

11/2/11 History of the Atom

400s BC Greek philosophers
 Democritus and Leucippus

Thought experiment:

- If you cut a piece of matter in half, how long can you keep cutting and still have a piece of that matter?

Democritus said that **matter could be cut in half over and over until you had only one “*atomos*”**

- atomos is Greek for “indivisible”

Democritus said the world is made of two things:

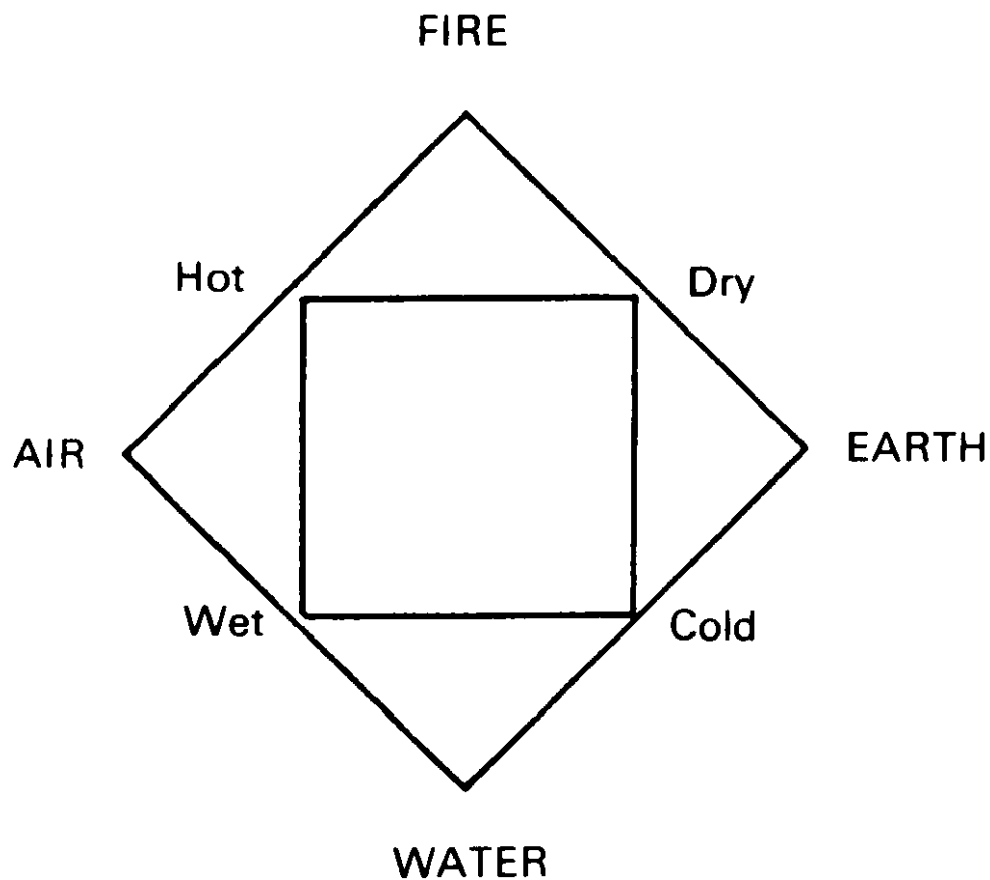
- empty space
- tiny particles called “atoms”

