines cast by pillars on a checkered tile floor, he observed the lines creating angles across the tiles. His interest in numbers and geometry inspired him to count the tiles.

Pythagoras



Pythagorean Number Theory

Matter Numbers

- Fire is as One
- Air is as Two
- Water is as Three
- Matter is as Four

Geometry Numbers

- One is to Point
- Two is to Line
- Three is to Plane
- Four is to Solid

Order of the Pythagoreans

- Secret Society – near Religious with influence across the Grecian World
- Interested in the Study of Medicine
- A fair amount of evidence suggests the Pythagoreans began study of the Golden Ratio
- Orally treasured teaching were gradually committed in writing.
- Treatise by Philolaus came into possession of Plato

Solid Geometry of the Pythagoreans

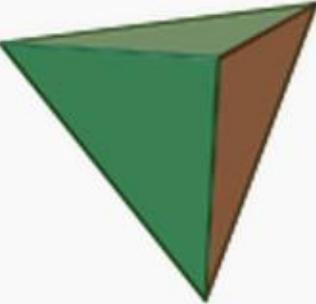
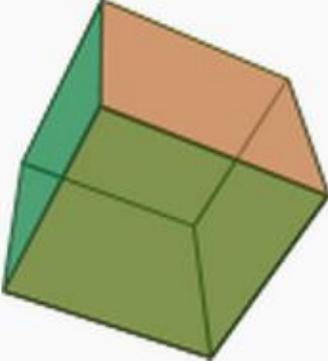
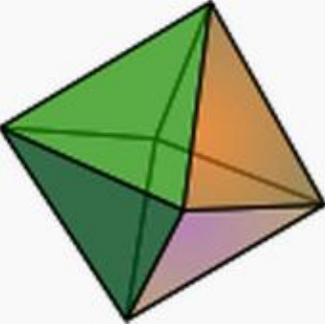
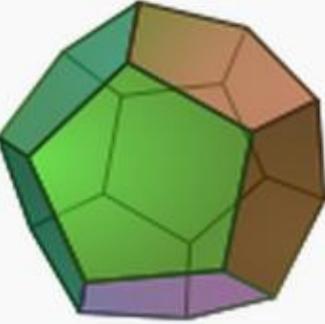
Egyptians knew of three basic geometric solids

- Tetrahedron - 4 Sides
- Pyramid - 5 Sides
- Cube - 6 Sides

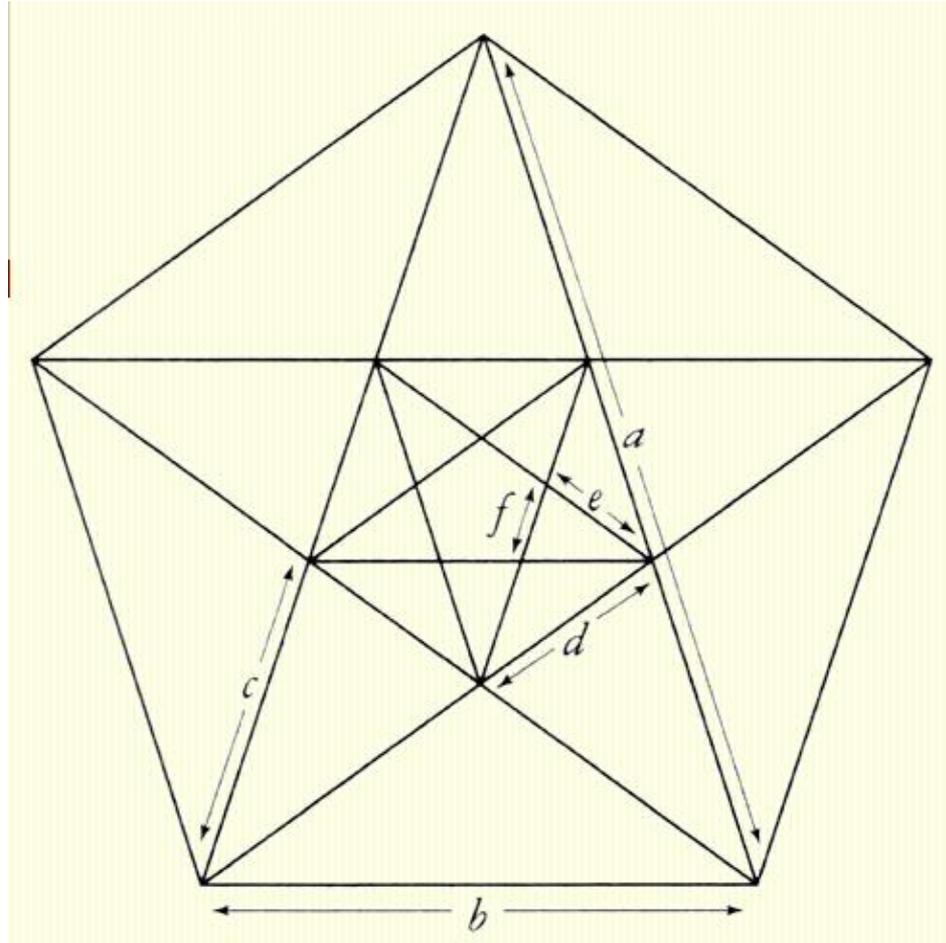
Pythagoreans envisioned two new “regular”
Geometric Solids

