

Greek Puzzles and Enigmas: A Paradox?

by Pantazis Constantine Houlis



Figure 1: A wooden interlocking “Greek Flag” puzzle made by Michael Toulouzas.

Greece has always been a source of extraordinary objects and philosophies, so it is no surprise that puzzles, enigmas and paradoxes are also part of this list. And despite a relative drought of puzzling objects and subjects in the past few centuries (due to exhausting wars), Greece has always been an inspiration to many puzzlers.

The Very First Mechanical Puzzle

The oldest known mechanical puzzle whose (partial) information was saved in scripts is the **Ostomachion**, and it was invented by Archimedes. It was made in the 3rd century BC. The game consists of a square divided into 14 parts, and the aim was to create different shapes from those pieces. This is not an easy task.

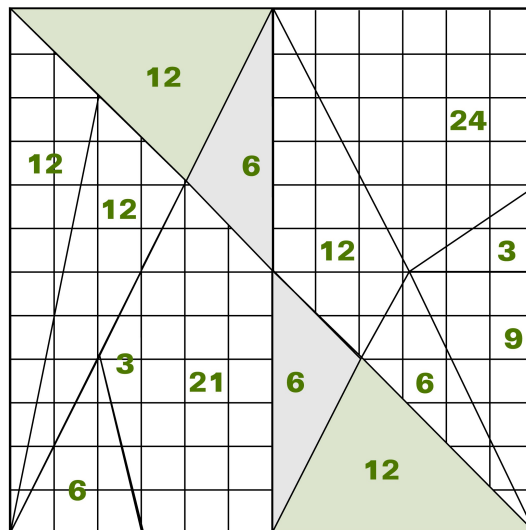


Figure 2: The Ostomachion (In Greek: Οστομάχιον) by Archimedes.

Minoan Monuments

I was very fortunate to complete my Bachelor's Degree in Mathematics at the University of Crete in Heraklion. Not only it is a highly regarded University, but it is also situated just one kilometer away from the Palace of ancient Knossos, where King Minos used to rule. Knossos is related to many puzzles and mysteries, one of which is the Disc of Phaistos.



Figure 3: The Disc of Phaistos (In Greek: Δίσκος της Φαιστού).

The disc was discovered in 1908 by the Italian archaeologist Luigi Pernier in the Minoan palace-site of Phaistos, and features 241 tokens, comprising 45 unique signs, which were made by pressing pre-formed hieroglyphic "seals" into a disc of soft clay, in a clockwise sequence spiraling towards the disc's center. The Phaistos Disc has captured the imagination of many archeologists, and attempts have been made to decipher the code (written in "Linear B") behind the disc's signs.

