

# What the Greeks knew

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- **Part III: Philosophers to Aristoteles**

# What the Greeks knew

- Greek Philosophy
  - The universe makes systematic sense, and we can make sense of it (rationality and intelligibility of the world)
  - Problem of the nature of the world: an original substance must be the source of everything that is in the world today
  - Problem of change: what is it that does NOT change when we say that something “changed”? What persists so that we can say that “it” changed?

$$1+1=2$$



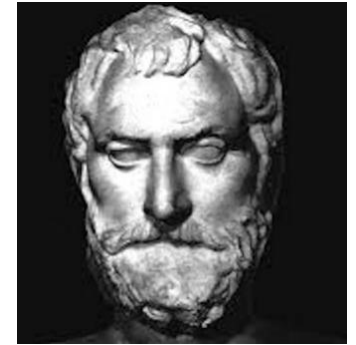
# What the Greeks knew

- Greek Philosophy
  - Problem of categorization:
    - Every particular thing belongs to a kind of thing
    - Every thing has a set of properties that makes it the kind of thing it is
    - Kinds of things have similar behavior



# What the Greeks knew

- School of Miletus, Ionia (western Turkey)
  - Thales (active 60x BC, Ionia):
    - Philosophy vs myth (logos vs mythos)
    - Reason vs gods
    - Knowledge (episteme) vs opinion (doxa)
    - Nothing does not exist
    - Change and form and substance
    - Everything is water
    - Everything is alive



# What the Greeks knew

- School of Miletus
  - Anaximander (active 62x BC):
    - The first scientist
    - The Earth is not supported by anything: it is surrounded by sky, and everything falls towards the Earth, the Earth does not fall towards anything else



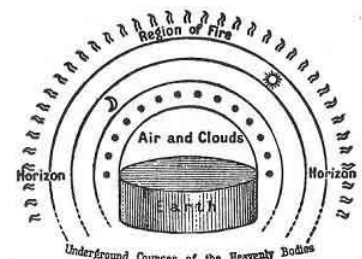
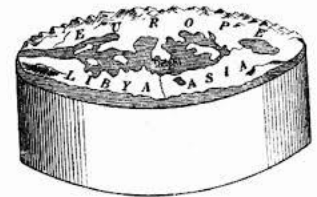
# What the Greeks knew



- School of Miletus
  - Anaximander (active 62x BC):
    - The fundamental substance is not one of the known substances
    - “Apeiron” (the absolute, infinite) generates the world and its elements (it turns successively into wind, steam, water, earth, stone)
    - Animals **evolved** from more primitive forms of life, a primeval soup heated by the Sun (proto-evolutionary theory)
    - The earth (shaped like a drum) is floating in the vacuum, surrounded by concentric spheres (first cosmological model)



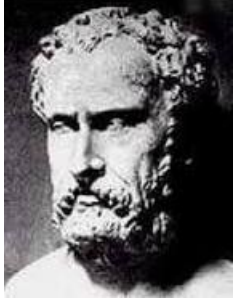
Anaximander's Map of the World



# What the Greeks knew

- School of Miletus
  - Anaximenes (active 5xx BC)
    - Everything is air (fire is rarefied air, water is condensed air)

# What the Greeks knew



- School of Miletus
  - Xenophanes (Colophon, active 5xx BC)
    - Gods are not anthropomorphic, in fact **there is only one God** (proto-monotheism) and God is the entire universe (proto-pantheism)
      - Blames Homer and Hesiod for spreading the false notion that deities are capable of theft, adultery and deception
    - What we know, how we know it and what we can know (proto-epistemology)
    - It is up to humans (their genius and their discipline) to acquire knowledge (no help from gods): **knowledge comes from human endeavour**
    - Wisdom (not athletic fitness) is the only virtue



# What the Greeks knew

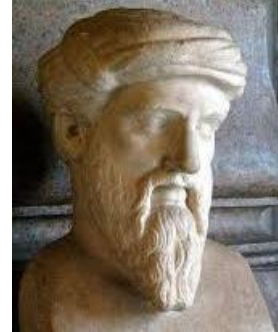
- **Art of Memory**
  - **Simonides of Ceos (5-6th c BC): remembering by means of places and images**

# What the Greeks knew

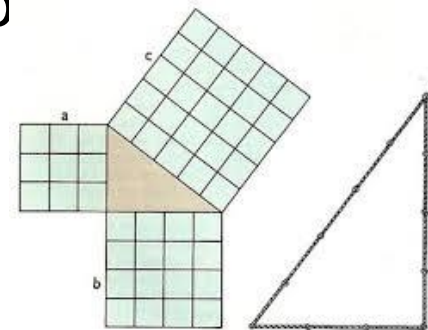
- Magna Grecia



# What the Greeks knew



- Pythagoras (southern Italy, active 530 BC):
  - Probably never existed
  - Mathematics as mysticism
  - Contemplating is more important than acting
  - Contemplation leads to logic/mathematics
  - Mathematics is evidence of eternal truths/divine truths beyond the human mind
  - Geometry is evidence of perfect forms beyond the forms of nature,
  - Ecstatic revelation of the essence of nature (Logic becomes religion)
  - (Meditation: mathematics as the origin of spirituality?)

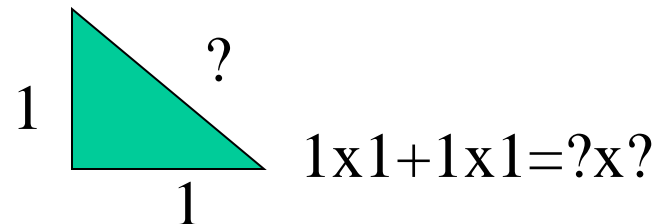
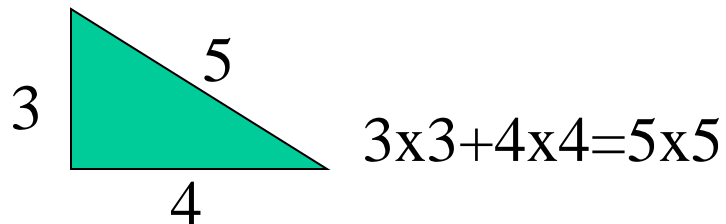


# What the Greeks knew

- Pythagoras (southern Italy, active 530 BC):
  - The mind can only grasp numbers, thus everything must be a number
  - Numbers as the ultimate reality (e.g., music, geometry)
  - The fundamental substance is not a material substance, but an abstract principle (number)
  - Dualism: distinction between matter and spirit
  - **Immortality of soul** and metempsychosis (similar to Orphism): the soul is a fallen god, trapped in a body, and doomed to a perpetual cycle of rebirth

# What the Greeks knew

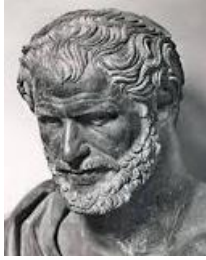
- Pythagoras (530 BC):
  - The earth is a sphere (shape of the earth during a lunar eclipse)
  - At the center of the universe is a great fire
- Irrational numbers
  - square root of 2
  - circumference/diameter of a circle (pi)
  - Pythagoras' theorem



# What the Greeks knew

- Pythagoras' followers
  - Ascetic life, vegetarianism
  - Sex only for procreation, not for pleasure
  - Very popular among women

# What the Greeks knew



- Herakleites/Heraclitus (Ephesus, act. 53x BC)
  - Change & movement
  - Everything changes all the time ("you can't enter the same river twice")
  - Even we ("we are and we are not")
  - Everything flows
  - Identity is defined by the process, not by the thing
  - Identity is a pattern (of flow, of growth, etc)



# What the Greeks knew

- Herakleites

- The essence of a natural kind is defined by the specific pattern according to which that natural kind changes over time. Eg, a tree is a tree because it grows from seed to branches and leaves. Not defined by its constituents.
- Humans are both body (soma) and soul (psyche)
- Body and soul are different substances
- One of the attributes of soul is its “logos”

ψυχή

λόγος



# What the Greeks knew

- Herakleites
  - Knowledge of the absolute can only come from reasoning (logos) not from perception
  - The fundamental unity and order of the universe “is” the logos (proto-pantheism)
  - Logos permeates everything
  - Logos as the personification of cosmic justice and distinct from the gods

# What the Greeks knew

- Herakleites
  - The universe is eternal fire: “The world, the same for all, no god or man made, but it always was, is and will be, an everlasting fire”
  - Cyclic patterns of the universe (“ekpyrosis”): the universe decays, then collapses, then explodes, then returns to what is now, and so forth

# What the Greeks knew

- Herakleites
  - Psyche (soul) distinct from the body
  - Logos permeates all souls

# What the Greeks knew

- Herakleites
  - Human laws originate from divine law
  - “War is the father of all and king of all”

# What the Greeks knew

- Theater (550BC)
  - "Theatron" = "seeing place", the place where the audience sat
  - "Tragedia" = "goat-song" (goat skins of the chorus)
  - "Chorus" = "dance"
  - Theater began as a religious ceremony
  - The Athenian theatre focused on Dionysus, god of fertility, wine, sexuality, agriculture
  - Yearly Dionysian fertility festival in March, including
    - one week of public wine drinking
    - phallus-worshiping orgy
    - dithyrambos (dance and chant to the god)
  - The dithyrambos evolves into tragedy

# What the Greeks knew

- Theater (550BC)
  - The first plays were transcriptions in verse form of these religious rites
  - The first playwrights were poets and the first plays were mostly recited (or sung) and danced by the chorus
  - The first actors were characters addressing the leader of the chorus during intervals
  - Second actor added by Aeschylus. Third actor added by Sophocles. Masks help play many parts.
  - Scenery introduced by Sophocles
  - Machinery to impersonate a god ("deus ex machina") introduced by Euripides
  - Contests and competition like in athletic games