- Icosahedron - Polyhedron of 20 triangle faces
- Dodecahedron – Polyhedron of 12 pentagons

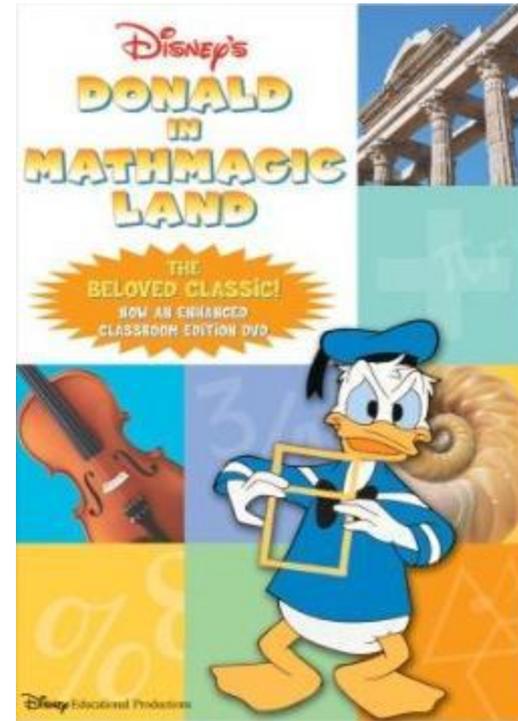
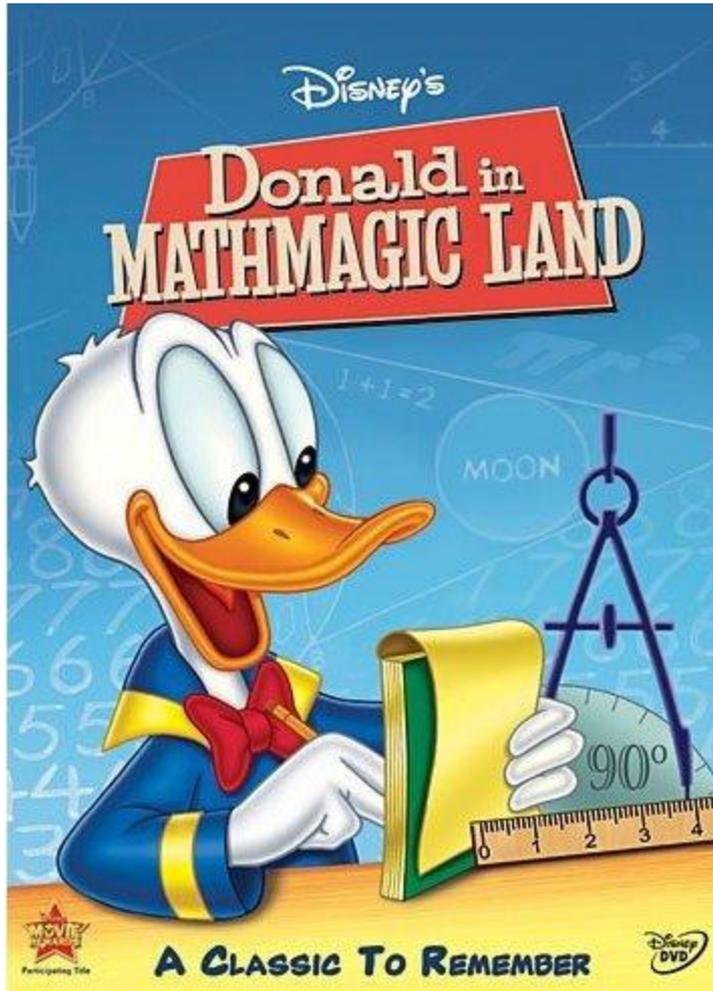
Pythagorean Platonic Solids