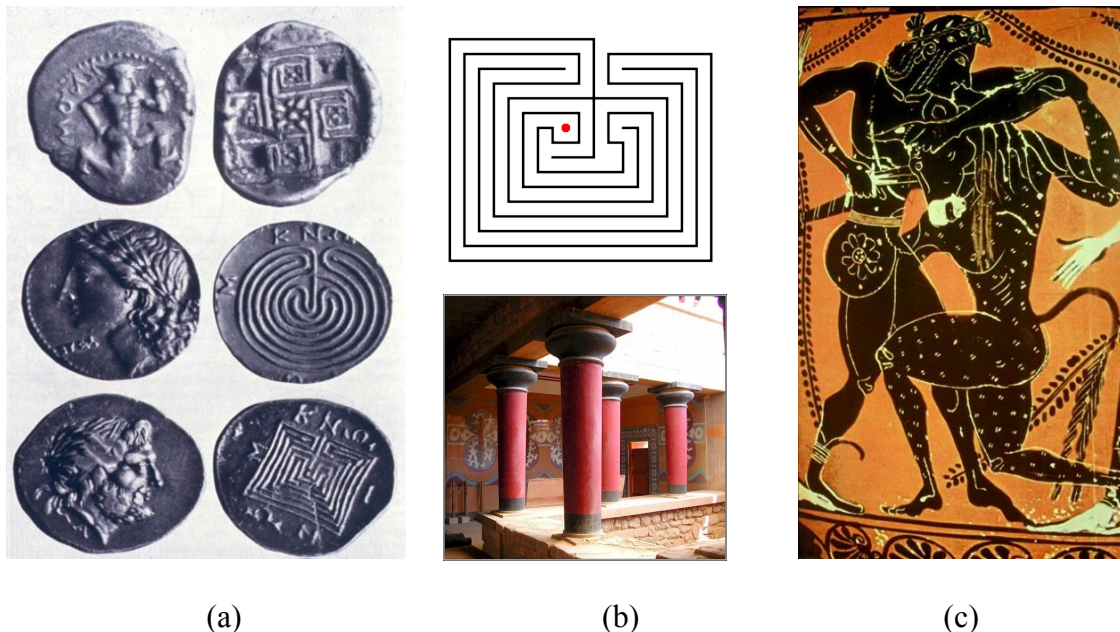


Figure 4: (a) Greek coins with different versions of the Labyrinth (Λαβύρινθος) inscribed on them, (b) a more detailed view of the Labyrinth and columns at the Palace of Knossos, and (c) an ancient drawing of Theseus slaying Minotaur.

The Palace of Knossos was also the home of the Labyrinth, an elaborate structure designed and built by the artificer Daedalus for King Minos. Its function was to hold the Minotaur, a creature that was half man and half bull. The structure was essentially a maze, and its details were inscribed on ancient Greek coins.

Although the design of Labyrinth does not seem as a real challenge for an experience puzzler, the name is widely used today to describe many maze-like structures.

Great Alexander and the Gordian Knot

Aristotle was one of the greatest philosophers of ancient Greece. Little he knew that his student, Alexander the Great, would be using a more physical than philosophical approach to solve the “Gordian Knot” puzzle.

An oracle at Telmissus (the ancient capital of Phrygia) decreed that the next man to enter the city driving an ox-cart should become their king. This man was a poor peasant, Gordias, who drove into town on his ox-cart. He was declared king by the priests. In gratitude, his son Midas dedicated the ox-cart to God Zeus and tied it to a post with an **intricate knot**.

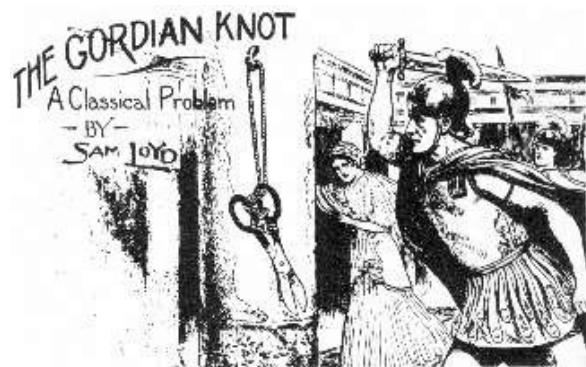


Figure 5: The Great Alexandrian solution has been presented in many paintings and drawings, and was also listed in Sam Loyd’s famous puzzle book.

In 333 BC, Alexander the Great arrived and attempted to untie the knot. When he could not find the end to the knot to unbind it, he sliced it in half with a stroke of his sword, producing the required ends (the so-called "Great Alexandrian solution"). An oracle had prophesied that the one to untie the knot would become the king of Asia.

The knot may in fact have been a religious knot-cipher guarded by Midas's priests and priestesses. Until today, this legendary story has been interpreted in various ways, and the name “Gordian Knot” has been given to many different puzzles.



Figure 6: Various puzzles adopted the name “Gordian Knot” (“Τόρδιος Δεσμός”).

Pythagoras’ Cup, Mystery Tablet, Theorem, and Chromatic Scale

Pythagoras (585-500 b.c.) was born in Samos but resided and flourished for years in the southern town of Krotona, Italy. His parents named him Pythagoras honoring the ancient prophet Pythia. He is considered one of the most significant of ancient Greek philosophers and mathematicians. Founder of the Pythagorean School, and father of the renowned mathematical theory, his teachings evolved from travel experiences.





Figure 7: The Pythagorean Cup of Justice (In Greek: Δικαία Κούπα).

The **Pythagorean cup** is a form of drinking cup which allows the user to fill the cup with wine up to a certain level. If the user fills the cup no further than that level he may enjoy his drink in peace. If he exhibits gluttony however, the cup wreaks instant retribution by spilling its contents out through the bottom. Pythagoras' cup looks exactly like a normal drinking cup, except that the bowl has a central column in it.

The central column of the bowl is positioned directly over the stem of the cup and over the hole at the bottom of the stem. A small, open pipe runs from this hole almost to the top of the central column, where there is an open chamber. The chamber is connected by a second pipe to the bottom of the central column, where a hole in the column exposes the pipe to the contents of the cup. When the cup is filled, liquid rises through the second pipe up to the chamber at the top of the central column.

