Aristotle (384-322)

His scientific thinking, his physics.

Aristotle: short biography

- **Aristotle** was a Greek philosopher, a student of Plato and teacher of Alexander the Great. He wrote on many different subjects, including physics, metaphysics, poetry, theater, logic, rhetoric, politics, government, ethics, biology and zoology.
- His thinking on physics and science had a profound impact on medieval thought, which lasted until the Renaissance.

Brief Biography:

- Aristotle was born in Stageira, Chalcidice, in 384 BC. His father was the personal physician to King Amyntas of Macedon. At about the age of eighteen, he went to Athens to continue his education at Plato's Academy.

- Aristotle remained at the academy for nearly twenty years, not leaving until after Plato's death in 347 BC. He then traveled to Asia Minor. While in Asia, Aristotle married Hermias' daughter Pythias. She bore him a daughter. Aristotle was then invited by Philip of Macedon to become tutor to Alexander the Great.

- After spending several years tutoring the young Alexander, Aristotle returned to Athens. By 335 BC, he established his own school there, known as the Lyceum. He conducted courses at the school for the next twelve years. While in Athens, his wife Pythias died, and Aristotle married Herpyllis of Stageira, who bore him a son whom he named after his father, Nicomachus.

Biography…

- After Alexander's death, anti-Macedonian sentiment in Athens once again flared. Aristotle was now denounced for not holding the gods in honor.

- Aristotle fled the city to his mother's family estate in Chalcis, explaining,

"I will not allow the Athenians to sin twice against philosophy."

Summary of Aristotle's Scientific Thinking

The central idea of his scientific thinking:

It is not enough to know <u>what</u> a scientific fact is, you must also know <u>why</u> it is a scientific fact.

Summary of Aristotle's Scientific Thinking

Central requirement of scientific explanation:

Only deductive reasoning (similar to Euclid's geometric reasoning) is valid.

I. There are First Principles of all scientific reasoning.

II. There are First Principles of Physics that can be "discovered" (but are not scientifically knowable).

III. These principles can be discovered by observation and intuition.

IV. Only terrestrial phenomena are amenable in scientific investigation.

V. There are necessary, universal facts that can be deduced from these principles.

Summary…

First Principles of thought (all reasoning):

The Principle of Identity

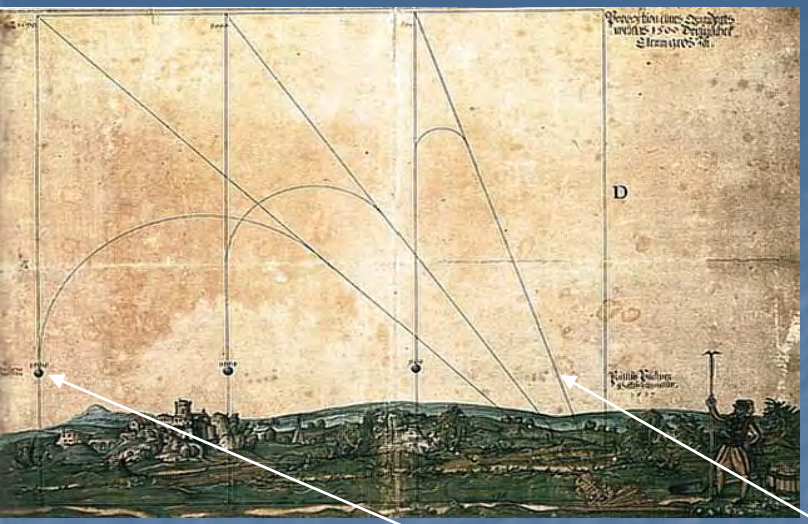
(A is A, or: A cannot be both A and not A)

The Principle of Non-Contradiction

(A cannot be B and not B)

The Principle of the Excluded Middle

(A is either B or not B)



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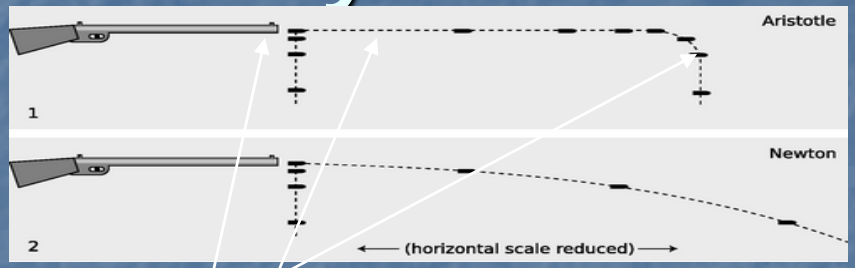


The First Principles of Physics:

All motion is either natural or violent.