# What the Greeks knew

- Theater (550BC)
  - The chorus' part was gradually reduced, the actors' dialogue gradually increased
  - The chorus danced in front of the stages ("orchestra")
  - A play included loud music, bright colors, spectacular dancing
  - A play consisted of: 1. prologue (a simple speech), 2. introduction of the chorus, 3. the acts/scenes
  - The chorus commented on the action AND guided the audience's reactions
  - All the actors were male, and they all played multiple roles (and wore masks to identify the character)
  - The performance took place in an open-air theater
  - The audience was 15-17,000 people

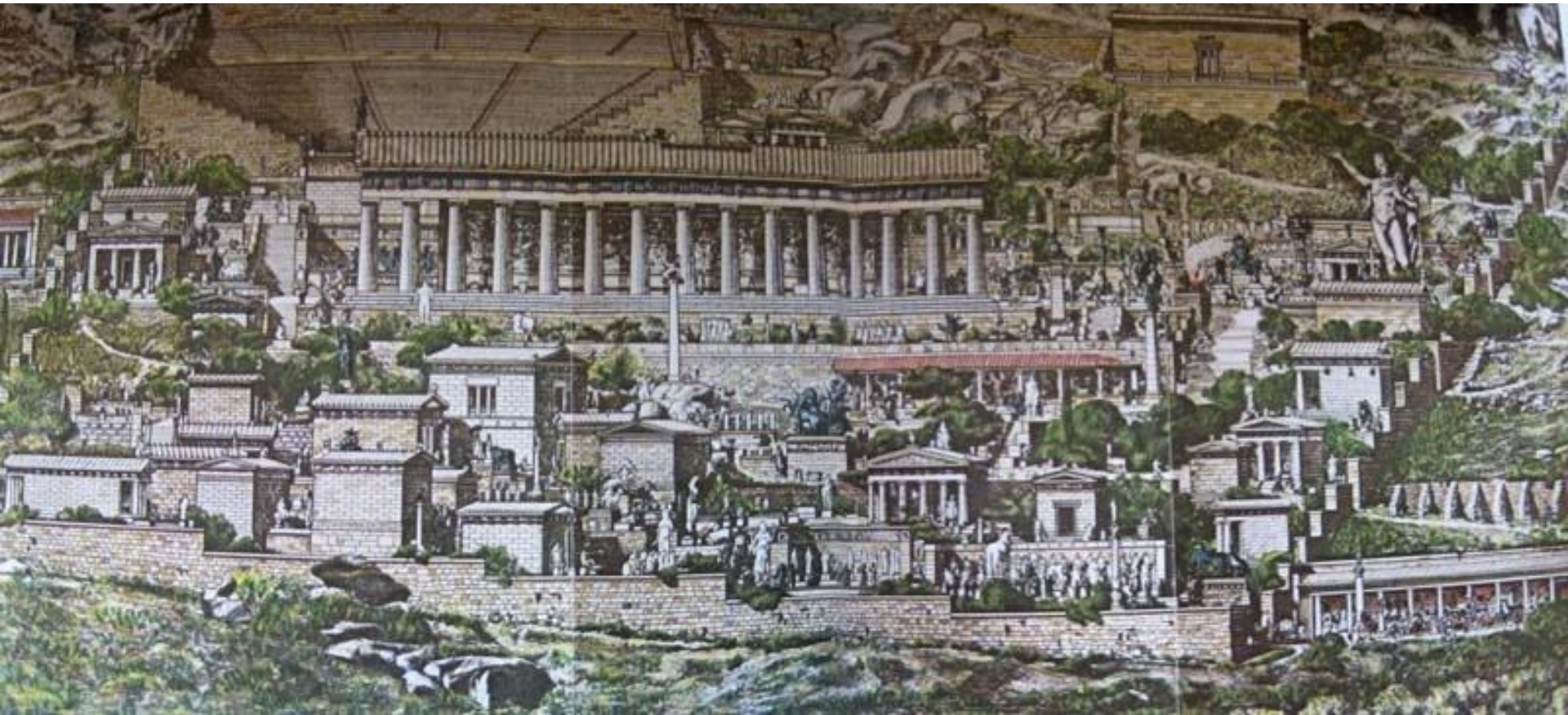
# What the Greeks knew

- **Tragedy as narrative of the gods and heroes (500BC-400BC)**
  - The plot is already known to the audience (ancestral legends or famous episodes)
  - Leitmotiv: the destiny of humans (as driven by the gods)
  - Phrynicus: one actor discussing with the chorus
  - Aeschylus (525 BC): "Oresteia", humans instead of gods
  - Sophokles/Sophocles (496 BC): "Oedipus", horror of human condition
  - Euripides (485 BC): "Medea", madness rather than accept the human condition; ordinary men
- **Music and Dance**



# What the Greeks knew

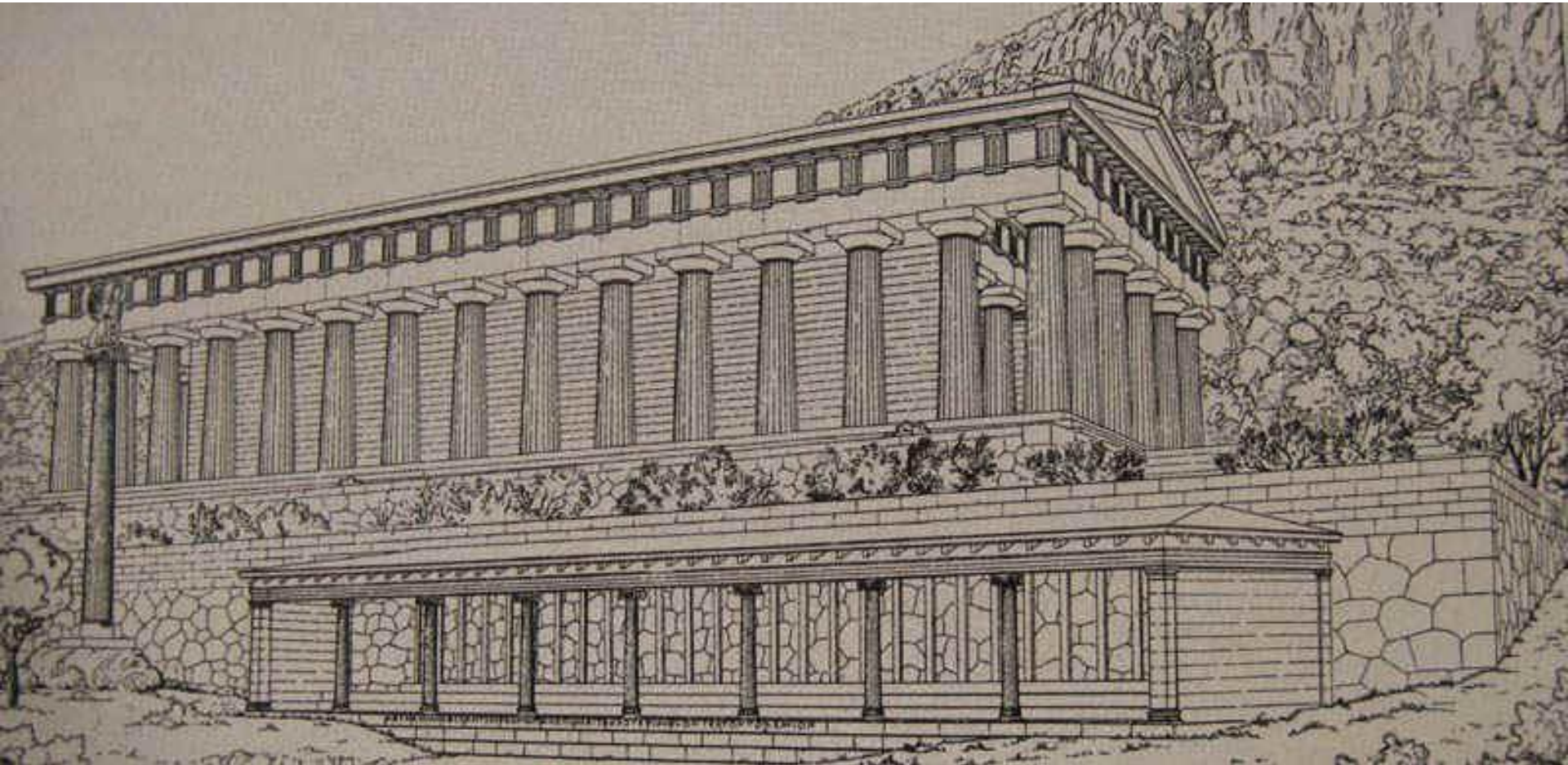
- Delphi's Sanctuary of Apollo



(Reconstruction, Photios Petsas)

# What the Greeks knew

- Delphi's Sanctuary of Apollo



Stoa of the Athenians (5th c BC) and temple of the Alkmeonidai (reconstruction by Amandry)

# What the Greeks knew

- Delphi's Sanctuary of Apollo



# What the Greeks knew

- Delphi's Sanctuary of Apollo



North frieze of Siphnian Treasury (525 BC)

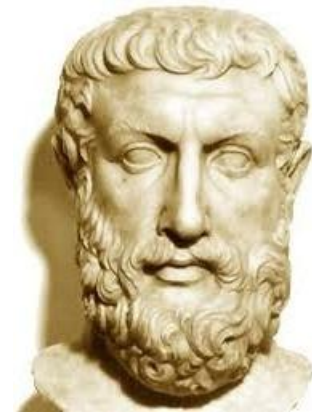


The Charioteer (478 BC)