As long as the level of the liquid does not rise beyond the level of the chamber, everything is all right. If the level rises further however, the liquid spills through the chamber into the first pipe and out through the bottom. Hydrostatic pressure then creates a siphon through the central column causing the entire contents of the cup to be emptied through the hole at the bottom of the stem. This way, the avid is punished.

It is also called Cup of Justice because except from hydrostatic pressure, it reflects one of the basic principles of justice, the principle of Vituperation (in Greek: Ὑβρις) and Vengeance (in Greek: Νέμεσις).

When the limit is exceeded (vituperation), not only are lost those that have exceeded the limit, but also all the precedents that had been acquired (vengeance). With a simple example of hydrostatic pressure, Pythagoras teaches us to accept what we already have and not ask for more and more.

Note that, Chinese versions of this cup were found two millenniums later during the Ming Dynasty.

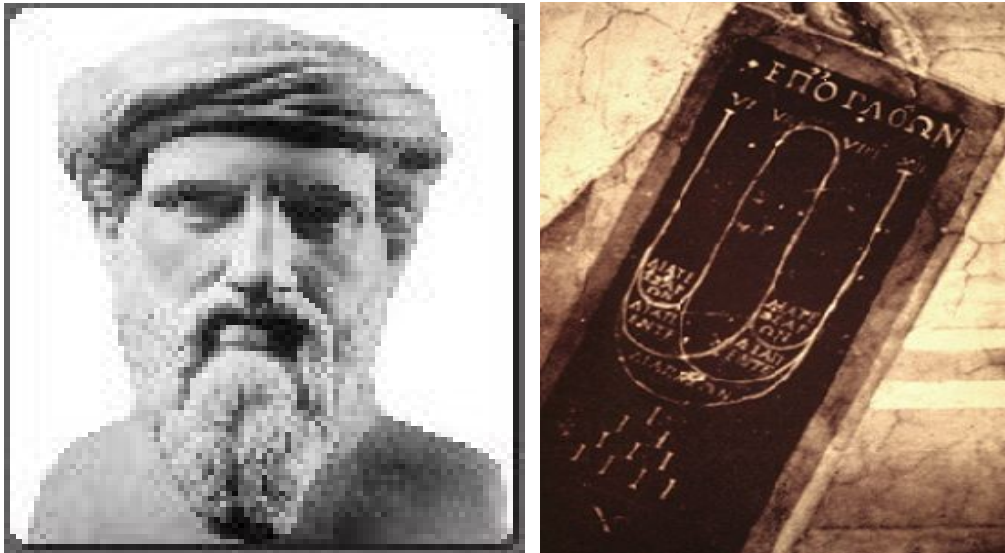


Figure 8: Pythagoras and his Mystery Tablet.

The Pythagoras **Mystery Tablet** is a code that is believed to provide "The Keys to Heaven and Hell." Whoever can decipher its true meaning and utilize the process therein can enter the other worlds. Some extreme cult beliefs suggest that it is a formula for inter-dimensional portal travel!

Pythagoras believed that no such thing as coincidence existed. All things happened in accord with the Gods will. When he proved the Pythagorean Theorem, it was the first time that the structure of nature was translated into numbers. And the form of those numbers describes the exact laws that bind the universe.

It is very interesting that numerology was very much a part of some of the most famous philosophers and mathematicians in ancient Greece. A perfect example is the **different symbolic meanings** (until today) of his Pythagorean Theorem, especially when using specific numbers, such as 3, 4, and 5 (also know as Euclid's 47th Problem).



Figure 9: Euclid's 47th Problem and Pythagoras' Chromatic Scale.

Yet another interesting concept developed by Pythagoras was the Chromatic Scale. It is a musical scale which was harmonised with the vibration of the spinal column, each vertebrae being a note on an ascending scale. The lower notes beginning at the base of the spine, becoming higher as one goes up towards the brain. His musical scale put middle C at [2.5.6] vibration to match the [2.5.6] spinal column vibration and thus music was used for healing purposes successfully. In fact, Pythagoras was the one who came up with the standard 12-note system. And he used his skills in mathematics to work it all out. The puzzle (of properly organising the music) was over!

The Antikythera mechanism

At about 80 B.C. off the small Greek island of Antikythera, a ship sank in rough seas. It carried a remarkable device called the Antikythera Mechanism, the most complex mechanical device from antiquity. The origin of the device (based on evidence found on the ship), seems to have been **the island of Rhodos**, which at that time was one of the biggest educational centers of the known world.

