PHYSICS 1A
H. E. SMITH

LECTURE #1

[redacted]

Let us try to imagine that we are a gathering of 16th century scholars here today discussing "natural philosophy" - that's what we call physics or science. We are probably all Catholics or at least have been schooled in the philosophy of St. Thomas Aquinas which is basically the Aristotelian point of view. Forgetting virtually everything you have learned about science since the first grade, what do you know?

1) Our world consists of four elements earth, air fire and water, each seeking its natural place:

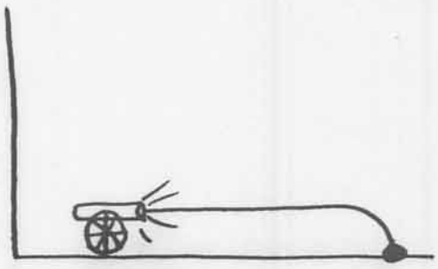
flame leaps through air
air bubbles rise in water
rain falls from the heavens
and flows to the sea
rocks fall to the earth

2) Our Universe consists of the sun, moon and five planets Mercury ☿, Venus ♀, Mars ♂, Jupiter ♃ and Saturn ♄ which wander through the pattern of the fixed stars. The earth imperfect and insignificant as it is lies, stationary at the center.

3) The subject of motion is basically a description of the way in which material bodies seek their appropriate places. Let me provide you with some examples:

a) bodies of earth, seeking their proper place, fall to earth (self-evident, no Bodies containing a greater amount of earth seek their natural place faster than "lighter" Any material when released gains speed (accelerates) toward its natural position. Now, I am not a great fan of experimentation. All that is true and good may be directly reasoned from the natural philosophical principles which have been set forth for us. But this behavior can be readily demonstrated - feather + hammer

b) projectile motion requires a more sophisticated understanding. In firing a projectile we endow it with a certain amount of impetus which carries it along until the impetus runs out at which point it seeks its natural place and falls. Again this is readily demonstrated



c) once a body has attained its proper place in the hierarchy its proper state of motion is at rest. The earth, as we can easily tell, is at rest and all material bodies will eventually come to rest (We'll return to this point)

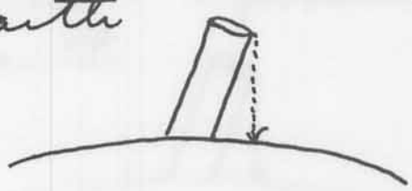
d) the heavenly bodies are different. As everyone knows the sun moon and planets inhabit the heavens and as such are perfect and immutable. Plato has deduced that there motions must therefore be perfectly circular. We recognize that mathematics is abstract and precise and therefore inappropriate for describing the tangible, imperfect world. Nonetheless Claudius Ptolemy has provided a model which passably describes the observed motions of the planets. We may envision each as mounted on a crystalline sphere rotating as shown.

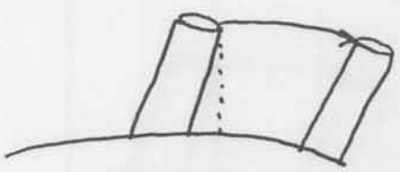
We will ignore the roguish words of Alfonso X (Castillian Monarch 13th century) who remarked

> "If the Lord Almighty had consulted me before embarking on the creation, I would have suggested something simpler.

I should also remark that a Polish monk, Nicholas Kopernig has published a rather revolutionary work <u>De Revolutionibus Orbium Celestium</u> which proposes that the sun is the centre of the planetary system and that (get this) the earth is in motion around the sun.

This idea can be quickly disproved Toss an object up in the air and watch it fall. It will fall at your feet. If the earth were moving then the earth would move out from under the object as it falls. It would fall somewhere else - depending on the motion of the earth





e.g. ball dropped from Pisa's tower could fall behind it if earth were rotating as shown.