Sphinx from Naxos  
(560 BC)

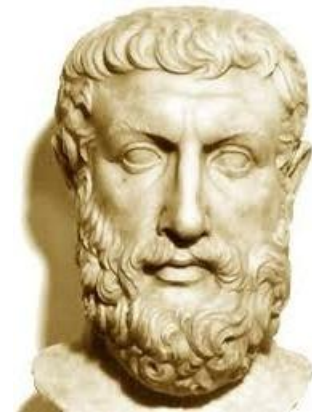
# What the Greeks knew



- Parmenides (southern Italy, active 47x BC)
  - First dialectic philosopher (justifies his beliefs)
  - The “what is not” is impossible (e.g. the void does not exist)
  - Nothing can come from nothing, therefore change is illusory.
  - Nothing ever changes.
  - Time and change are illusion.
  - Reality is eternal and timeless



# What the Greeks knew



- Parmenides (southern Italy, active 47x BC)
  - Only one substance which is "the one", indivisible and infinite (monism)
  - Reality is a changeless whole (not the plurality that we perceive)
  - A finite, spherical, motionless, continuous plenum
  - The (changing) world of the senses is an illusion

# What the Greeks knew

- Parmenides (southern Italy, b 51x BC)
  - Parmenides' poem (written in dactylic hexameters) is a mystical allegory in three parts:
    - 1. his ascent to the realm of the goddess Dike (a journey in a chariot, accompanied by the daughters of the sun god), a place where mortals usually are not admitted (metaphor for the realm of real truth):
      - *“The horses which bear me conducted me as far as desire may go, when they had brought me speeding along to the far-famed road of a divinity who herself bears onward through all things the man of understanding.”* (Translation by Arthur Fairbanks)

# What the Greeks knew

- Parmenides (southern Italy, b 51x BC)
  - 2. what she taught him about "the unshaken heart of persuasive Truth":
    - “Therefore thinking and that by reason of which thought exists are one and the same thing, for thou wilt not find thinking without the being from which it receives its name. Nor is there nor will there be anything apart from being”
    - Being is whole, indivisible and eternal, like a “well-rounded sphere”. Being “is equal on all sides, it abides in equality within its limits”



# What the Greeks knew

- Parmenides (southern Italy, b 51x BC)
  - 3. our world and "and human opinions in which rests no true belief":
    - "everything is at the same time full of light and of obscure darkness"
  - Every single figure (whether human or animal) that Parmenides encounters in his journey is a female
  - Dike (goddess of Justice) speaks in arguments and proofs

# What the Greeks knew

- **Empedocles (Sicily, b 49x BC)**
  - The plurality of the world is real, but change is not (“what is” does not turn into “what is not”)
  - “Change” is simply a redistribution of four fundamental elements that are eternal and unchangeable
  - All four elements (water, fire, air, earth) exist from the beginning in fixed proportions and will exist forever

# What the Greeks knew

- **Empedocles (Sicily, b 49x BC)**
  - The whole oscillates between the force of love/harmony (attraction) and the force of hate/strife (separation)
  - The elements are one when the force of love rules, and they become distinct when hate rules
  - Worlds can only exist in between the two extremes of absolute harmony and absolute strife

# What the Greeks knew

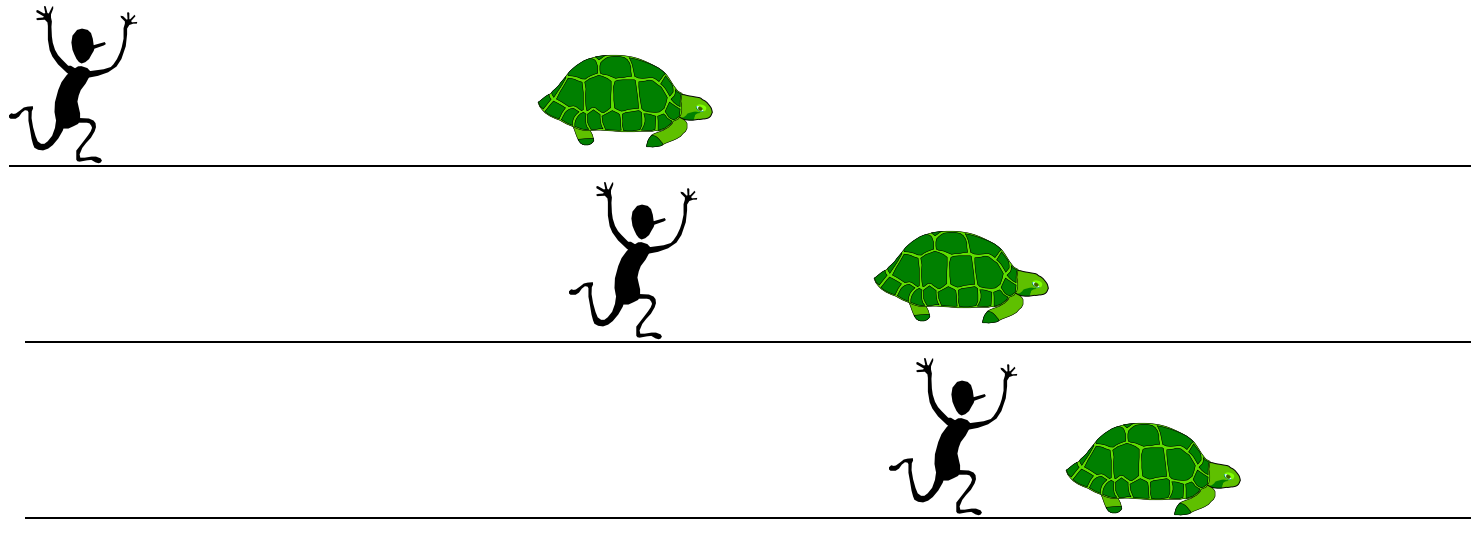
- **Empedocles (Sicily, b 49x BC)**
  - At each stage of the progress from one to the other, different kind of creatures are produced
  - Our world belongs to the stage of increasing separation
  - Each object has the four elements in a specific ratio (eg, blood is 1:1:1:1)

# What the Greeks knew

- **Empedocles (Sicily, b 49x BC)**
  - **Sensations are reliable: they are material effluences that penetrate the body through the pores, and are perceived by “like” components: earth is perceived by the earthly component of our body, fire is perceived by the fire component of our body, etc**
  - **Parts of plants and limbs of animals have combined to create new forms of life, and only the best fit survived**

# What the Greeks knew

- **Zenon/Zeno (southern Italy, active 47x BC)**
  - Change is impossible
  - The world as we see it is an illusion
  - **Proof: three paradoxes**

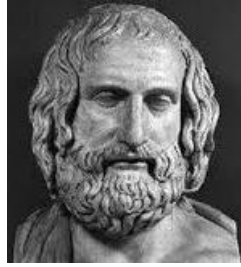


- **Motion between two points requires going through an infinite number of points, which requires an infinite amount of time**

# What the Greeks knew

- **Zenon/Zeno (southern Italy, active 47x BC)**
  - One cannot finish the act of sequentially going through an infinite sequence

# What the Greeks knew



- Anaxagoras (Ionia, active 450 BC)
  - The plurality of the world is real, but change is not
  - Each thing is made of a combination of the basic elements (blood, flesh, wood, stone...)
  - The natural substances pre-existed, but it was Nous (mind) that created the world as we know it
  - Mind is a substance because it could not possibly be made of other non-mind substances
  - Everything is divisible in smaller units (ad infinitum)
  - Each unit contains a dose of each element and of its opposite (everything is warm and cold, to some extent)
  - Infinitesimally small (indivisible) atoms have existed ever since



# What the Greeks knew

- Anaxagoras
  - One of the basic elements is Nous, and it is the only one that is not present in everything
  - Nous (intelligence, thought, mind) gives the atoms an order
  - Nous is the element that yields life (all movement that does not have a cause)
  - "Mind" as the organizing principle of the universe

VOUÇ

# What the Greeks knew

- Anaxagoras
  - Life was dispersed as seeds in the universe and eventually landed on Earth ("panspermia")
  - The cosmic bodies are not gods but objects made of hot stone (meteorite of Aegospotami, 467 BC)
  - The Sun is a hot stone and the Moon is made of Earth
  - First openly atheistic philosopher

# What the Greeks knew

- **Hecataeus (b550BC)**
  - “Genealogies”: important people and geography
- **Herodotus (b485)**
  - Explanation, not only storytelling
  - Non-theological history
  - History as a continuation of the Greek project of understanding the real nature of the world
  - Ethnography
  - Focus on the action of the individuals
  - A manifestation of a new sense of curiosity
  - Begins the exploration of the past

# What the Greeks knew

- **Hippocrates (b460)**
  - **Medicine: disease is not a punishment by the gods**
  - **Anatomy**
  - **The mind resides in the brain**
  - **Four humours (phlegm, blood, yellow bile, black bile) correspond to the four elements**
  - **Dissection of human bodies de facto illegal until the 4th c BC (the body is as sacred as the soul)**
- **Thucydides (b 455BC)**
  - **Sociopolitical analysis**
  - **Focus on the action of human society**

# What the Greeks knew

- **Geometry**

Circle	Area = $\pi r^2$ Circumference = $2\pi r$
Sphere	Volume = $\frac{4}{3} \pi r^3$ Surface = $4 \pi r^2$
Cylinder	Volume = $\pi r^2 h$ Curved Surface = $2 \pi r h$ Total Surface = $2 \pi r (h + r)$
Cube	Volume = $a^3$ Each face area = $a^2$ Total Surface area = $6a^2$