In 2005 and 2006, X-rays had enabled almost all of the Greek internal inscriptions to be viewed and translated (over 2,160 characters, representing about 95% of the extant text). Those findings shed new light concerning the function and purpose of the Antikythera mechanism. Research is ongoing until today.

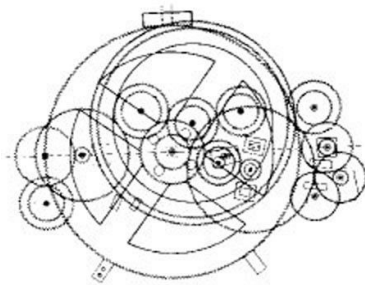


Figure 10: Scan view (top-left), original view (bottom-left) and 3D reconstruction view (right) of the Antikythera Mechanism.

The front dial of the Antikythera mechanism tracked the motions of the moon and sun along the months and zodiac. The inner dial (months) was moveable. It is thought that the inside part of the dial was painted with the constellations.

The rear dials are slightly trickier, since hardly anything of them survived. Their purpose had to be deduced by counting gear teeth and calculating their ratios. The upper rear dial calculated the synodic month (a period of 27.5 days, calculated by subtracting the sun's motion from the moon's), while the lower rear dial probably showed lunar eclipses over four year cycles. Both rear dials had smaller subdials which probably showed some yearly cycle but their exact purpose will probably never be known.

Famous Enigmas, Paradoxes, and Oracles

The oldest and most famous known Enigma is the **Sphinx's Enigma**.

It was said that Hera or Ares sent the Sphinx from her Ethiopian homeland to guard the entrance to the Greek city of Thebes, where she asked all travellers the riddle:

"Which creature in the morning goes on four legs, at mid-day on two, and in the evening upon three, and the more legs it has, the weaker it be?"

She strangled and devoured anyone unable to answer. **Oedipus** solved the riddle by answering: Man—who crawls on all fours as a baby, then walks on two feet as an adult, and then walks with a cane in old age.

Today, there are myriads of enigmas and riddles in our everyday life. They are in fact an integral part of the knowledge-seeking attributes of the human beings.



Figure 11: Oedipus and the Sphinx (left), and Pandora's Box/Jar(!) (right)

Pandora means "giver of all" (in Greek: "Πανδώρα"), and she was said to be the first woman on Earth. She was created upon the command of Zeus to Hephaestus, the God of craftsmanship. Hephaestus created her using water and earth, and other Olympian Gods granted her many gifts (for example, beauty from Aphrodite, persuasiveness from Hermes, and music from Apollo).

After Prometheus stole fire from Mount Olympus, Zeus sought reprisal by handing Pandora to Epimetheus, the brother of Prometheus. At the same time, Pandora was given a jar that she was ordered not to open under any circumstances. Despite this warning, overcome by curiosity Pandora opened the jar. Upon doing so, the evils contained within escaped into the world. Scared, Pandora immediately closed the jar, only to trap Hope inside, as was Zeus' will.

This story has inspired the creation of many puzzles which withhold **hidden** features and/or mechanisms. But besides the puzzle-like interpretation, Pandora's Box symbolizes many more.

The **Epimenides Liar paradox** is the most famous of all paradoxes. The Cretan philosopher Epimenides once said:

"All Cretans are liars!"

Did Epimenides speak the truth? A first glance is very deceiving, but by thinking more carefully, one can reveal the confusing nature of those words. If Epimenides was telling the truth, then according to his own words, how can he be a liar? And if he was lying, then that very same statement converges to someone who is a truth teller!

A **paradox of self-reference** is commonly supposed to arise when one considers whether Epimenides spoke the truth. However, if Epimenides knew of at least one Cretan (other than himself) who was not a liar, then his statement is a non-paradoxical lie in that it does not lead to a logical contradiction.

Philetas of Kos (Kos is an island beside Rhodes), a scholar and poet, died prematurely, due to the unbearable anxiety which this paradox had caused him.

The **Delphic Oracle** was established in the 8th century BC. During this period the Delphic Oracle was the most prestigious and authoritative oracle in the Greek world. Pythia, the priestess at the Temple of Apollo at Delphi, delivered oracles in a frenzied state induced by vapors rising from a chasm in the rock, and that she spoke gibberish which priests reshaped into the enigmatic prophecies preserved in Greek literature.

The most striking attribute of those prophecies, was their riddling form which sometimes could be interpreted in more than one ways!