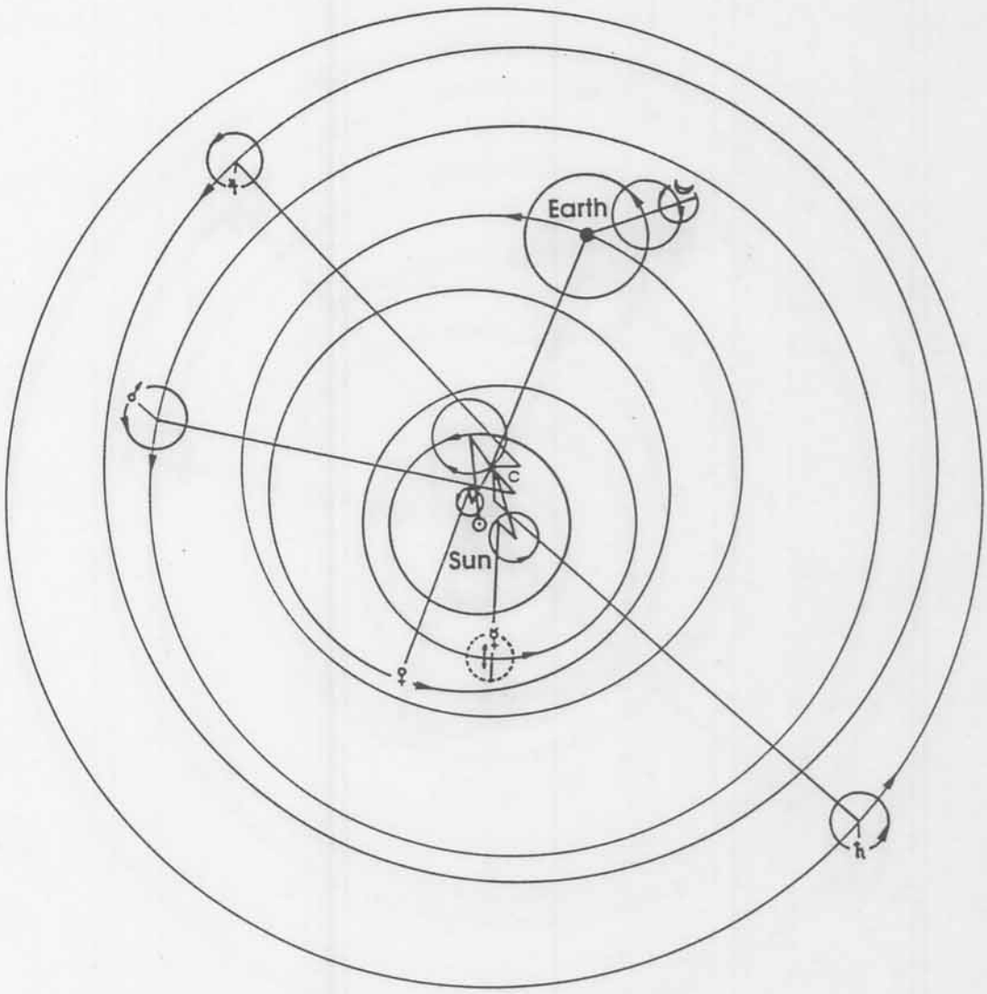


Figure 1. The Copernican model

COPERNICUS
(1543)