				
Tetrahedron {3, 3}	Cube {4, 3}	Octahedron {3, 4}	Dodecahedron {5, 3}	Icosahedron {3, 5}

Pentagon Star Segments



MATHMAGIC LAND



<http://www.youtube.com/watch?v=d6MAinPdKPQ>

<http://www.youtube.com/watch?v=gYia02Dk8Nc&feature=related>

Divine Rectangles from Segments

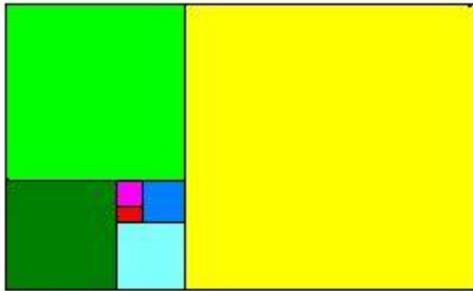


Figure 2

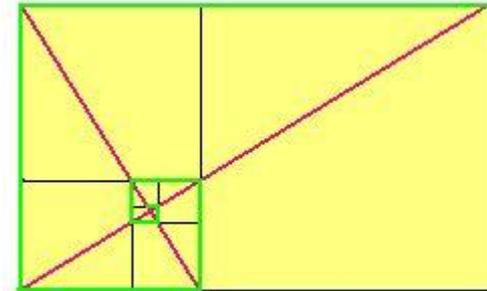


Figure 3

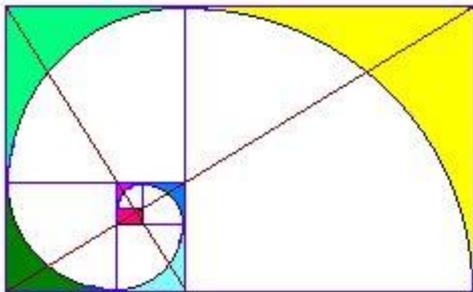
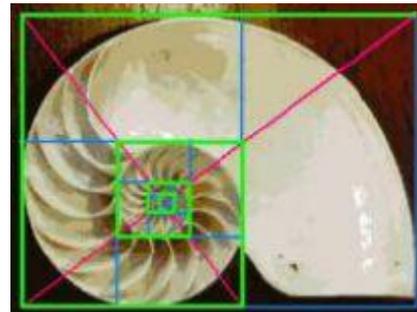