Puzzling Mathematical Notions

Some of the biggest puzzles and enigmas in ancient Greece were directly related to mathematics. This is no surprise as mathematics flourished during those ancient times.

The Delian problem (also known as the **doubling of the cube**) is one of the three most famous geometric problems unsolvable by compass and straightedge construction. To "double the cube" means to be given a cube of some side length s and volume V , and to construct a new cube, larger than the first, with volume $2V$ and therefore side length s times the cubic root of 2. The problem is known to be impossible to solve with only compass and straightedge, because the cubic root of 2 is not a constructible number.

Squaring of the Circle. Just like the Delian Problem, squaring the circle involved the calculation of π , which is a non-constructible number. Anaxagoras, Hippocrates of Chios, Archimedes, Antiphon the Sophist, Eudemos, and Oenopides, were just some of the ambitious Greeks who attempted to solve the problem. Each of them used a different method, but as expected, the best they could achieve was an approximation.

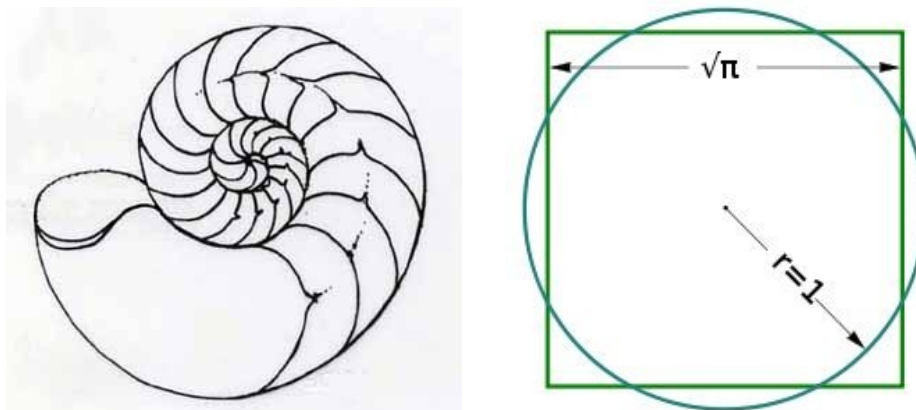


Figure 12: The Golden Ratio in nautilus (left) and Squaring the Circle (right).

The Golden Ratio (Divine Proportion mysteriously found in nature) was first used by Pheidias when building the Parthenon. The properties of the Golden Ratio are so puzzlingly amazing, that it is widely used even in applied mathematics and engineering (for example in Numerical Analysis methods).

Also known as the Golden Section, the Golden Ratio is a proportion produced when a line is divided so that the ratio of the length of the longer line segment to the length of the entire line is equal to the ratio of the length of the shorter line segment to the length of the longer line segment. The ratio is the unending number 0.618033...

Since antiquity, philosophers, artists, and mathematicians have been intrigued by this ratio that is accepted

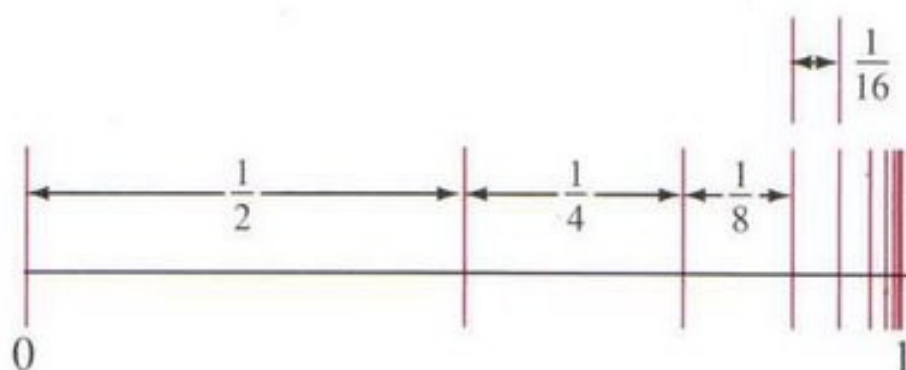


Figure 13: Zeno's Paradox.

Zeno's paradox: Suppose we wish to cross the room. First, we must cover half the distance. Then, we must cover half the remaining distance. Then, we must cover half the remaining distance. Then we must cover half the remaining distance, and so on forever. The consequence is that we can never get to the other side of the room.