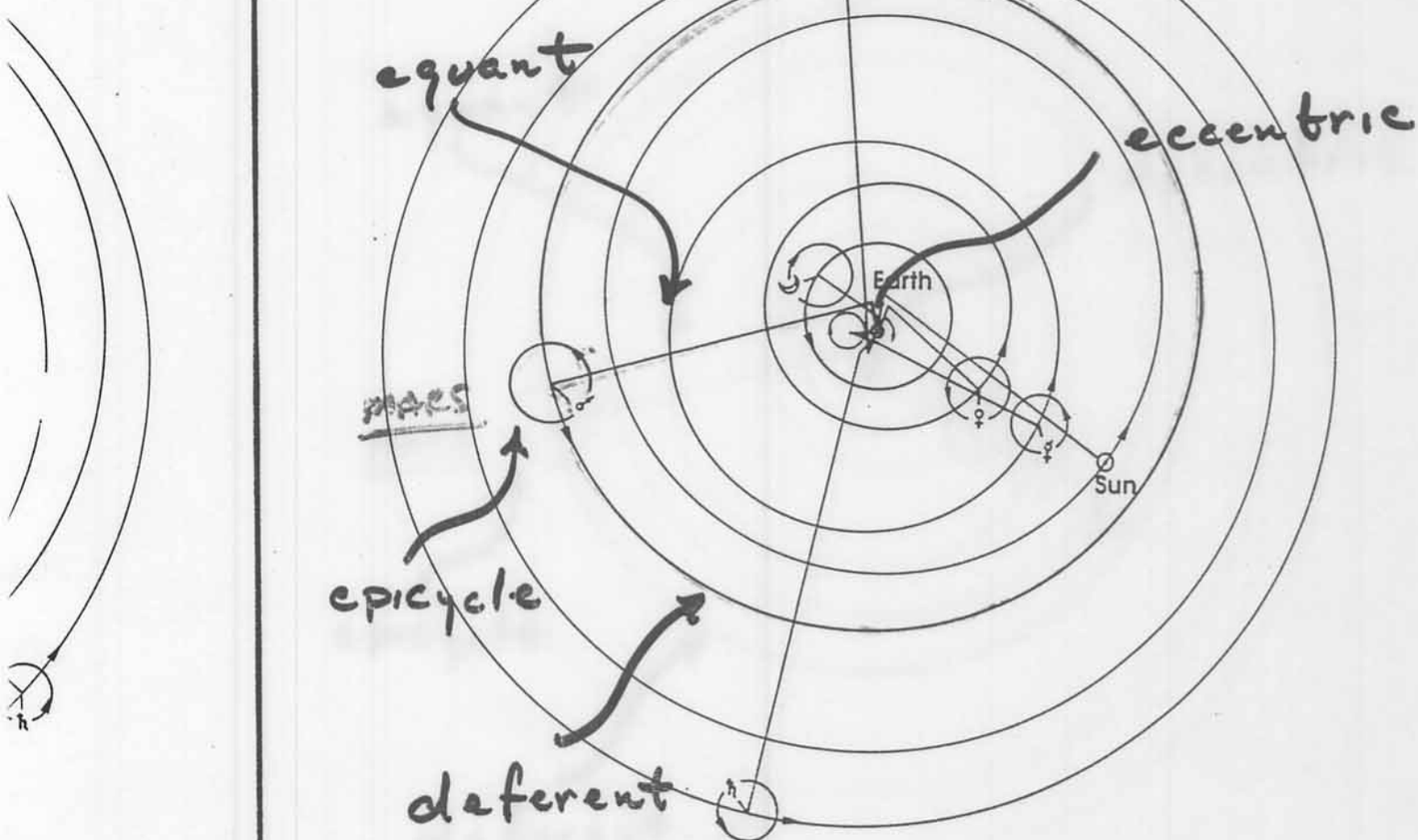


Figure 2. The Ptolemaic model

PTOLEMY
(2ND CENTURY AD)

GALILEO GALILEI (1564-1642)

First applied telescope to astronomical observations:

1) Sunspots, craters - mountains on moon - imperfection of heavens

2) Galilean satellites of Jupiter

3) Phases of Venus

which essentially disproved the Ptolemaic view of the "solar system (and was consistent w/ the Copernican system) published in Sidereus Nuncia

Galileo was also essentially the first modern physicist. Galileo's ideas and his strong belief in the Copernican system were viewed with some disdain by his fellow scholars (many upset his observations w/o ever daining to look through a ~~the~~ telescope) so Galileo published his work in Italian rather than the scholarly Latin in an attempt to reach the educated clergy and nobility. He wrote most of his work in terms of dialogues among a trio of Renaissance scholars [redacted] Salviati (Galileo's pt of view Fr. Filippo Salviati

Simplicio (Aristotle) and

[redacted] Sagredo (who reasoned through the dialogues and ended up siding w/ Sagredo. Salviati was an actual person, a close friend of Galileo's in Padua

Believed that the language of natural philosophy was mathematics - too abstract for the real world as argued by the Aristotelians - "Show me a spherical ball in reality which has but a single point of contact w/ a plane. Similar difficulty w/ abstracting to free-fall in a vacuum

Believed in careful experimental tests of physical rules

Discourses and Mathematical Demonstrations Concerning Two New Sciences 1638

In it he writes "I am presenting a very new science of a very old subject - motion"

Dialogues Concerning the Two World Systems (1632)

Discussion of Ptolemaic vs. Copernican models of the Solar System.

INERTIA

Experiments w/ rolling balls showed that ball rolling down an inclined plane will return to same height on another plane. Concluded that ball on "horizontal" plane would continue indefinitely