Figure 1

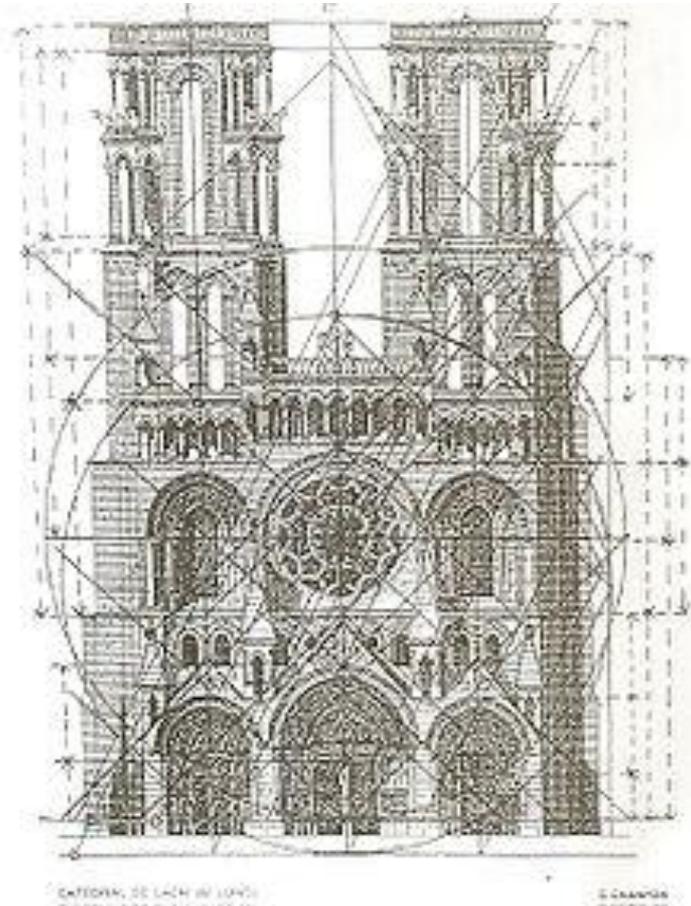
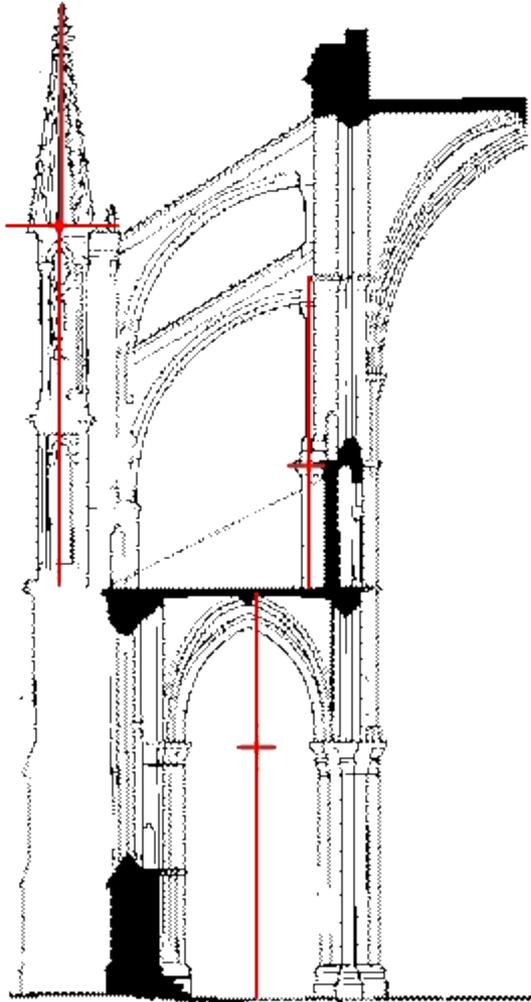


Greek Art and Architecture

Poseidon, our local replica of the famous statue that appears in the National Archeological Museum in Athens. The Sacramento Poseidon, located in a public park between the Sacramento Convention Center and a community theater, was a gift to the city from the government of Greece in 1972



Gothic Architecture

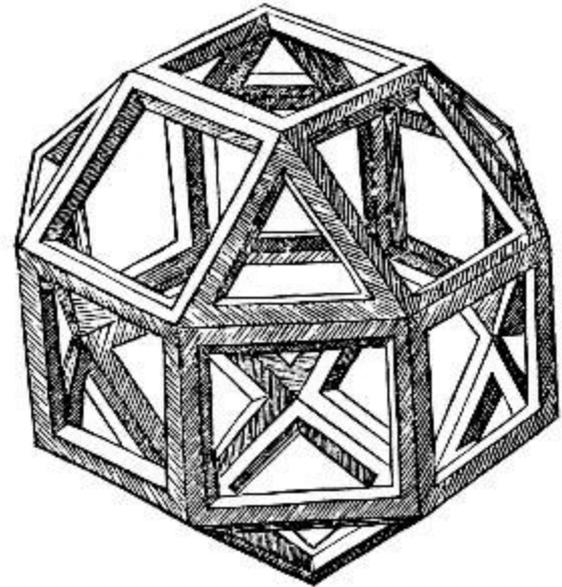
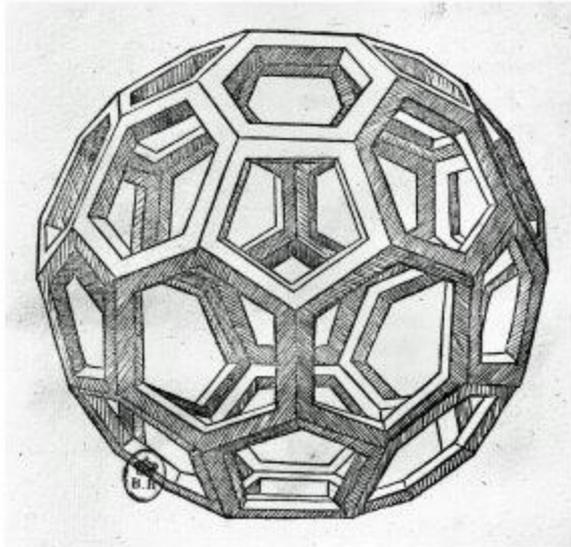