This paradox was part of a tale between a Tortoise and Achilles. In today's mathematics, it described the limit of a summable infinite series.

The **Sieve of Eratosthenes** is a simple, ancient algorithm for finding all prime numbers up to a specified integer. It works very efficiently for the small primes. The prime numbers (only divisible by 1 and themselves) were of special importance not only to mathematicians, but also to philosophers and religious symbolisms.

Wonder Puzzles

A brief note is also deserved for the extremely puzzling nature of five of the **Seven Wonders of the Ancient World** which were built by Greeks. Those were:

1. Statue of Zeus at Olympia (466-456 BC, built by Greeks).
2. at Ephesus (550 BC, built by Lydians, Persians, & Greeks).
3. Mausoleum of Halicarnassus (351 BC, built by Carians, Persians, & Greeks).
4. Colossus of Rhodes (292-280 BC, built by Greeks).
5. Lighthouse of Alexandria (280 BC, built by Greeks).



Figure 14: The Colossus of Rhodes (left), the Temple of Artemis (center), and the Statue of Zeus (right).

The architecture, design, quality, accuracy, of those elegant structures was simply breathtaking. Until our days, it is difficult to conceive the technology which was employed during those ancient times to eventually bring to life monumental marvels whose glory is still celebrated a few millennia later.

The sad aspect of the story, is that much of the information is lost and most of the clues missing, raising many puzzling questions of gigantic proportion regarding many of their mythical features and mysterious nature. But this also serves as an inspiration to seek for more knowledge and to one day unlock their well hidden secrets.

Intriguing Designs: The Greek Key and the Byzantine Chain

One of the founders of modern studies in Greek mythology, Károly Kerényi, pointed out, "the Greek Key (also known as meander) is the figure of a **labyrinth in linear form**". Greek Keys were among the most important symbols in ancient Greece. They symbolized infinity and unity. Greek vases, especially during their Geometric Period, were likely the genesis for the widespread use of the Greek Key. They were even used on Greek battle shields.



Figure 15: The Greek Key found on streets of Rhodes made with mosaics (left) and the Byzantine Chain (right).

A **Byzantine chain** is a metal link chain design used in jewellery that incorporates a rope-like texture and **intriguing puzzling textural design**. The chains are supple and flexible, draping gracefully about the neck. Byzantine Chains are said to be originated from Rome, but it was during the Byzantine Empire years where this style continued to decorate early Byzantine jewellery. Then, Christian themes emerged in the 5th century, and Crosses and Byzantine chain necklaces became very popular.

Greek Puzzles in the 21st Century

Today, there is a dynamic of new puzzles coming from Greece. The most prominent of all are the V-Cubes, based on **Panagiotis Verdes'** (a surveying engineer from Nafplio) revolutionary mechanism, extending the traditional 3x3x3 Rubik's Cube to cubes with squares divided up to 11x11x11. Before the development of the V-Cube mechanism, puzzle designers had hit a concrete wall for two decades, while searching for a stable 6x6x6 cube.

The V-Cubes have already been accepted and embraced by puzzlers, collectors, hobbyists, and speedsolvers, and their design has inspired many puzzle builders and opened new expanding mechanical ways to develop non-cubic twisty puzzles. Even the magical structures of the internal pieces of a V-cube, also looks like it has something ancient Greek to it. Was it made by luck? I don't think so!