# What the Greeks knew

- **Greek Art**

- Much smaller temples than Egyptians
- Flat-roof temples and palaces like in Egypt (no arch, no vault), but columns to break the monotonous stone walls (probably the column derived from the wooden buildings that predated the stone temples)
- The support (column) and the interval (between columns) allowed architects to achieve effects of rhythm and harmony

# What the Greeks knew

- **Greek Art**

- **Bronze allowed sculptors to depict movement that was impossible with marble**
- **Bronze statue of Zeus (470 BC)**
  - **movement**
  - **not monumental frontality but expression**
- **Bronzi di Riace (460/430 BC)**

# What the Greeks knew

- **Greek Art**

- **Bronze of 550 BC from Armentium (Puglia)**



British Museum



# What the Greeks knew

- Zeus (Athens, 460 BC)



# What the Greeks knew

- **Bronzi di Riace (Athens, 460 & 430 BC)**



# What the Greeks knew

- **Greek sculpture**
  - **Pheidias (450BC)**
    - beauty, pathos, grandeur
    - the soul, not just the body
    - Parthenon
  - **Myron (450BC)**
    - movement ("Diskobolos")
  - **Polykleitos/Polyclitus (450BC)**
    - proportion and symmetry of the human body
    - ("Doryphoros")

# What the Greeks knew



# What the Greeks knew

**Myron (450BC)**  
movement  
("Diskobolos")



Copy in Rome

**Polyclitus (450BC)**  
proportion and symmetry  
("Doryphoros")



# What the Greeks knew

**Aphrodites (425BC, Italy)**



Getty Museum

# What the Greeks knew

- **Coins**
  - **One-point perspective**



Coin from Himera (Sicily) of 480BC  
(British Museum)

# What the Greeks knew

- **Coins**
  - **Severe style**



Coin from Naxos (Sicily) of 5<sup>th</sup> c AD  
(Cabinet des Medailles, Paris)



# What the Greeks knew

- **Architecture**
  - **Mostly religious**

# What the Greeks knew

- **Temple**

- Facing outward (rites performed at altars in front of the temple, not inside)
- The temple itself was a warehouse for the statues of the deities
- Focus on the exterior, not the interior
- Grace, harmony, grandeur
- Ornament on the upper part (eg, frieze)
- Parthenon (432BC)

# What the Greeks knew

- **Acropolis**

- **Kallikrates' Parthenon (438 BC) - not the main temple (mainly a warehouse)**
- **Kallikrates' Temple to Athena Nike (424 BC)**
- **Mnesciles' Erechtheion (405 BC) - main temple**
- **Caryatid Porch**
- **Propylaea (449 BC)**
- **Pheidias' colossal statue of Athena**

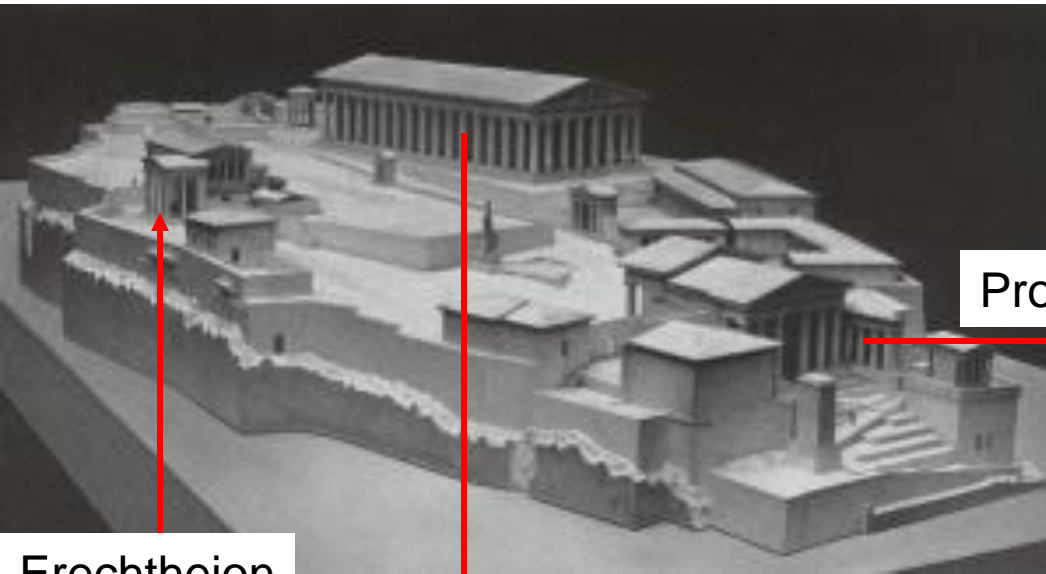
# What the Greeks knew

- **Acropolis**



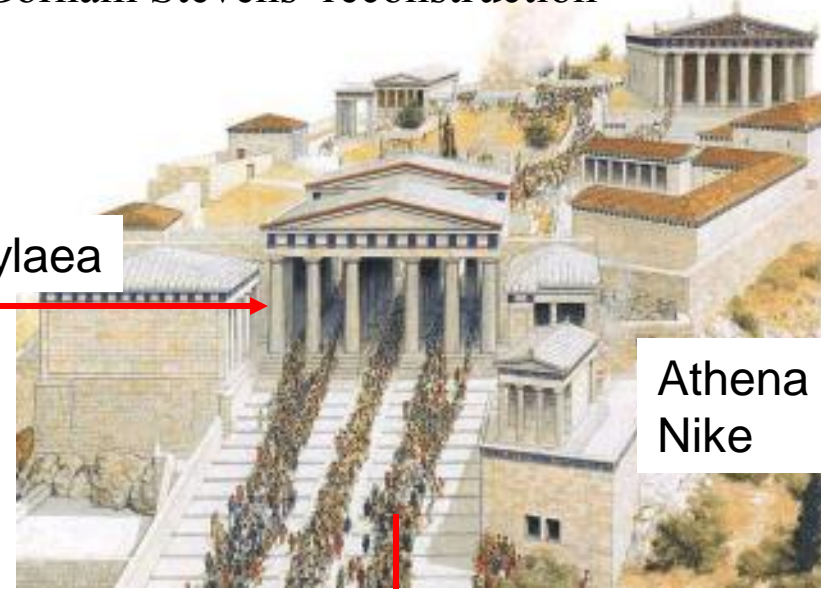
# Acropolis

Gorham Stevens' reconstruction



Erechtheion

Propylaea



Athena Nike

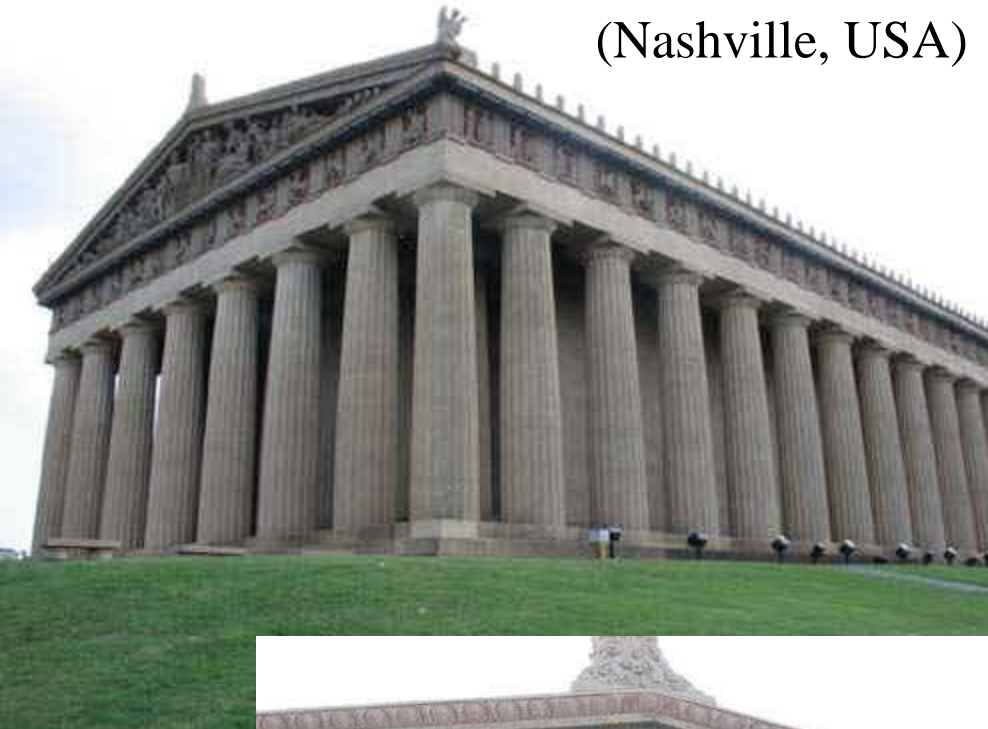


# What the Greeks knew

- **Ictinus' and Kallicrates' Parthenon (438 BC)**
  - **A rectangle of 30.9 m x 69.5 m**
  - **Golden ratio**
  - **Not one right angle in the Parthenon**
  - **Doric columns 1.9 m in diameter and 10.4 m high**
  - **Phidias: three levels of sculptures**
    - **Pediment (bigger than life-size)**
    - **Metopes frieze above the columns (life-size)**
    - **Frieze at the top of the walls (smaller than life-size)**

# What the Greeks knew

(Nashville, USA)