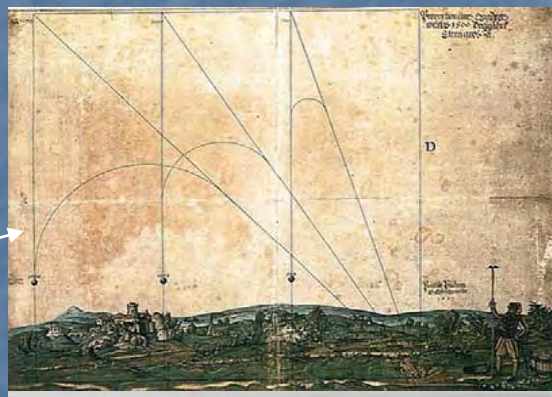
All natural motion is toward a natural place

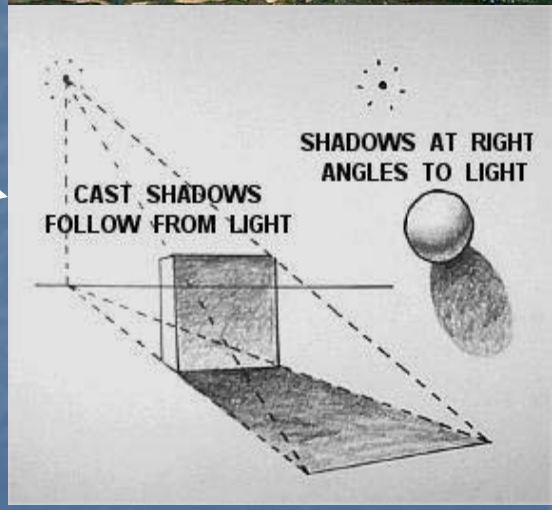
Violent motion is caused by the continuing

Action of an agent.

A vacuum is impossible.

Summary…





<u>Universal Propositions for Physics</u>:

Light travels in a straight line.

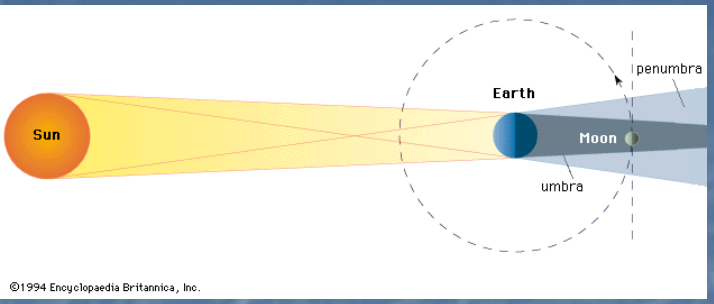
All heavy objects fall toward the center of the earth.

All opaque objects cast a shadow.

<u>Predicates proper to physics</u>:

Position, speed, resistance.