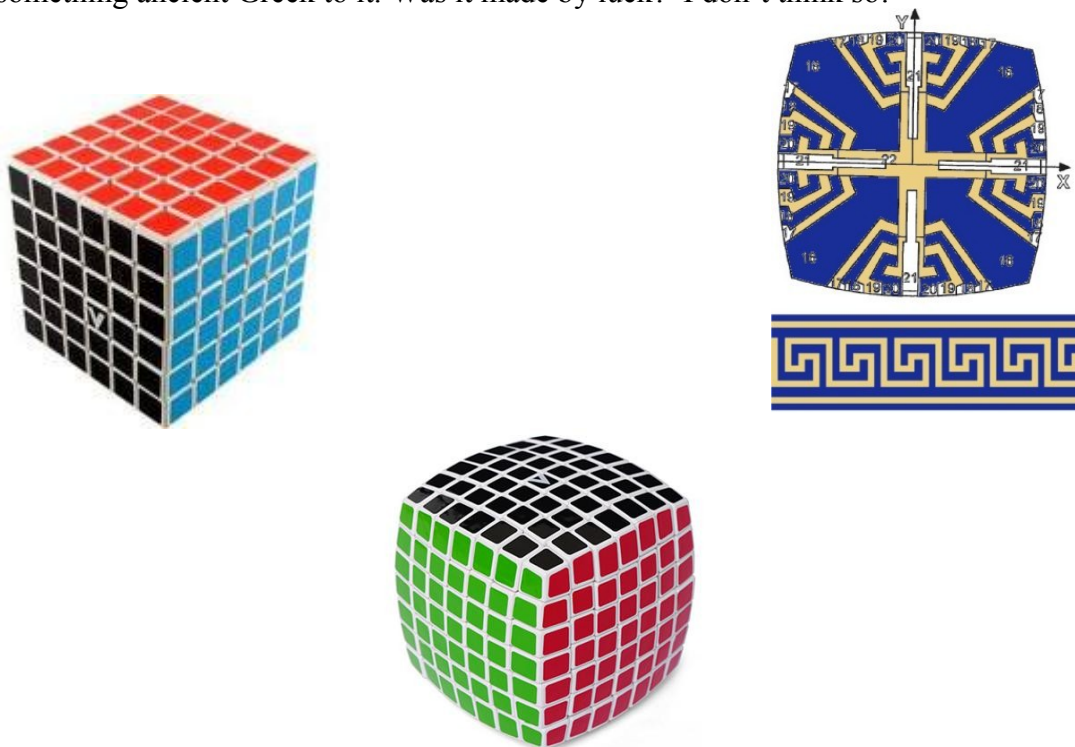


Figure 16: V-Cube 6 (left), V-Cube 7 (center) by Panagiotis Verdes, and the “Greek-Key” internal mechanism (right).

Then there are the exceptional wooden designs by **Michael Toulouzas**, an Athenian master craftsman whose precision is sought by many puzzle collectors. The Australian born author of this article (whose origin is from Kastellorizo) also uses Greece as an endless source of inspiration to come up with new ideas, never thought before, such as mathematical puzzles related to gravity, water, four dimensional symmetry, and interlocking structures.

It cannot be stressed well enough how true Plato's teachings and theories are (Balance for the Body and the Mind) to a successful life.

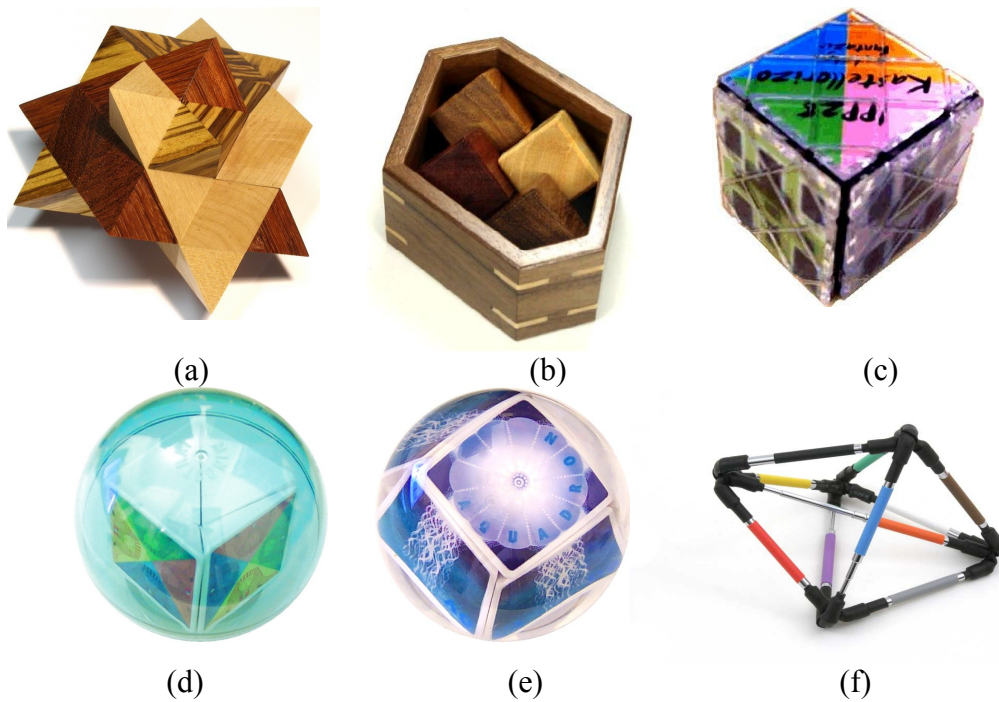


Figure 17: (a) Wooden Puzzle by Michael Toulouzas, (b) Interlocking, (c) Folding, (d) Gravity, (e) Water, and (f) 4D symmetry puzzles by Pantazis C. Houlis.