# What the Greeks knew

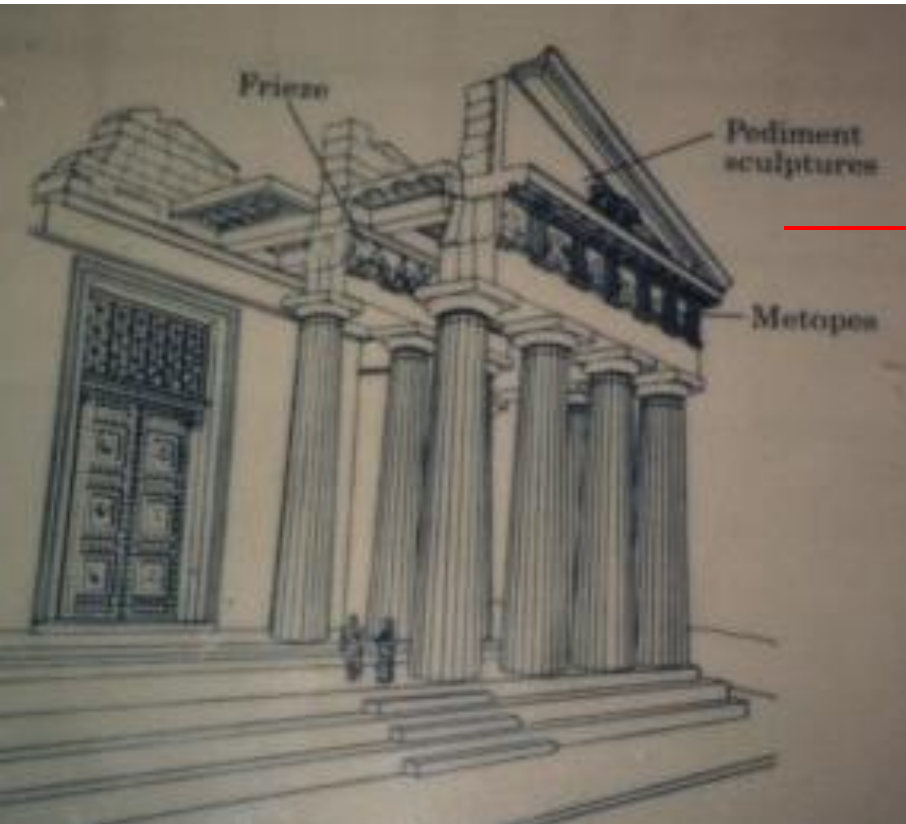
- **Ictinus' and Callicrates' Parthenon (438 BC)**



(Iowa Center for Emerging Manufacturing)



# Parthenon frieze



Pheidias, Figures from the Eastern Pediment of the Parthenon (British Museum)



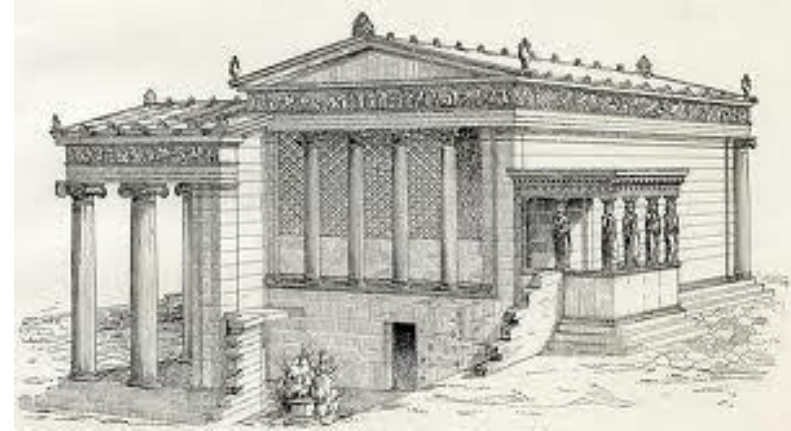


- **Parthenon's eastern frieze: the Panathenaic procession (first representation of a non-mythological subject on a temple relief)**



Reconstruction of Parthenon's East Frieze slabs 4-6  
(Royal Ontario Museum, Toronto, Canada)

# Erechtheion



# Amphitheatres

Epidavros/Epidauros: A marvel of acoustic engineering (4th c BC)



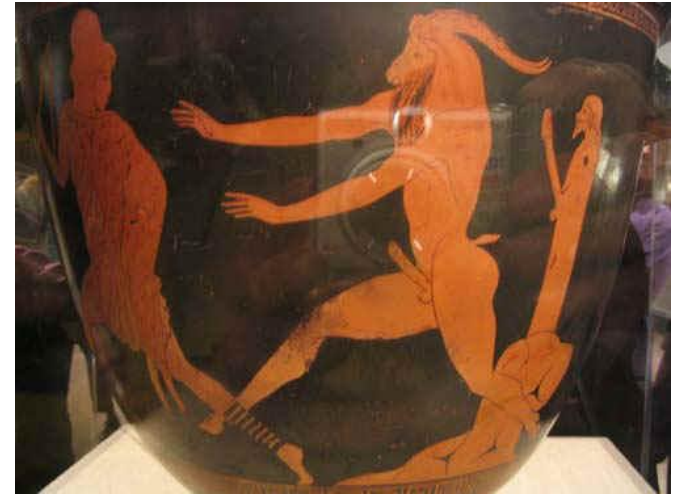
# What the Greeks knew

- **Greek Life**
  - **Vases**



450 BC  
(Metropolitan Museum)

Women carrying water from fountain  
(Boston Museum of Fine Arts)



Vase of 470 BC from Cumae  
(Boston Museum of Fine Arts)



# What the Greeks knew

- **Sophistes/Sophists of 5th century BC**
  - **Sophia = wisdom**
  - **Itinerant teachers**
  - **Truth and morality are essentially matters of opinion**
  - **The only thing that matters is achieving success in life**
  - **A by-product of the rise of the middle class that needs a practical philosophy**
  - **Champions of liberty, equality and pacifism**
  - **Protagoras, Gorgias, Hippias of Elis**

# What the Greeks knew

- **Protagoras (b 485 BC)**
  - **The gods do not exist** or are irrelevant
  - The only reality is subjective knowledge
  - Judgements are relative to speakers
  - "Man is the measure of all things"

# What the Greeks knew

- **Sokrates/Socrates (Athens, b469BC)**
  - **(Disclaimer: Sokrates is a character in Platon's socratic dialogues)**
  - **A philosophy of man not of cosmos**
  - **A practical philosophy not a theoretical one**
  - **Moral preoccupations instead of ontological speculations of Pre-Socratic philosophers**
  - **Courage, piety, virtue, justice**



British  
Museum



# What the Greeks knew

- **Sokrates/Socrates (Athens, b469BC)**
  - **Virtue is knowledge, and ignorance is the cause of all evil**
  - **Wisdom is knowing what one does not know**
  - **All learning consists in being reminded of what we already know**
  - **Arguments based on hypotheses and definitions**
  - **Eidos (form, idea, universal that can only be thought of, but non perceived with the five senses)**

# What the Greeks knew

- **Sokrates/Socrates**
  - All humans are equal
  - Socrates' virtue ethics: to live virtuously
  - Rule by the most virtuous
  - Gods cannot be capable of evil action

# What the Greeks knew

- **Sokrates/Socrates**
  - Not what the world is, but how can one know what it is?
  - Not answers to old questions, but new questions
  - Not what is true, but what is Truth?
  - Not what is the world made of, but why do we want to know what the world is made of?

# What the Greeks knew

- Sokrates/Socrates
  - Philosophizing is the only authority to decide how to live a life (gods are irrelevant)
  - The effect of anything on your life depends on the values defined in your soul
  - Therefore the condition of your soul determines the real value of anything (money, success...)
  - The ideal condition of a soul is virtue, wisdom, knowledge, i.e. how close you are to the ultimate truth
  - Philosophizing is an endless process of refinement
  - “True philosophers make dying their profession”

# What the Greeks knew

- **Sokrates/Socrates**
  - **Plato's "Phaedrus": Socrates' encomia to pederasty**
  - **Xenophon's "Memorabilia": Socrate's attack against physical sex**

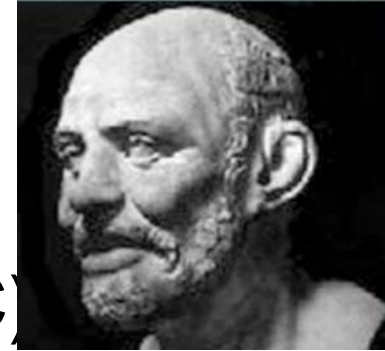
# What the Greeks knew

- **Sokrates/Socrates**
  - **Socrates' trial = trial of atheism that signals the end of the dictatorship of the gods and the beginning of “rational superstition” (the most famous religious trial before Jesus')**
    - **Turning point from traditional values to philosophical values**
    - **Turning point from traditional optimism to philosophical skepticism**

# What the Greeks knew

- **Philosophy after Sokrates/Socrates**
  - **Philosophy is a guide to living your life**
  - **Philosophy is to be lived**
  - **Philosophy is a way of life**
  - **Philosophy starts with ethics**
  - **Ethics leads the philosopher to a study of the world, i.e. to metaphysics**
  - **Your place in the world depends on what the world is**

# What the Greeks knew



- Demokritos/ Democritus (Thrace, b460BC)
  - The world can be comprehended using reason
  - The plurality of the world is real, but change is not: there always is and always has been and always will be change
  - Everything is made of atoms (as per his master Leukippos/Leucippus)
  - Everything is divisible in atoms
  - Atoms come in an infinite number of shapes
  - Atoms cannot be further divided
  - Atoms are always in motion
  - Motion is governed by natural laws