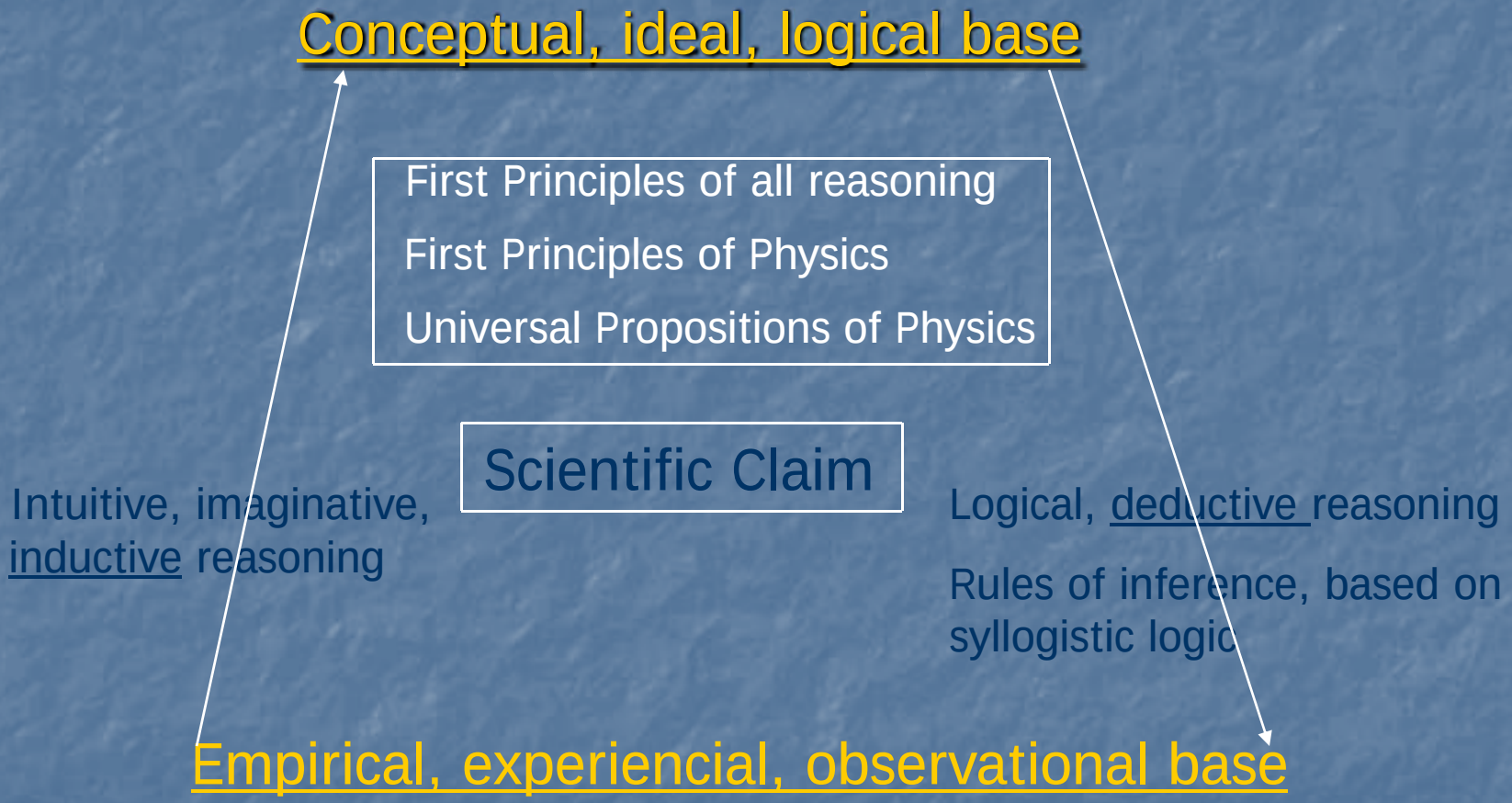
Summary…



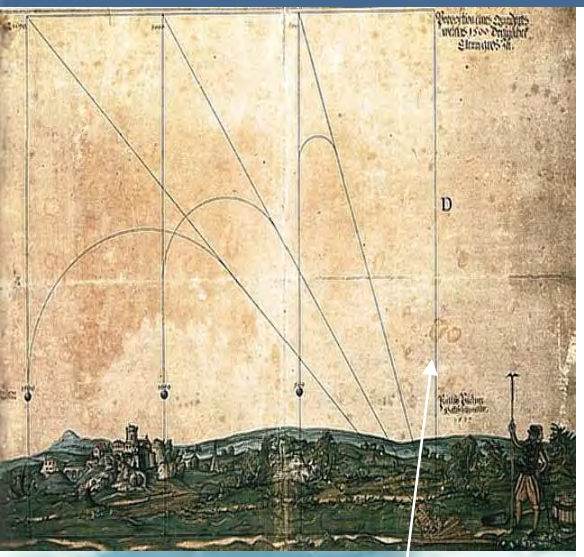
An example of scientific reasoning:

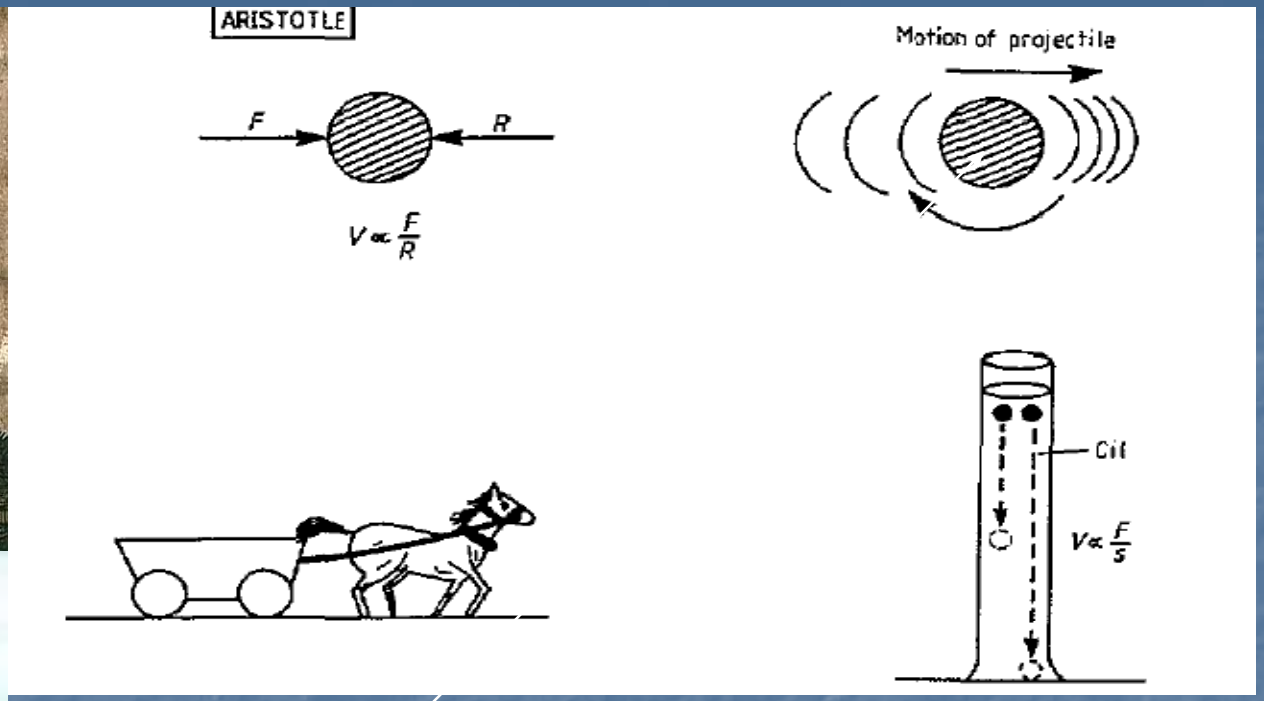
1. Why is there a round shadow on the moon?
2. Because a round shadow is produced when a round opaque body (the earth) is in the path of sun's light that travels to the moon in straight lines.
3. Oh, I see. The sun's light, traveling toward the moon, is intercepted by the earth just now, and that is why there is a shadow on the moon.

Aristotle's Scientific Reasoning



By induction, to the principles (laws), and by deduction, to the "reasoned scientific fact"





Aristotle's physics of motion

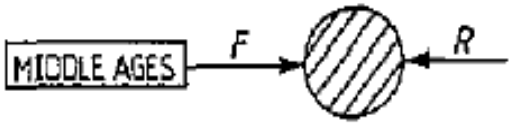
Aristotle thought that a cart will come to rest when the horse stops pulling it When objects fall they fall through a medium, such as air or water. He saw a world where there was always resistance offered to motion.

There were two kinds of terrestrial motions: natural and violent.

The physics of motion between Aristotle and Galileo

ORESME

BURIDAN



PHILOPONUS (5th century AD)

$V \propto F - R$

Self-expending impressed force

BURIDAN (14th century AD)

Impetus theory

Impressed force = mass × speed

Permanent impetus

ORESME (14th century AD)

Law of inertia?

'It is not possible to detect uniform rectilinear motion.'

'The Earth rotates and air and water share the motion.'

Aristotle in the middle ages

The medieval Italian poet Dante says of Aristotle in his *Inferno*:

I saw the Master there of
those who know,
Amid the philosophic family,
by all admired, and by all
reverenced;
There Plato too I saw, and
Socrates,
Who stood beside him closer
than the rest.

Tribute to Aristotle

- Not until Galileo's kinematics (around 1600) and Kepler's laws of planetary motion (around 1620), was Aristotle's physics of motion and his cosmology discredited.

<u>But we must remember:</u>

- Aristotle's view was the dominant, indeed, virtually the only view of the physical sciences for almost two thousand years. Every new way of looking at the world had either to effect a reconciliation with it, or mount sufficient reason to reject it.

- The scholastics' attempt to fuse Aristotle's views with Christian theology, culminating in Thomas Aquinas's works, nearly stopped all efforts to develop alternative approaches to the study of nature.

- Aristotle, the logician:

  Outlined the rules of ‘syllogistic logic”, illustrating deductive reasoning.

  In his work *Prior Analytics*, he defines syllogism as "a discourse in which, certain things having been supposed, something different from the things supposed results of necessity because these things are so."

Aristotle…

If it rains, then the sidewalks will be wet.
The sidewalks will be wet.
Therefore, it rained.
(This is deductively incorrect)
However:
If it rains, then the sidewalks will be wet.
The sidewalks were not wet.
Therefore, it did not rain.
(This is deductively correct)

- Major premise: All humans are mortal.
  - Minor premise: Socrates is human.
  - Conclusion: Socrates is mortal.

If it rains, then the sidewalks will be wet.

It is raining.

Therefore, the sidewalks will be wet.

(This is deductively correct)

If it rains, then the sidewalks will be wet.

The sidewalks will be wet.

Therefore, it rained.

(This is deductively incorrect)

<u>However</u>:

If it rains, then the sidewalks will be wet.

The sidewalks were not wet.

Therefore, it did not rain.

(This is deductively correct)