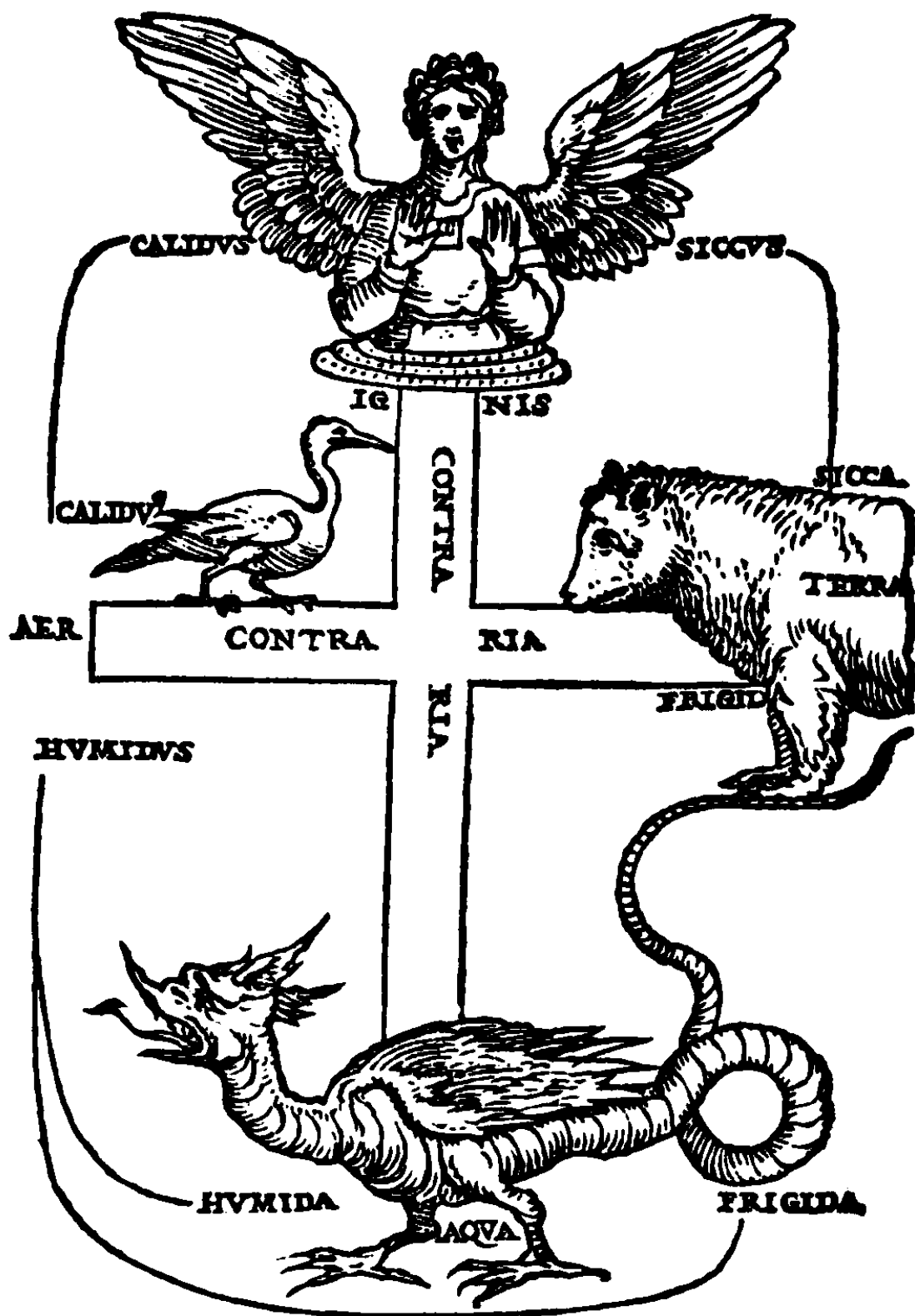
300s BC Aristotle disagreed

Aristotle said matter wasn't made of particles

- said matter could be cut in half forever
- also said that matter was made up of four elements: **earth, air, fire, and water**

AN ERRONEOUS THEORY THAT LASTED 2,000 YEARS





200s BC Alchemists

Alchemists were **searching for a way to turn cheap base metals into gold** by finding the “Philosopher’s Stone”

- They tested most materials on Earth
- They were Egyptian, Arab, Greek, Persian, and Chinese
- They discovered the elements mercury, sulfur, and antimony

1600s Isaac Newton and Robert Boyle

- Isaac Newton and Robert Boyle published papers saying **they agreed with the atom idea**
- Boyle:
 - defined an element as a substance that can’t be broken down into two or more simpler substances
 - used flame tests to identify chemicals
- Newton said **matter was composed of impenetrable, moving particles** (like tiny pool balls)

1700s Chemistry begins!

Two famous French chemists of the time:

1) Antoine Lavoisier

- **developed the Law of Conservation of Mass**
- He showed that a chemical changed in a closed container has the same mass before
- didn't know why his law worked

2) Joseph Louis Proust

- **developed the Law of Definite Proportions**
- The law of definite proportions states that specific substances always contain elements in the same ratio by mass.
- Examples:
 - $\text{NaCl} = 29.3\% \text{ Na}, 70.7\% \text{ Cl}$
 - $\text{H}_2\text{O} = 11.2\% \text{ H}, 88.8\% \text{ O}$
 - $\text{NaClO}_3 = 45.09\% \text{ O}$
- the **RATIO** of the masses of the elements stays the same!

- didn't know why his law worked!

1800s John Dalton (British)

- studied the experimental evidence of Lavoisier and Proust.
- came up with a way to explain their discoveries called the Atomic Theory

Atomic Theory:

1) Matter is made of tiny particles called **atoms**.

- **An atom is the smallest part of an element**
- **All atoms of a given element are identical.**
- All atoms of a given element show the same chemical properties
- Atoms of different elements show different properties

2) **Atoms can't be broken into smaller particles**

- 3) In an ordinary chemical reaction, **no atom of any element is changed into an atom of another element and no atom of any element disappears**
- explains the Law of Conservation of Mass
 - atoms can't be destroyed; they're just re-arranged in reactions
 - the number of atoms must stay the same, so the mass before and after must be the same
- 4) Atoms combine in simple, whole number ratios to form compounds
- explains the Law of Definite Proportions

**Dalton is called the
“Father of the Modern Atomic Theory”**

Dalton also came up with the

Law of MULTIPLE Proportions

- The law of multiple proportions said that **elements can combine with each other in more than one ratio**

- Examples:
 - Hydrogen and oxygen can make H_2O (water) or H_2O_2 (peroxide)
 - Carbon and oxygen can make CO_2 (carbon dioxide) or CO (carbon monoxide)