ἄτομος



# What the Greeks knew

- Democritus
  - The motion of atoms causes the creation of complex bodies such as our universe
  - There are many such universes (galaxies)
  - Worlds come into being and disappear because of haphazard collisions
  - Nothing comes from nothing
  - Some worlds have neither sun nor moon. Some worlds have neither plants nor animals
  - Space (the “void”) is infinite

# What the Greeks knew

- Democritus
  - The soul is also made of atoms and thought is a form of motion
  - Humans do not have a special status in the universe
  - The senses perceive qualities (such as taste and color) that are not inherent qualities of bodies but are the effect of atoms on our senses
  - Humans only know what their senses tell them: “In reality we apprehend nothing exactly, but only as it changes according to the conditions of our body and of the things that impinge on it”

# What the Greeks knew

- **Socratic philosophers**
  - **Philo-sophia: “love of wisdom”**

# What the Greeks knew

- No unified view of the self
  - Psyche, pneuma, logos, thymos...
  - A person can be identified in many different ways (like in ancient Egypt)

Πνεύμα θυμός

νοῦς ψυχή

λόγος

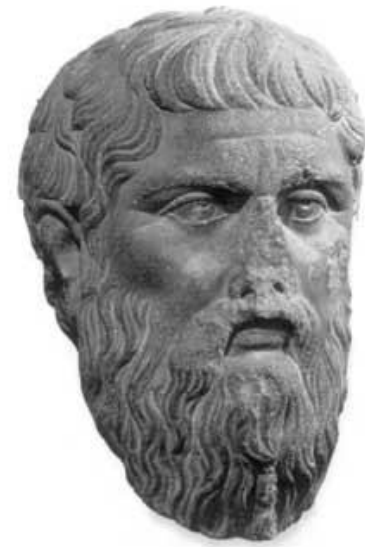
# What the Greeks knew

- No unified view of the self
  - Once the body dies, it has to be buried (or cremated) or the dead person will haunt the living
  - The dead person “migrates” to Hades (has to pay passage to Charon the ferryman to cross the river)
  - Hades is not a place of punishment or reward, simply the next destination
  - Virtuous and sinners live the same life in Hades
  - Immortality is not a big deal (Ulysses would rather return home)
  - Dead Achilles envies the living (Ulysses)

# What the Greeks knew

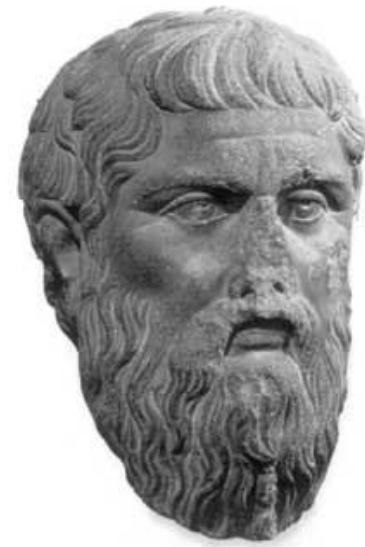
- **Schools**
  - **Museums = schools dedicated to the muses**

# What the Greeks knew



- Platon/Plato (Athens, b427)
  - Academy (387 BC)
  - 46 imaginary dialogues (only 24 authentic) between Socrates and various interlocutors (sophists, poets, politicians, aristocrats, believers)
  - A new literary form (part drama and part narrative)
  - All the talking is done by Socrates
  - Meaning via counterpoint

# What the Greeks knew



- **Platon/Plato**

- Senses are the problem, not the solution
- Reality vs appearance
- Particular vs universal
- Objects and phenomena are like shadows on the walls of a dark smoky cave
- Ideas/forms (such as “circle”, “beauty”, etc) are eternal and unchangeable
- An idea/form (eidos) exists independently of the mind that thinks it and of the object that instantiates it.
- Matter is characterized by change (becoming).
- Ideas (forms) are characterized by immanence (being)
- Everything changes and nothing changes.



# What the Greeks knew

- **Platon**
  - **Forms cannot be perceived by the senses, but they can be known**
  - **We “know” what a circle or beauty are**
  - **Knowledge cannot be derived from sense experience**
  - **Knowledge can only be attained by reason**
  - **Knowledge is about eternal, unchangeable entities**
  - **Knowledge is about forms, universals**

# What the Greeks knew

- **Platon**

- The body is an obstacle to knowledge, only the soul (“psyche”) can “know”
- The value of introspection
- Emphasis on innate knowledge: knowledge is “remembering” innate knowledge (anamnesis)
- Body-soul dualism: immortal soul in mortal body
- Man decays like an animal but lives forever like a god
- The soul pre-existed the body, like all other forms
- The soul “remembers” from its previous lives the innate categories: space, time, equality, inequality, etc

# What the Greeks knew

- **Platon**
  - The soul grows just like the body
  - Through proper training, the soul can become one with the ultimate idea of the universe
  - “Salvation” of the soul is an individual process
  - There is an escape from Pythagoras’ perpetual cycle of rebirth: reason
  - For example, the soul should admire a beautiful body not for its carnal appeal but as a model (“theoria”) of eternal ideal beauty (Platonic love)

# What the Greeks knew

- **Platon**

- **“The soul is in the very likeness of the divine, and immortal, and intellectual, and uniform, and indissoluble, and unchangeable; and the body is in the very likeness of the human, and mortal, and unintellectual, and multiform, and dissoluble, and changeable” (Phaedo 80b)**
- **“The body is the grave of the soul” (Cratylus 400b)**
- **“The soul when using the body as an instrument of perception is dragged into the world of the changeable, and wanders and is confused” (Phaedo 79b)**

# What the Greeks knew

- **Platon**

- **“Last of all, he will be able to see the sun, and not mere reflections of it in the water, but he will see it in its own proper place, and not in another; and it will contemplate it as it is”.**  
**("Republic")**

# What the Greeks knew

- **Platon**
  - **"Republic"**
    - **The soul has three components**
      - **Desire**
      - **Reason**
      - **Thymos**

# What the Greeks knew

- **Platon**
  - The ultimate form (the form all all forms) is **Good**
  - **Virtue (good) can be taught**
  - **To know Good is to do good**
  - **Ignorance is the cause of evil**

# What the Greeks knew

- **Platon**
  - Time is “the moving image of the immutable eternity”



# What the Greeks knew

- Platon
  - Timaeus
    - Physical phenomena on Earth are governed by the celestial bodies
    - The Demiourgos (Demiurge) or Theos created the world according to the eternal forms
    - The universe is a rational being with a soul

θεός

# What the Greeks knew

- Platon
  - Hatred for Athenian democracy which had failed
  - Contempt for ordinary people's ability to choose the best system
  - Ordinary people judge based on their senses, which are misleading
  - Social and political problems are caused by the ignorance of ordinary people
  - Only philosophers can find out the truth
  - Need for a new form of government, not based on ordinary people but on philosophers

# What the Greeks knew

- Platon
  - Ideal republic:
    - Citizens fund but not govern the state
    - Auxiliaries educated in isolation (no family, no property) by the elite to become Guardians of the republic
    - Women and children are held in common so not to distract the men
    - Totalitarian regime by the Guardians
    - Three classes: Guardians (intellectual elite), army, farmers/artisans/merchants
    - Equality of sexes
    - Homology among soul, state and cosmos

# What the Greeks knew

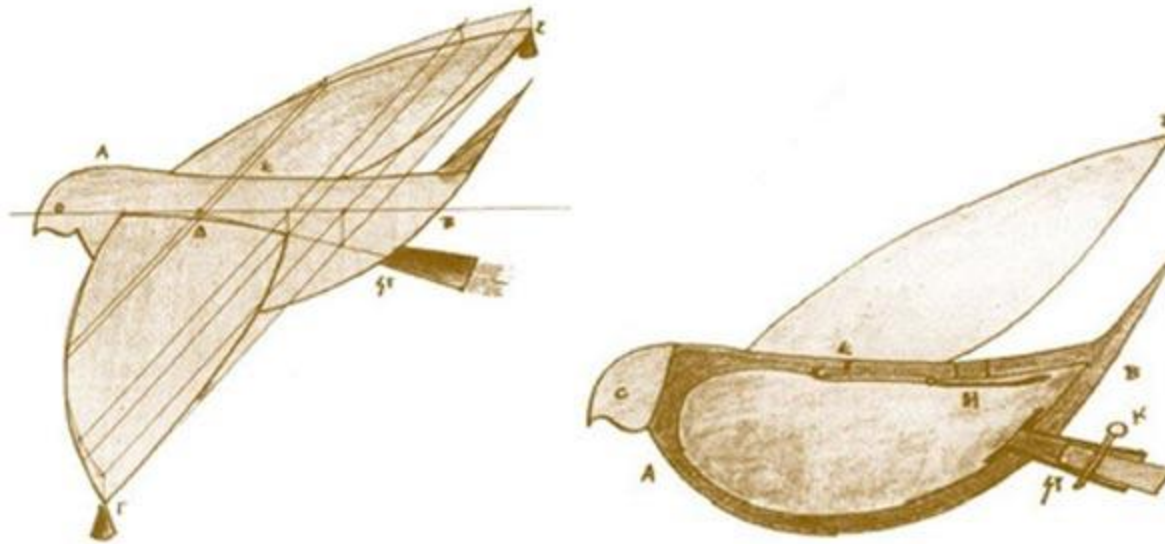
- Platon
  - Ideal republic:
    - Poets and artists banned from the republic: they are useless and misleading