Going back to the Department of Mathematics at the University of Crete, one of today's most prolific experts in Greek enigmas is Professor **Michael Lamprou**. As expected for a mathematician who is full of passion, he always prepares new enigmas for today's students.

An Epilogue “Gift”

In Marcel Danesi's book, "The Ten Greatest Puzzles of All Time", **three of the aforementioned Greek puzzles, are in the top-ten list**. To be more specific, they are the Riddle of the Sphinx (which is listed first), Epimenides' Liar Paradox and the Cretan Labyrinth.



Figure 18: Pantazis in front of a huge wooden Trojan Horse during one of the tours at the Prague IPP28.

And who can ever forget the Trojan Horse, the puzzling gift, which has inspired the designs of many of today's puzzles, and even more... computer virii!

Much more can be said to the reader about puzzles which have originated from Greece. Only the stories and myths behind them can be expanded to fill many books. But my personal goal here was to merely present a brief introduction to the intriguing nature of those puzzles, as well as to inspire.

My own experience putting together this article was even more rewarding than a simple inspiration. This was because, the more I researched, the more material I was able to find. It just underlines the richness of puzzling concepts that could be found in Greece.



Figure 19: Map of Ancient Greece. Are you able to relate all the previous puzzles, enigmas, and paradoxes, to their corresponding origins?

References:

- [1] <http://en.wikipedia.org/wiki/Ostomachion> (The Ostomachion)
- [2] http://en.wikipedia.org/wiki/Phaistos_Disc (The Disc of Phaistos)
- [3] <http://en.wikipedia.org/wiki/Labyrinth> (The Knossos Labyrinth)
- [4] http://en.wikipedia.org/wiki/Gordian_Knot (The Gordian Knot)
- [5] <http://www.math.uoc.gr/dept/> (Mathematics Department, University of Crete)
- [6] http://en.wikipedia.org/wiki/Pythagorean_cup (The Pythagorean Cup of Justice)
- [7] <http://www.antikythera-mechanism.gr/> (The Antikythera Mechanism)
- [8] <http://demonews.com/download-966.html> (Software simulation of the Antikythera Mechanism)
- [9] http://applied.math.utsa.edu/~gokhman/ecz/ak_m.html (An excellent lecture on the construction and hypothesized function of the Antikythera device).
- [10] <http://en.wikipedia.org/wiki/Sphinx> (The Riddles of the Sphinx)
- [11] http://en.wikipedia.org/wiki/Epimenides_paradox (Epimenides' Paradox)
- [12] http://en.wikipedia.org/wiki/Pandora's_box (Pandora's Box)
- [13] <http://en.wikipedia.org/wiki/Pythia> (Pythia and the Delphic Oracle)
- [14] http://en.wikipedia.org/wiki/Doubling_the_cube (The Delian Problem)

- [15] http://en.wikipedia.org/wiki/Golden_ratio (The Golden Ratio)
- [16] http://www.mathacademy.com/pr/prime/articles/zeno_tort/index.asp
(Zeno's Paradox)
- [17] http://en.wikipedia.org/wiki/Squaring_the_circle (Squaring the Circle)
- [18] http://en.wikipedia.org/wiki/Sieve_of_Eratosthenes (The Sieve of Eratosthenes)
- [19] http://en.wikipedia.org/wiki/Seven_Wonders_of_the_Ancient_World (The Seven Wonders of the Ancient World).
- [20] [http://en.wikipedia.org/wiki/Meander_\(art\)](http://en.wikipedia.org/wiki/Meander_(art)) (Greek Key/Meander)
- [21] http://en.wikipedia.org/wiki/Byzantine_Chain (Byzantine Chain)
- [22] <http://www.v-cubes.com/index.php> (V-Cubes website)
- [23] http://en.wikipedia.org/wiki/V-Cube_7 (V-Cube 7)
- [24] <http://www.puzzzlevision.com/> (Michael Toulouzas' Puzzle website)
- [25] <http://www.mindstratpuzzles.com/> (MindStrat Puzzles website)
- [26] <http://twistypuzzles.com/forum/viewtopic.php?f=9&t=7141> (Pantazis' designs)
- [27] <http://www.houlis.com> (Pantazis' puzzle website)