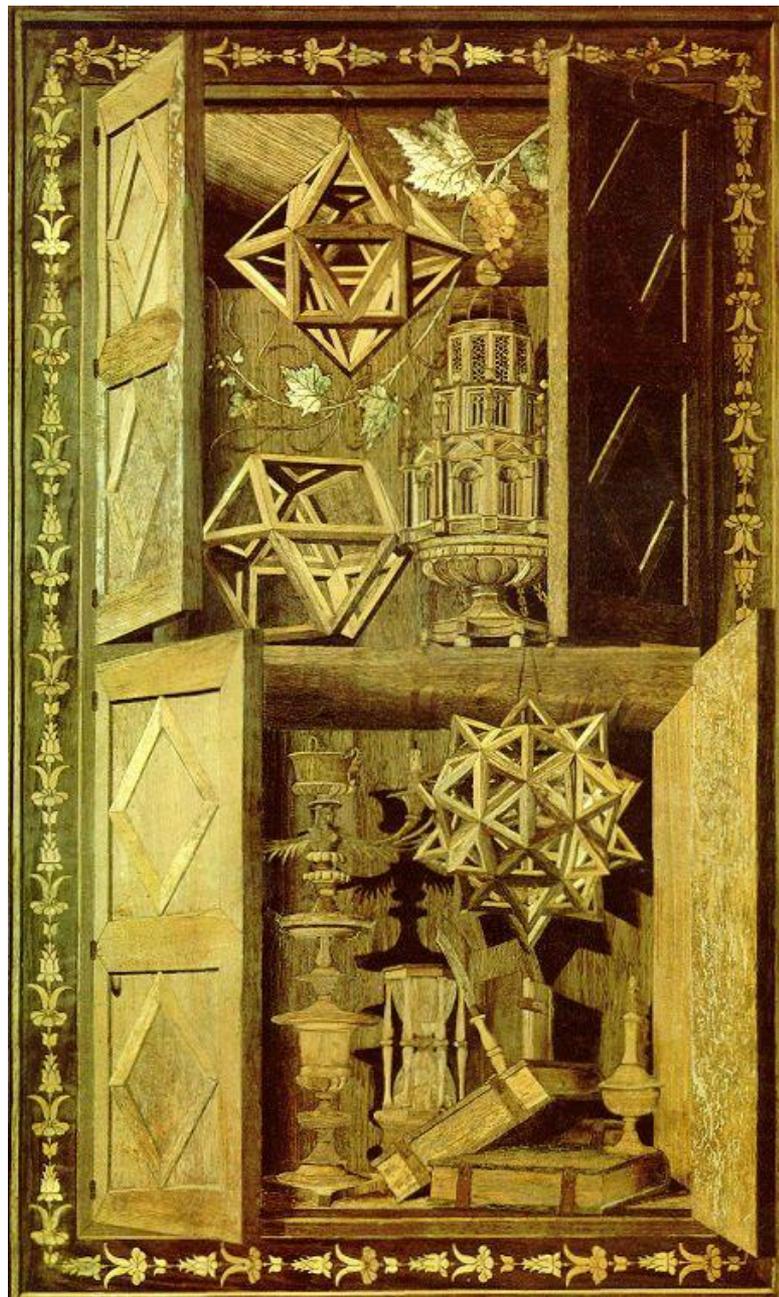
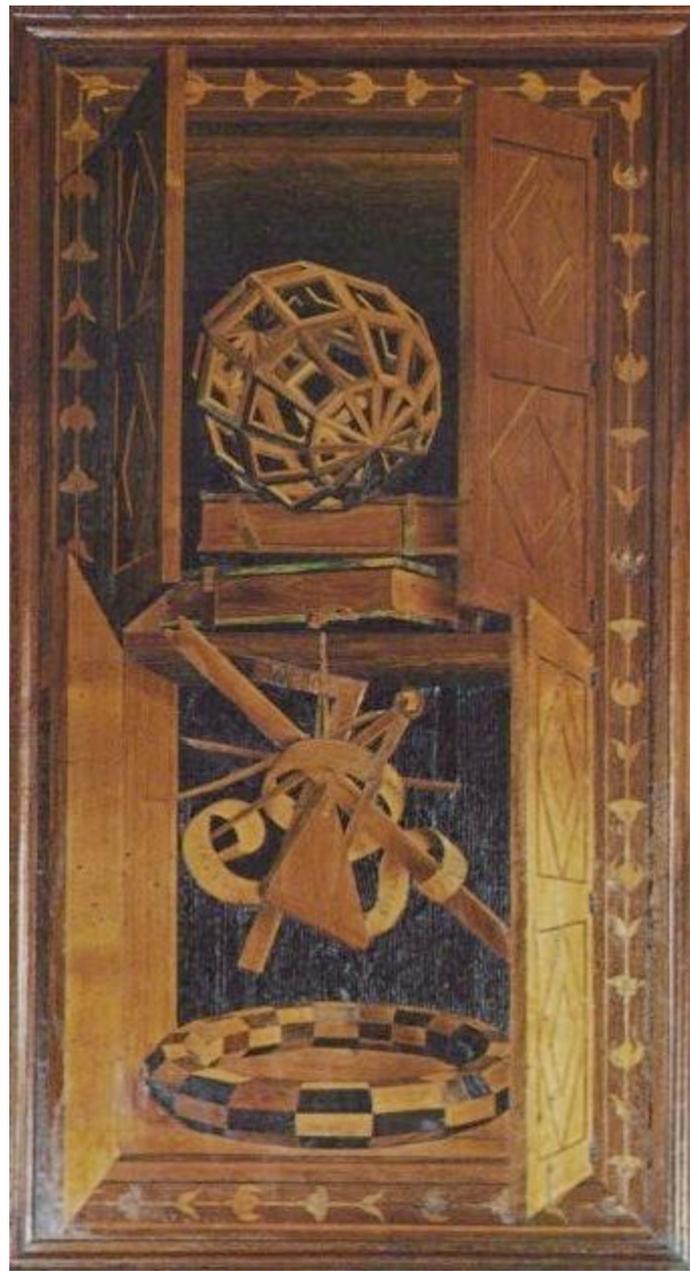
2000 Years Later