# What the Greeks knew

- Platon
  - “Phaedra”: the Earth is a globe

# What the Greeks knew

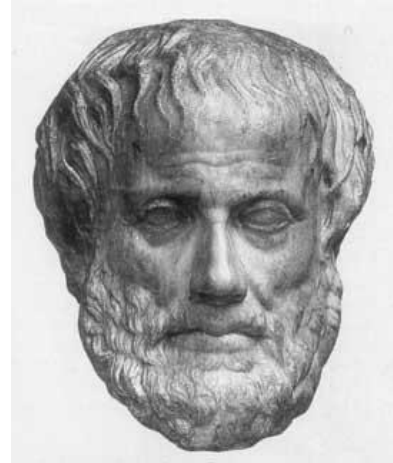
- Archytas (b. 428BC in Taranto)
  - Founder of mathematical mechanics
  - Steam-powered flying device



# What the Greeks knew

- Eudoxus of Cnidus (b.390 BC)
  - Astronomer and Mathematician
  - Theory of proportions

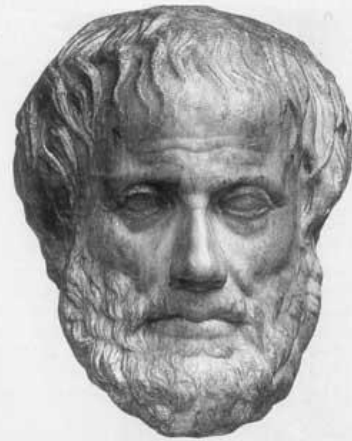
# What the Greeks knew



- Aristoteles/Aristotle (Macedonia, b384)
  - Senses are the solution, not the problem
  - Systematic classification of knowledge
  - Knowledge is attained via logic (“Organon”) and via observation
  - Emphasis on acquired knowledge: “There is nothing in the intellect that was not first in the senses”

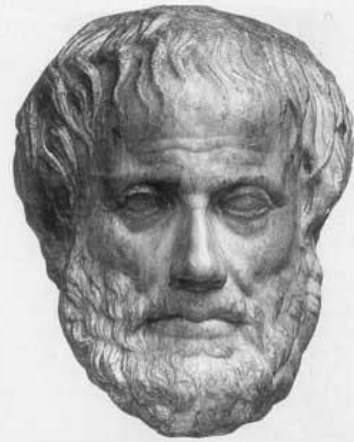


# What the Greeks knew



- **Aristoteles/Aristotle (Macedonia, b384)**
  - **Form/eidos (essence of an object, actuality) vs matter/hyle (common to all objects, potentiality)**
  - **Form is immanent, not transcendent**
  - **Form is determined by function (the table has the shape it has because it has to support objects)**
  - **Matter does not imply form, but form implies matter (because form is due to a function, and the function most likely requires a specific material composition)**

# What the Greeks knew



- **Aristoteles/Aristotle (Macedonia, b384)**
  - Forms are the causes of all things
  - Forms shape matter into the plurality of objects and beings
  - Objects and beings evolve according to their form (e.g., a child grows to be an adult because that is the human form)
  - God/Theos is form without matter

θεός

# What the Greeks knew

- **Aristoteles/Aristotle (Macedonia, b384)**
  - Form is part of an object, it does not pre-exist it
  - Form does not belong to a separate world, but is simply a feature of an object
  - Form is inseparable from the object
  - The soul is inseparable from the body

# What the Greeks knew

- **Aristoteles**
  - **Categories**
    - **Substance**
    - **Quality**
    - **Quantity**
    - **Relation**
  - **Everything that exists falls into one of these categories**

# What the Greeks knew

- **Aristoteles**

- **Logic: how to obtain knowledge from observed facts**
- **The law of non-contradiction is the foundation of all logical reasoning**
- **Syllogism: inference rules that can be chained together to create truth**
- **“All humans are mortal” and “All Greeks are humans” imply “All Greeks are mortal”**
- **Modus pones: if you know that A causes B and that B causes C, then you can also assume that A causes C**
- **Modus tollens:  $(A \rightarrow C \ \& \ \text{NOT } B \rightarrow C) \Rightarrow \text{NOT } (B \rightarrow A)$**
- **Excluded middle: It cannot be that P and NOT P**
- **Dialectic (Plato-like) but also Analytic reasoning**

# What the Greeks knew

- Aristoteles
  - Syllogism
    - Q: Some, Some not, All, None
    - Premise1: Q(A), B
    - Premise2: Q(B), C
    - Conclusion: Q(A), C
    - Examples: Some Greeks are human, All cows are big, No politician is honest
    - $4 \times 4 \times 4 = 64$  possible syllogisms
    - Only 27 are valid

# What the Greeks knew

- Aristoteles
  - De Anima, De Memoria, De Somno
    - Three levels of cognition
      - Vegetative life (reproduction, metabolism)
      - Sensory-motor life (perception, locomotion)
      - Sentient life (reason, free will)

# What the Greeks knew

- **Aristoteles**

- De Anima, De Memoria, De Somno

- The soul (psyche) is the form of the body which is potentially alive
    - Body is potentiality, soul is actuality
    - The soul makes the body “alive” (vital spirit)
    - The soul (psyche) is individual and determines the identity of the body whereas the mind is shared by all rational beings (it is a way of sharing in god)
    - The mind (that thinks) is immortal because it can think immortal things (such as mathematics)



# What the Greeks knew

- **Aristoteles**

- De Anima, De Memoria, De Somno

- “Nothing is in the mind that did not pass through the senses”
    - Perception is perception of form, causing physical change in the perceiver (“phantasms”)
    - The sense “becomes” the form that it perceives
    - “The mind is, in a way, all things”

# What the Greeks knew

- **Aristoteles**
  - De Anima, De Memoria, De Somno
    - Thought (Nous) treated like a sensory organ
    - Thought becomes the phantasms that it is thinking
    - Thought is about phantasms, therefore we can only think what we perceive
    - (Active thought, De Anima III.5: eternal, not bodily)
    - Integration of senses (unity of consciousness) occurs in the heart (not the brain)

# What the Greeks knew

- **Aristoteles**

- De Anima, De Memoria, De Somno

- No separation between mind and body
    - Mind is part of life, Psychology is part of Biology
    - Psyche = animate features (including thought)
    - Pneuma = vital force that moves animals, constrained by desires and beliefs
    - The soul (psyche and/or pneuma) is the principle of vital movement of living beings, not something that can exist separately

# What the Greeks knew

- Aristoteles
  - Metaphysics
    - The principles of natural motion
    - There is a reality that exists apart from anyone experiencing it, and human senses are capable of accessing it
    - Natural state is rest

# What the Greeks knew

- Aristoteles
  - Metaphysics
    - The heavens are made of concentric spheres with a spherical Earth at its center (based on the mathematical models of Eudoxus)
    - Four elements: earth, air, fire, and water
    - Outer spheres made of a fifth element, the aether
    - Planets are moved by either 47 or 55 interconnected spheres
    - Each sphere is moved by its own "unmoved mover"

# What the Greeks knew

- Aristoteles
  - Physics
    - Celestial bodies are made of a “quintessence”
    - Natural state of the heavens is uniform circular motion
    - The universe is eternal (has always been, will always be)
    - Heavier bodies of a given material fall faster than lighter ones
    - Universe not created by a Demiurge but existing from all eternity and for eternity

# What the Greeks knew

- **Aristoteles**
  - **Physics**
    - **Time is due to motion. Time is the measure of motion.**
    - **Space is finite, as big as the universe**

# What the Greeks knew

- **Aristoteles**
  - **Four causes (aitia)**
    - **efficient (the agent and the agency)**
    - **material (the stuff)**
    - **formal (the form/idea)**
    - **final (the purpose)**
    - **the father is a cause of the child**
    - **bronze is a cause for a statue**
    - **the ratio of 2:1 is a cause for an octave**
    - **a good diet is a cause for good health**
    - **Efficient, formal and final ultimately coincide (“The form of a thing and what it is for and from which it originates are the same”)**



# What the Greeks knew

- Aristoteles
  - Formal cause
    - *“In the case of living things... to explain behavior we must refer... to the functional organization that the individuals share with other members of their species. This is the form; this, and not the shape remains the same as long as the creature is the same creature. The lion may change its shape, get thin or fat, without ceasing to be the same lion.... A corpse has the same shape as a living man; but it is not a man, since it cannot perform the activities appropriate to a man ... I am asking for an account of what it is to be a lion: how lions are organized to function, what vital capacities they have, and how these interact.”*

# What the Greeks knew

- **Aristoteles**

- **Time**

- **The number or count of change**
    - **Past, present and future**
    - **Euclides' space and Aristoteles' time become the foundation of western science**

# What the Greeks knew

- Aristoteles
  - Metaphysics
    - Theos/God as the first cause of motion (the motor that does not move)
    - The thought of thought
    - Theos/God is form without matter (pure thought, immutable)

# What the Greeks knew

- Aristoteles
  - Virtue ethics
    - All humans share a single idea of Good
    - Every action aims at some end (“telos”)
    - There is a hierarchy of ends and a highest end, eudaimonia (happiness, well-being)
    - Bodily pleasure and ambition are not necessarily good (do not necessarily lead to happiness)
    - The highest virtue is contemplation/reasoning
    - Eudaimonia is best achieved via an active life of reasoning/contemplation
    - The function of the human being is to remain active and employ reason in her/his life

# What the Greeks knew

- **Aristoteles**
  - **Mechanics**
    - **First engineering text of the western world**

# What the Greeks knew

- Eubulides of Miletus (4th century BCE)
  - Ferocious critic of Aristoteles
  - Paradoxes
    - The Liar paradox: A man says that he is lying. Is what he says true or false?
    - The Bald Man (sorites paradox): Would you describe a man with one hair on his head as bald? Yes. Would you describe a man with two hairs on his head as bald? Yes. ...

1 grain of wheat does not make a heap.

If 1 grain of wheat does not make a heap then 2 grains of wheat do not.

If 2 grains of wheat do not make a heap then 3 grains do not.

...

If 9,999 grains of wheat do not make a heap then 10,000 do not.

# What the Greeks knew

- Greek science
  - Mostly mechanics and optics
  - No conflict between science/philosophy and religion because no universally accepted dogma on religion
  - Preference for geometry over algebra
  - Emphasis on ideal forms of geometry (as if geometry is part of Platonic philosophy) instead of practical applications of geometry
  - Clumsy numerical system in which the letters of the alphabet are used for numbers
  - Symbolic algebra virtually impossible because letters can't stand for unknown numbers

# What the Greeks knew

- Greek science
  - Greek astronomers do not speculate on the physical constitution of the stars, planets and Moon: they are divine objects not made of Earthly materials (Plato's "Timaeus")
  - No science based on the experimental method
  - Aristotle: Physics is philosophical speculation, is about the relationship between qualities not about how to measure them
  - Doctrine of the four elements so prevalent that it discouraged scientific thought



# What the Greeks knew

- Greek science
  - Technology happened (eg Hero) despite the absence of science, not because of an understanding of nature
  - At the same time technology was not used to provide tools for science to conduct experiments
  - Technology was based on trial and error, science was only philosophy, and the two didn't interact
  - Technology is mainly used to make toys, to entertain, a sister discipline to magic
  - Beauty superior to usefulness
  - Inanimate machines useless when there is abundance of human machines (slaves)

# What the Greeks knew

- Greek science
  - Mental work regarded superior to practical work, philosophy regarded superior to engineering
  - Idle speculation regarded superior to useful invention
  - A tool that is useful in practice regarded almost as something to be ashamed of, not as an invention to be proud of, something to be admired
  - A perfect sculpture, instead, something to be proud of, something to be admired
  - Technology used in warfare though

# What the Greeks knew

- Comedy (400BC)
  - Comedy evolves from the phallic processions of the Dionysian rituals
  - Aristophanes (450 BC):
    - “Lysistrata” (411 BC) the women force the men to make peace by refusing them sex (rare representation of husband/wife relationship)
    - “The Frogs”: ridicules Dionysus
  - Menander (): "Comedies" (324 BC)

# What the Greeks knew

- Praxiteles (350BC)
  - Serenity ("Aphrodite")
  - First monumental female nude in Western sculpture
  - (Destroyed in a fire at Constantinople in 475)

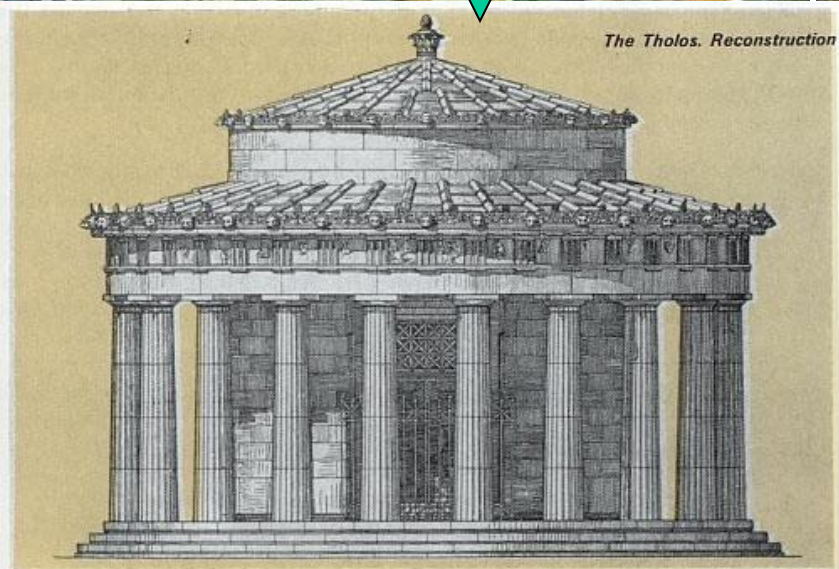


# What the Greeks knew

- The Five Wonders:
  - Pyramid of Cheops (by Hemon, Egypt, 2500 BC)
  - Hanging Gardens (Babylon, 580 BC)
  - The Statue of Zeus at Olympia (by Pheidias, Greece, 432 BC)
  - Temple of Artemis at Ephesos (Greece, 356 BC)
  - The Mausoleum at Halicarnassos (Greece, 354 BC)

# What the Greeks knew

- Delphi's Sanctuary of Athenia Pronaia (380 BC)





Temple of Artemis  
at Ephesos, Ionia, 356BC  
by Chersiphron (Larrinaga)  
destroyed 262AD by Goths



Roman coin of 235AD  
(British Museum)

Tomb of Mausolos at Halicarnassus, 350BC  
Architect: Pythios  
Sculptures by Scopas, Bryaxis, Timotheus,  
Leochares  
Destroyed by earthquake in the 12th c AD



(M. Larrinaga)

Statues are at the British Museum





The Colossus  
(Helios) of Rhodos  
(built by Chares of  
Lindos, 290 BC)

# Lykia

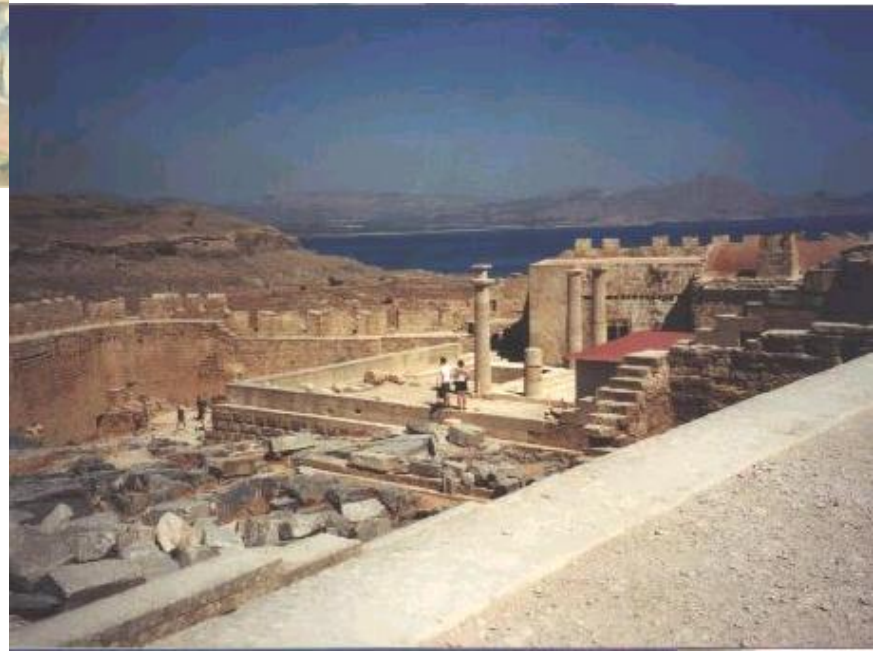
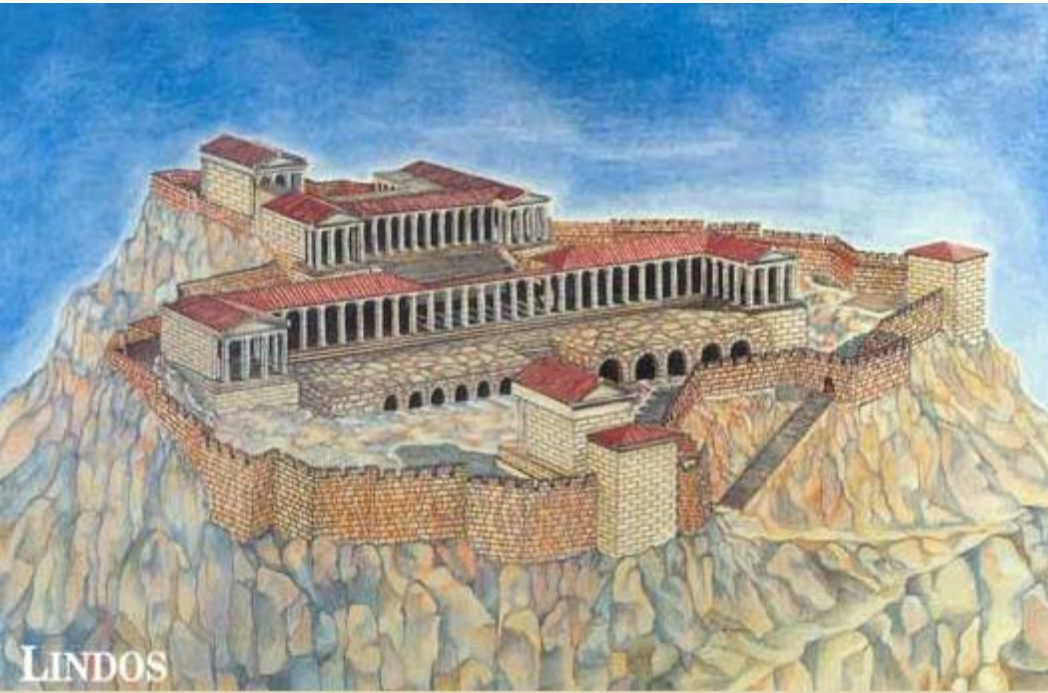
- Nereid Monument (Lykian, 390 BC), first example of a temple tomb (before Halikarnassos)



(British Museum)



# Lindos, sanctuary to Athena



Continued on Part IV

Piero Scaruffi

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