- Luca Pacioli (1445-1517) in *Divina Proportione* wrote about the divine proportion including drawings by Leonardo da Vinci

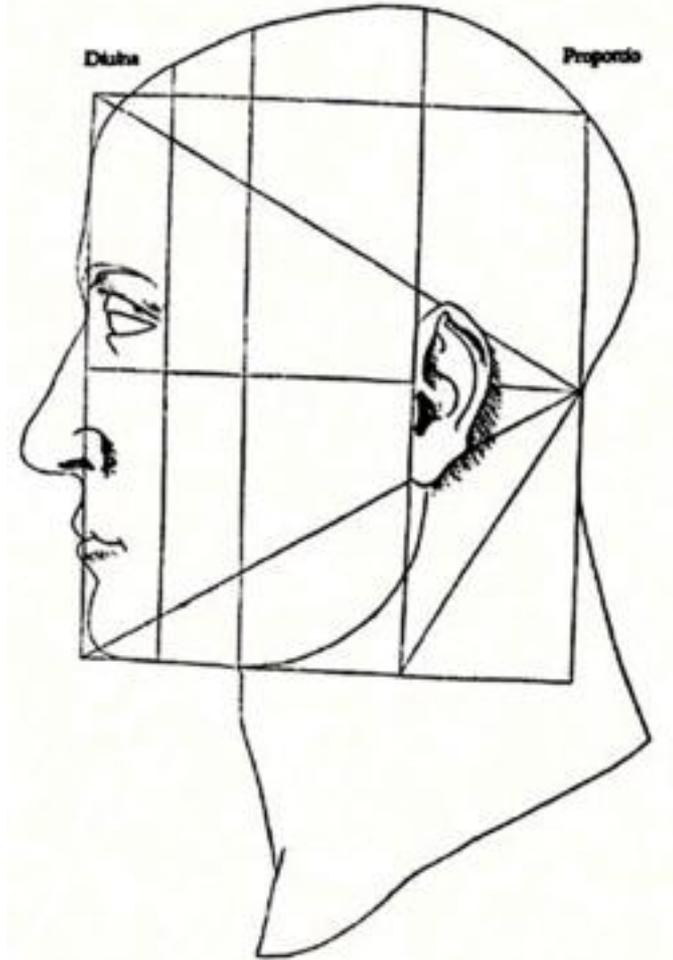
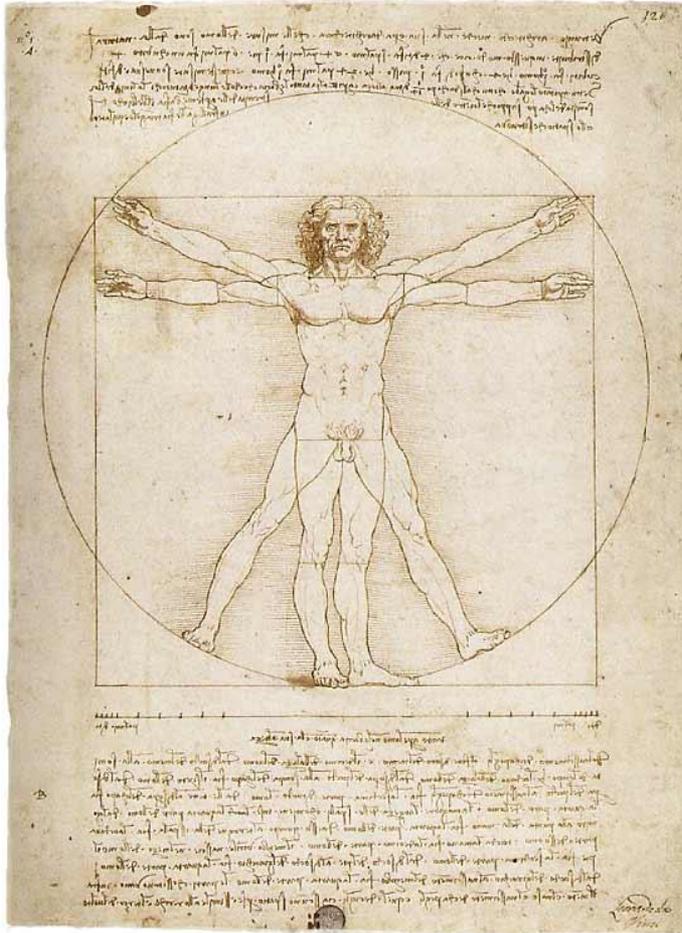


Leonardo's Wooden Solids from Divine Proportion





Da Vinci and the Golden Ratio



The Annunciation – da Vinci



Fibonacci and the Rabbit Series

- In 1202, the mathematician Leonardo of Pisa, also called Fibonacci, published an influential treatise, Liber abaci. It contained the following recreational problem:
- "How many pairs of rabbits can be produced from a single pair in one year if it is assumed that every month each pair begets a new pair which from the second month becomes productive?"

Month:	1	2	3	4	5	6	7	8	9	10	11	12
No. of pairs:	1	1	2	3	5	8	13	21	34	55	89	144

The series converges on the golden ratio in 12 steps, becoming better:
 $1/1$, $2/1$, $3/2$, $5/3$... $89/55$, $144/89 = 1.6179775$

Divine Ratio goes Symbolic

- Algebraically: $\frac{a+b}{a} = \frac{a}{b} \equiv \varphi$.

Φ – phi – 1.618... Φ Conjugate – 0.618...

- Symbolically assigned the Greek letter (phi) in 1909
- Pheidias (circa 480 BCE – 430) the Athenian sculptor identified in Protagoras with “I know that Pheidias is a sculptor”. Pheidias is also the assumed architect of the Parthenon

Albrecht Dürer

German painter, printmaker and theorist (1471 –1528)

Multiple theoretical works involving principles of mathematics, perspective and ideal proportions.



Gustave Caillebotte - 1882



Modern Cosmology and the Golden Ratio

- The Grand Design refers to the cosmogony of Plato as that which requires a “miracle”
- Presumably the Divine Section is apparent in the M-Verse

Φ

- “Geometry has two great treasures...one is the theorem of Pythagoras; the other, the division of a line into extreme and mean ratio. The first we may compare to a measure of gold; the second we may name a precious jewel”.
(Johannes Kepler)